Appendix C: Animals

Birds

SPECIES ACCOUNT: *Accipiter striatus venator* (Puerto Rican sharp-shinned hawk)

Species Taxonomic and Listing Information

Listing Status: Endangered; September 9, 1994; Southeast Region (R4)

Physical Description

The Puerto Rican sharp-shinned hawk is a small hawk measuring approximately 28 to 33 cm (11 to 13 inches). The dark slate gray upper parts and heavily barred rufous underparts ofthe adults are distinctive. Immature birds are brown above and heavily streaked below. In flight, the short, rounded wings and long, narrow tail are characteristic (Raffaele 1989).

Taxonomy

The sharp-shinned hawk (Accipiterstriatus) is also a polytypic species with nine subspecies distributed in the western hemisphere, from Alaska to Canada and south to Argentina and to the West Indies (including Cuba, Hispaniola, and Puerto Rico) (Wattel 1973). The Puerto Rican sharp-shinned hawk was first discovered in 1912 in the Marican Forest and described as a distinct subspecies, Accipiter striatus venalor (Wetmore 1914).

Historical Range

Although the Puerto Rican sharp-shinned hawk was previously known from the Rio Abajo and Guajataca Commonwealth Forests ofthe karst region, Cruz and Delannoy (1986) did not find any evidence ofits presence in these areas. Fossil evidence indicates that the species was once more widespread in the karst region (Wetmore 1922). Puerto Rican sharp-shinned hawks have been searched for and not sighted in the Cambalache, Vega, Susiia, and Guánica Commonwealth Forests (Cruz and Delannoy 1986).

Current Range

At present, this species is restricted to montane forests along the Cordillera Central, Sierra de Cayey, and Sierra de Luquillo. Extant breeding populations ofthe Puerto Rican sharp-shinned hawk are known from montane habitat of the Maricao Commonwealth Forest, Toro Negro Commonwealth Forest, Guilarte Commonwealth Forest, Carite Commonwealth Forest, and the Caribbean National Forest. As of 2018, higher presence within private lands contrary to what was previously reported (Vilella and Gallardo 2016, Thorstrom 2017). This area includes the region encompassed by the Commonwealth Forests of Guilarte, Toro Negro and Tres Picachos, La Olimpia Forest and the surrounding private lands of this region (Gallardo and Vilella 2014, Vilella and Gallardo 2016, Thorstrom 2017). SSHA have been reported in the municipalities of Maricao, San Germán, Orocovis, Adjuntas, Jayuya, Juana Diaz, Utuado, Ponce and Peñuela (Vilella and Gallardo, 2016). Two SSHA individuals also were observed in the municipalities of Arecibo and Manatí (Tetra Tech, Inc. Final Report 2011) (USFWS, 2018).

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: In 1974 and 1977, Snyder et al. (1987) studied the diet at two Puerto Rican sharp-shinned hawk nests in West Fork area, Caribbean National Forest. All 148 identified prey observed at these nests were small birds, almost without exception the size of tanagers (30 grams) or smaller. They had only one apparent record of a thrasher (100 grams) taken by male sharp-shinned hawks, which were considerably smaller than female broad-winged hawks (about 70 grams less), and it was possible that female hawks take thrashers with some regularity.

Reproduction Narrative

Egg: Cruz and Delannoy (1986) reported an incubation period, from laying to hatching ofthe last egg, of 32 days.

Juvenile: Cruz and Delannoy (1986) found that the combined average fledging age was 30 days.

Adult: Studies on breeding and nesting habitat ofthis species, conducted by Cruz and Delannoy (1986), showed that the Puerto Rican sharp-shinned hawk population in the Maricao Commonwealth Forest nests in both natural forest and maría plantations. Plantation nest sites tended to have more large canopy trees and less understory than natural forest nest sites. Sharp-shinned hawks appear to select plantation and natural forest nest sites with similar vegetative structure and topography. These authors found that vegetation structural requirements (closed canopies and dense stands) were sought by the Puerto Rican sharp-shinned hawks in the selection of nest sites in the Maricao Commonwealth Forest and apparently in other parts of its range in Puerto Rico. They also found that Puerto Rican sharp-shinned hawks placed their platforms nests below the canopy on horizontal branches against the trunk or in crotches away from the trunk.Cruz and Delannoy (1986) found that most ofthe Puerto Rican sharp-shinned hawk activities during early occupancy ofnesting sites (December to January) consisted of courtship and territorial display flights. These authors reported that most Puerto Rican sharp-shinned hawks started the construction of their nests shortly after remaining permanently on their nesting areas in January of each year. Egg laying occurred during March and April. The laying of second clutches occurred irregularly from May to July. They also found that females laid second clutches only after losing a brood. It took two females approximately 27 and 30 days, respectively, to lay again after losing their first broods.Cruz and Delannoy (1986) found that, in Puerto Rican sharp-shinned hawks, only the female incubated and that the role of the male was to provide food to the incubating female. and an average clutch size of 2.63 eggs. Of the 105 eggs laid, 62.9 percent hatched and 29.5 percent of the eggs survived to the fledgling stage. Less than half (47 percent) of the nestlings survived to fledging. They found that the combined nest success was 28.6 percent including renesting. Warble fly(Philornis sp., Diptera, Muscidae) parasitism accounted for 69.2 percent ofthe nest failures during the post-hatching stage.

Habitat Narrative

Adult: In the Carite Commonwealth Forest, territorial and epigamic activities were reported by Hermindez (1980) in the northeastern and north-central parts. These areas are located in the caimitillo-granadillo forest type of the subtropical wet forest and subtropical lower montane wet forest life zones (Department ofNatural Resources 1976). Delannoy (1992) reported that in the Maricao Commonwealth Forest, the center of sharp-shinned hawk epigamic and territorial activities was located in the north-central and eastern parts. All of these areas are located within the subtropical lower montane wet forest and subtropical wet forest life zones (Ewel and

Whitmore 1973). The Podocarpus and caiinitillo forest types dominate these life zones (Department of Natural Resources 1976). In Toro Negro, the Puerto Rican sharp-shinned hawk territorial and epigamic activities were reported in the eastern segment ofthe forest (Delannoy 1992). These activities took place in the elfin woodland, sierra palm, caimitillo-granadillo, and tabonuco forest types ofthe subtropical wet forest and subtropical lower montane wet forest life zones (Department ofNatural Resources 1976). A solitary territorial sharp-shinned hawk pair was reported by Delannoy (1992) in the south-central part ofthe Caribbean National Forest. This area is located within the palo colorado forest type of the lower montane forest life zone (Ewel and Whitmore 1973).See reproduction narrative for breeding habitat.

Dispersal/Migration

Dispersal/Migration Narrative

Juvenile: The nestling period ended when the young flew short distances from the nest and roosted in trees located 10 to 15 meters from the nest (Cruz and Delannoy 1986).

Population Information and Trends

Population Trends:

Declining (as of 1992)

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Number of Populations:

4

Population Size:

100 (USFWS, 2018)

Population Narrative:

Overall, populations of 154 sharp-shinned hawks have been estimated. Sixty individuals of Puerto Rican sharp-shinned hawks were counted in island-wide surveys conducted in 1983, and a breeding density of.73 hawks/km2 was estimated (Cruz and Delannoy 1986). In 1985, seventy-two individuals were counted and a breeding population of.76 hawk/km2 (230-250 island-wide) was estimated in island-wide surveys (Cruz and Delannoy 1986). In 1992, a total of 285.6 km2 censused yielded 82 sharp-shinned hawks: 40 in Maricao, 30 in Toro Negro, 10 in Carite and 2 in the Caribbean National Forest. An overall population of 129 individuals has been estimated for these forests (Delannoy 1992) (Table 2). Although the Guilarte Forest population was not censussed in 1992, a population of 25 individuals was estimated for the forest in 1985 (Cruz and Delannoy 1986).The Puerto Rican sharp-shinned hawk experienced a 40 percent population decline in a period of 7 years (from about 250 individuals in 1985 to 150 in 1992).

Threats and Stressors

Stressor: Habitat destruction
Exposure:
Response:
Consequence:
Narrative: During the first half of the 20th century, forested areas were drastically reduced for intensive agricultural uses. Timber harvest without considering the vegetation structural features needed by both species and inappropriate management practices in public forests could result in negative effects on these species, reducing the number of individuals and/or diminishing habitat quality. Road construction in several forests has resulted in substantial habitat alteration and fragmentation. Road construction and/or road repair have been proposed and/or conducted in the Caribbean National Forest, Río Abajo Commonwealth Forest, and Maricao Commonwealth Forest. In the Maricao Commonwealth Forest, the reconstruction of Road 362 destroyed approximately 15.4 ha of Puerto Rican sharp- shinned habitat. Construction of recreation facilities has been proposed for the western and northern sides of the Caribbean National Forest. Such recreation facilities could potentially eliminate habitat or bring human activities too close to preferred nesting areas. In the Maricao Commonwealth Forest, the Puerto Rico Energy and Power Authority has a power substation located in the lower montane wet forest life zone, the center of Puerto Rican sharp-shinned hawk nesting habitat. Many kilometers of aerial power lines run through forest lands. The access road for the substation is located adjacent to sharp-shinned hawk habitat in the subtropical wet forest life zone (Delannoy 1992). The construction of this access road resulted in the destruction of approximately 2.6 ha of Puerto Rican sharp-shinned hawk habitat (Delannoy 1992). The construction of new or the enlargement of the existing, communication infrastructure could potentially eliminate important sharp-shinned hawk habitat. Gould et al. (2007) suggested there is an increasing urbanization trend of the limited land area of eastern Puerto Rico where these forests are located. Urban development in this region increased more than 15 percent between 1991 and 2003 (Gould et al. 2007). (USFWS, 2018)

Stressor: Low Numbers and Restricted Distribution
Exposure:
Response:
Consequence:
Narrative: Extant populations are restricted only to five montane forests, respectively. Significant adverse effects to these species or their habitat could drive them to extinction.

Stressor: Devastation from Hurricanes
Exposure:
Response:
Consequence:
Narrative: The extensive devastation from hurricanes may be particularly detrimental to species with small population sizes and long generation times, such as the sharp-shinned hawk. Decline of this species has been attributed to possible direct and indirect effects of Hurricane Hugo in 1989 by Delannoy (1992).

Stressor: Parasitism by warble fly (bot fly, Philornis sp.)

Exposure:
Response:
Consequence:
Narrative: The mortality of sharp-shinned hawk nestlings due to parasitism by the warble fly Philornis sp. has been documented. Studies conducted in Maricao Commonwealth Forest attributed 61 percent of nestling mortality to Philornis parasitism (Cruz and Delannoy 1986).

Stressor: Lack of Comprehensive Management Plans
Exposure:
Response:
Consequence:
Narrative: The lack of comprehensive management plans for the Commonwealth Forests could be considered a serious threat to these species. In absence of such plans, policy makers and managers lack basic information on which to base decisions related to the best use and management of forest resources.

Stressor: Predation by pearly-eyed thrashers
Exposure:
Response:
Consequence:
Narrative: Pearly-eyed thrasher populations have been increasing and represent a direct predation threat to eggs and nestlings.

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: The SSHA is currently known only from specific habitat types at few locations in Puerto Rico, which makes the species susceptible to the effects of climate change. The distribution of tropical forest life zones in the Caribbean is expected to be altered due to both intensified extreme weather events and progressively drier summer months (Wunderle and Arendt 2011). Forest types over 800 m in elevation also are very sensitive to climate change because of their occurrence in narrowly defined environmental conditions (Lasso and Ackerman 2003).

Recovery

Reclassification Criteria:
A breeding population of a minimum of 250 pairs island-wide (five forests) should be reached.

Interim downlisting criteria that in each of five forests, breeding densities should be restored to the higher levels known in 1983 and 1985 (CCF = 0.42 pairs/km^2; GCF = 0.82 pairs/km^2; EYNF = 1.03 pairs/km^2; MCF = 1.15 pairs/km^2; and TNCF = 1.45 pairs/km^2) (USFWS, 2018).

Delisting Criteria:
1. SSHA occur in at least 75% of their respective suitable habitat. (USFWS, 2018)

2. Within the island-wide distribution there will be at least 3 populations within existing protected areas that show stable or increasing population trends, evidenced by natural recruitment and multiple age classes. (USFWS, 2018).

3. Habitat corridors exist between at least 3 protected areas that support populations. (USFWS, 2018).

Recovery Actions:

- 1. Conduct surveys and identify habitat.
- 2. Protect and manage populations and habitat.
- 3. Monitor populations.
- 4. Develop an education program.
- 5. Refine recovery goals.
- 6. Implement a captive breeding program to stabilize population to at least pre-hurricane Maria levels. (USFWS, 2018).
- 7. Plan and implement forest recovery and enhancement efforts in public and surrounding private lands to develop mature closed canopy forest with preferred tree species. (USFWS, 2018).

Conservation Measures and Best Management Practices:

- Conduct no management activities within 150 meters of nest trees or roosts.
- Conduct only compatible management activities (e.g., nonmanipulative research, placement of parrot nests, bee traps, or thrasher boxes, etc.) within 500 meters from nest trees or roosts.
- Plan other activities (e.g., recreational development, timber demonstration, etc.) at least 500 meters from nest sites, following biological assessment and consultation with the Fish and Wildlife Service.
- Timber demonstration or other silvicultural activities planned near nesting areas should be designed to result in stand conditions favorable to raptor recovery.
- Plan any activity with potential to disturb raptors 350 meters away from nest or roost sites; or time it to avoid the nest selection and breeding time (i.e., activities may occur from August through November).
- Conduct raptor inventories during nest selection/breeding seasons, prior to planning forest management activities.

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SPECIES ACCOUNT: *Acrocephalus familiaris kingi* (Nihoa millerbird (old world warbler))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

Small, thin-billed, brown and white songbird. From Morin et al. (1997): A 13-cm reed-warbler, dark olive and olive brown above with grayish margins on feathers; wing and retrices chaetura drab; whitish below with some grayish olive wash on both sided; and buffy brown flanks. Bill thin, blackish; tarsus and toes blackish gray. Sexes similar, but females slightly smaller (NatureServe, 2015).

Taxonomy

Some authors, including Olson (1996) suggest that A. f. kingi is specifically distinct from the subspecies A. f. familiaris that formerly occurred on Laysan Island (AOU 1983) (NatureServe, 2015).

Historical Range

See current range/distribution.

Current Range

Endemic of Nihoa Island, northwestern Hawaiian Islands; total area of island is 63 hectares (Morin et al. 1997) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Feeds on insects by probing and gleaning leaves and twigs, and by aerial hawking (Pratt et al. 1987); also obtains prey from leaf litter and soil surface (Matthews and Moseley 1990). Adults and immatures are insectivores. This species exhibits a diurnal phenology (NatureServe, 2015). The name "millerbird" comes from this species' habit of preying on "miller" moths (USFWS, 1984).

Reproduction Narrative

Adult: Clutch size apparently is 2. According to Matthews and Moseley (1990), nesting is thought to occur January - May. Nests in Sida and Chenopodium (NatureServe, 2015).

Geographic or Habitat Restraints or Barriers

Adult: Bunchgrass (USFWS, 1984)

Site Fidelity

Adult: High (USFWS, 1984; see dispersal/migration narrative)

Habitat Narrative

Adult: Low brush on hillsides; secretive, rarely leaves cover. From Morin et al. (1997): Nihoa Island is steep and rocky, with low, scrubby vegetation. In terms of cover, 20% is rock, 12% is bare soil, and 62% consists of the 4 most common plants: Chenopodium oahuense, Solanum nelsonii, Sida fallax, and Eragrostis variabilis. Millerbirds prefer dense cover near the ground, especially C. oahuense and S. nelsonii. Terrestrial habitat is characterized as shrubland/chaparral (NatureServe, 2015). Conant (1983) found the presence of millerbirds to be negatively correlated with the presence of bunchgrass (Eragrostis sp.) habitat (USFWS, 1984).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Low (inferred from USFWS, 1984)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015). Miller birds are apparently quite sedentary, rarely moving more than about 20 m from a territory (USFWS, 1984).

Population Information and Trends

Population Trends:

Not available

Species Trends:

Stable; varies with precipitation (NatureServe, 2015)

Resiliency:

Very low (inferred from NatureServe, 2015)

Representation:

Very low (inferred from USFWS, 2010)

Redundancy:

Very low (inferred from USFWS, 2010)

Number of Populations:

1 (USFWS, 2010)

Population Size:

346 - 936 (USFWS, 2010) As of 2012, 483 on Nihoa and 164 on Laysan Island (USFWS, 2017)

Adaptability:

Low (inferred from USFWS, 2010)

Population Narrative:

There are no strong multi-year trends apparent; relatively stable, although population size does appear to vary with precipitation (Morin et al. 1997). Of Nihoa's 63 ha, 32 - 40.5 are considered to be suitable Nihoa Millerbird habitat; however, Millerbirds can be found throughout the vegetated area (NatureServe, 2015). The Nihoa millerbird currently exists as a single, small population on Nihoa Island. The population is relatively small (the most recent estimate is 641 ± 295 [95% CI; Kohley et al. 2009]). Recent analysis indicates that the Nihoa millerbird is among the most genetically depauperate species ever recorded (Addison and Diamond in review) (USFWS, 2010).

Threats and Stressors

Stressor: Stochastic events (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: The small, very restricted population is threatened primarily by chance events such as storms, drought, or disease (Morin et al. 1997). A severe tropical storm or tidal wave could decimate the small population (Matthews and Moseley 1990) (NatureServe, 2015).

Stressor: Disease and predation (NatureServe, 2015 and USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Potential threats include predators such as rats (should they be introduced) and competitors such as ants, avian diseases that could be brought in by migrating birds (NatureServe, 2015). West Nile virus and avian flu may pose a risk to the Nihoa millerbird if these diseases reach Hawai`i and the Northwestern Hawaiian Islands. The susceptibility of the Nihoa millerbird to avian malaria and avian poxvirus is unknown. Both diseases are known to be severe threats to the Laysan finch and most of the endemic forest birds in the Main Hawaiian Islands (USFWS, 2010).

Stressor: Gray bird locust (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Concern about impacts of the invasive gray bird locust (Schistocerca nitens) to Nihoa's ecosystem has risen with observations since 2000 of increasing numbers of this alien species. This species undergoes periodic population explosions that result in the virtual denuding of the island. These extreme herbivory events may ultimately lead to wholesale changes in the island's flora and vegetation structure, with unknown consequences for the Nihoa millerbird and its prey base (USFWS, 2010).

Stressor: Climate change (USFWS, 2010)
Exposure:

Response:
Consequence:
Narrative: Climate change may also pose a threat to the Nihoa millerbird, as its range includes low-elevation habitat. However, current climate change models do not allow specific predications as to what those effects, and their extent, would be for this species (USFWS, 2010).

Stressor: Yellow crazy ants (Anoplolepis gracilipes) (USFWS, 2017)
Exposure:
Response:
Consequence:
Narrative: Yellow crazy ants may be transported on shipping vessels from Hawai'I base yard to Nihoa Island. (USFWS, 2017)

Recovery

Reclassification Criteria:
1. Put the necessary mechanisms in place that will protect [Nihoa Island] from exotic influences (USFWS, 2010).

2. Establish effective and reliable mechanisms to monitor for exotic organisms (USFWS, 2010).

3. Periodically assure and verify the existence of [a] reasonably stable [population of the Nihoa millerbird] (USFWS, 2010).

2019 Downlisting Criterion 1: Viable, self-sustaining populations of the species occur on at least two islands that are resistant to ocean inundation. (USFWS, 2019)

2019 Downlisting Criterion 2: Over a minimum 15-year period, populations of the species show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring. (USFWS, 2019)

2019 Downlisting Criterion 3: Threats to the species, including those from small population size, disease, climate variability, and invasive species, are sufficiently managed or addressed to allow Criteria 1 and 2 above to be met. (USFWS, 2019)

2019 Downlisting Criterion 4: The genetic diversity of extant populations of the species is maintained, and this diversity is represented and maintained in all translocated populations. (USFWS, 2019)

Delisting Criteria:
1. Viable, self-sustaining populations of the species occur on at least four islands that are resistant to ocean inundation. (USFWS, 2019)

2. Over a minimum 30-year period, populations of the species show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is

statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring. (USFWS, 2019)

3. Threats to the species, including those from small population size, disease, climate variability, and invasive species, are sufficiently managed or addressed to allow Criteria 1 and 2 above to be met. (USFWS, 2019)

4. The genetic diversity of extant populations of the species is maintained, and this diversity is represented and maintained in all translocated populations. (USFWS, 2019)

Recovery Actions:

- Prevent unauthorized entry to Laysan and Nihoa Islands (USFWS, 1984).
- Prevent establishment of exotic organisms (USFWS, 1984).
- Prevent the outbreak of avian diseases (USFWS, 1984).
- Monitor populations of the species and its habitat to allow for detection of changes in populations or habitat quality (USFWS, 1984). Refinement in 2017: refine survey protocols of millerbird populations and habitat without impacting other resident species. Also, conduct long term natural history research. (USFWS, 2017).
- Establish additional, disjunct populations of all three taxa to provide a buffer against catastrophic declines of natural populations (USFWS, 1984). 24 millerbirds were translocated from Nihoa to Laysan Island in 2011 and 26 were translocated in 2012. (USFWS, 2017)
- Climate Change modeling scale resolution refinement to resolve spatial limitations to modeling degradation of habitat, especially due to sea level rise. (USFWS, 2017)
- Manage gray bird grasshopper (Schistocerca nitens) on Nihoa. (USFWS, 2017)
- Update recovery plan. (USFWS, 2017)

Conservation Measures and Best Management Practices:

- Ensure adherence to access restrictions and quarantine protocols in the Northwestern Hawaiian Islands (USFWS, 2010).
- Field research to inform development of translocation methods (USFWS, 2010).
- Translocation; first to Laysan Island in 2011 (USFWS, 2010).
- Millerbird population and demographic monitoring on Nihoa and improve methods (USFWS, 2010).
- Post-release monitoring (USFWS, 2010).
- Determine second translocation site and restoration work needed (USFWS, 2010).
- Determine disease susceptibility of millerbirds (USFWS, 2010).

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SPECIES ACCOUNT: *Acrocephalus luscinia* (Nightingale reed warbler (old world warbler))

Species Taxonomic and Listing Information

Listing Status: Endangered; 06/02/1970; Pacific Region (R1) (USFWS, 2016)

Physical Description

The nightingale reed warbler is a slender, overall pale yellowish-buff bird. Pale yellow buff below; rufous brown or grayish olive brown above. The bill is horn colored on the upper mandible, more yellowish on the lower mandible, and rather long and slender. Feet are light gray. The various subspecies vary from about 15 to 20 centimeters in length. The female resembles the male but is slightly smaller (USFWS, 2016).

Taxonomy

Reed-warblers (Sylviinae: Acrocephalus) are widespread from Europe through Australasia (Mayr et al. 1986). Three subspecies of nightingale reed-warbler are currently recognized: A. l. luscinia (Guam, Saipan, Alamagan), A. l. nijoi (Aguiguan) and A. l. yamashinae (Pagan) (Mayr et al. 1986). (USFWS, 1998). At this time, only one subspecies is known to be extant: A. l. luscinia on Saipan and Alamagan (USFWS, 2010).

Historical Range

The species is historically known from six islands in the Marianas archipelago: Guam, Tinian, Aguiguan, Saipan, Alamagan, and Pagan. It has been extinct on Guam since the late 1960's, and was extirpated from Pagan before 1981 (USFWS, 1998).

Current Range

Nightingale reed-warblers remain on only two of the six islands in the Mariana Archipelago where they once occurred (Saipan and Alamagan) (USFWS, 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Birds have been observed (Craig, unpublished data) to eat insects, glean invertebrates from live leaves and a dead leaf, and probe a dead stub. Marshall (1949) reported insects, spiders, snails, and lizards as prey. Mosher (1997b) has observed nestlings being fed small caterpillars, large spiders, grasshoppers, skinks, geckos, ants, moths, and praying mantids (USFWS, 1998).

Reproduction Narrative

Adult: Ongoing studies indicate that clutch size is typically two eggs; of eight nests observed, seven nests had two and one had three eggs (Mosher 1997a, b). The incubation period for three pairs studied was 14 to 16 days. Craig (1992) found that A. luscinia appeared entirely monogamous (USFWS, 1998). Mosher (2006) found two breeding peaks, January through March and July through September. Males and females both incubate eggs, and brood and feed nestlings (USFWS, 2010).

Geographic or Habitat Restraints or Barriers

Adult: Mature native forest, beach strand, and swordgrass savannah (USFWS, 1998)

Habitat Narrative

Adult: Most birds found on Saipan occur in thicket-meadow mosaics, forest edge, reed marshes, and forest openings, but are largely absent from mature native forest, beach strand, and swordgrass savannah. The population of nightingale reed-warblers on Alamagan inhabits: (1) forests with open overstory and brushy understory; and (2) wooded edges adjacent to open grassland (USFWS, 1998).

Dispersal/Migration

Dispersal

Adult: Moderate (inferred from USFWS, 2010)

Dispersal/Migration Narrative

Adult: The most recent work on nightingale reed-warbler biology was conducted on Saipan by Mosher (2006) who studied birds in upland tangantangan and wetland habitats. The mean home range/territory size of male and female nightingale reed-warblers was estimated to be 4.43±2.83 (SD) hectares (10.95±6.99 acres) (USFWS, 2010).

Population Information and Trends

Population Trends:

Extirpated from three islands (USFWS, 2010)

Species Trends:

Saipan: declining; Alamagan: unknown (USFWS, 2010)

Resiliency:

Low (inferred from USFWS, 2010)

Redundancy:

Low (inferred from USFWS, 2010)

Population Size:

~6,225 (USFWS, 1998)

Population Narrative:

The total number of nightingale reed-warblers is currently approximately 4,225 on Saipan and 2,000 on Alamagan (USFWS, 1998). Surveys recently conducted on Saipan indicate that the nightingale reed-warbler population is declining and has declined since surveys were first conducted in 1982 (Camp et al. 2009; Engbring et al. 1986; USFWS 1998a). The nightingale reed-warbler has been extirpated from three islands, appears to be declining on Saipan, and has an uncertain status on Alamagan (USFWS, 2010).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Wetlands are in poor condition due to filling, dredging, altered hydrology, invasive introduced plants, ungulate disturbance, fires, erosion, pollution, and even volcanic activity (Stinson 1993, Wiles and Ritter 1993). Upland habitats are also being lost due to human population growth on Saipan, which increased 429 percent between 1980 and 2000 (Camp et al. 2009). Habitat loss, fragmentation, and degradation have not been addressed to date on a meaningful scale sufficient to reduce this threat. Fires are also a threat to upland and wetland habitats in the Mariana Islands (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The negative impacts of West Nile Virus and avian influenza on species elsewhere has raised the concern that these diseases may reach the Mariana Islands and impact species such as the nightingale reed-warbler. Predation by introduced species is considered to be a primary threat to the nightingale reed-warbler. Seventy five percent of nightingale reed- warbler nests failed due to predation by cats, rats, and unknown predators in a study on Saipan (Mosher 2006). The most serious threat, however, is the potential for the establishment of a brown treesnake population on Saipan (USFWS l 998b). It is believed that while several factors were likely involved in the extirpation of the nightingale reed-warbler on Guam, their final disappearance was likely attributable to the brown treesnake (Reichel et al. 1992, Wiles et al. 2003). The establishment of a brown treesnake population on Saipan is likely to have consequences similar to those of Guam (Brown Treesnake Working Group 2005) (USFWS, 2010).

Stressor: Contaminants (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Environmental contaminants are considered a threat to birds using wetland habitat (USFWS, 2010).

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:

Narrative: Climate change is believed to pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species (USFWS, 2015).

Recovery

Reclassification Criteria:
Populations on Saipan and Alamagan are secure from threats and maintained at their current numbers or increasing for at least 5 consecutive years (USFWS, 1998).

Delisting Criteria:
1. Nightingale reed-warblers in the Mariana Islands must number at least 8,000 individuals distributed in secure populations over at least 5 islands: 4,000 on Saipan, 2,000 on Alamagan, and 2,000 on at least 3 additional islands, to be chosen from a list including Rota, Aguiguan, Tinian, Anatahan, Pagan, and Agrihan (USFWS, 1998).

2. These populations must be stable or increasing for at least 5 consecutive years (USFWS, 1998).

Recovery Actions:
- Protect and manage existing populations (USFWS, 1998).
- Conduct research on populations dynamics and taxonomy (USFWS, 1998).
- Establish additional populations (USFWS, 1998).
- Revise recovery objectives, as necessary (USFWS, 1998).

Conservation Measures and Best Management Practices:
- Develop an island-wide Nightingale Reed-warbler conservation plan for Saipan. The plan should include actions needed to protect and manage upland habitat as well as protect and restore important wetland habitat (USFWS, 2015).
- Develop and implement plans to protect and manage upland habitat on Alamagan for Nightingale Reed-warblers (USFWS, 2015).
- Conduct regular monitoring of the Nightingale Reed-warbler populations on Saipan and Alamagan utilizing established survey methodology (Camp et al. 2009, Marshall et al. 2010) (USFWS, 2015).
- Develop plans for predator control in key areas, keep abreast of research on improvements in predator control, and implement improved methodology (USFWS, 2015).
- Continue work in the Saipan Upland Mitigation Bank (SUMB Addendum 2009) (USFWS, 2015).
- Conduct a population viability analysis to determine the minimum viable population number and the number of populations across the Mariana Islands necessary for long-term survival and recovery (USFWS, 2015).
- Develop and implement a native forest restoration plan for Alamagan. Plan should include removing feral ungulates, pigs (Sus scrofa), goats (Capra hircus), and cattle (Bos taurus), from the forest areas restored for Nightingale Reed-warblers on Alamagan as well as weed control and native plant outplanting (USFWS, 2015).
- Research the environmental factors and management actions that directly affect demographic parameters (e.g., habitat use of the Nightingale Reed-warbler on Saipan versus on Alamagan (USFWS, 2015).
- Continue brown treesnake interdiction to protect Saipan (USFWS, 2015).

- Develop and implement a plan for establishing Nightingale Reed-warblers populations on at least three additional islands (see recovery plan USFWS 1998) (USFWS, 2015).
- Develop public support for the protection of this endemic species (USFWS, 2015).

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SPECIES ACCOUNT: *Aerodramus vanikorensis bartschi* (Mariana gray swiftlet)

Species Taxonomic and Listing Information

Listing Status: Endangered; 08/27/1984; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Mariana gray swiftlet has sooty black upper parts with a slightly paler rump. The underparts are dark gray but with a brownish tinge. Some white is present at the base of the feathers in the loreal region. The tarsi are naked and the irises are dark hazel. The plumage of both sexes is alike. Weights of 21 birds averaged 7.4 grams (range = 6.4 to 9.0 grams). Other measurements include: wing, average of 107.6 mm and 108 mm; tail, average of 52.3 mm; exposed culmen, average of 4.0 mm; tarsus, average of 10.4 mm, and wingspan, maximum of 233 mm (USFWS, 2016).

Taxonomy

The taxonomy of this form is still debated. Some authors maintain this group of swiftlets belongs in the genus Collocalia, while others contend that A. v. bartschi is a distinct species. Also known as the Chachagauk or Vanikoro swiftlet (USFWS, 1991, 2015).

Historical Range

Endemic to Guam, Rota, Aguiguan, Tinian, and Saipan, but has declined on all islands and is extirpated from Rota and Tinian (Cruz et al. 2008; USFWS 1991; Valdez et al. 2011 and references therein) (USFWS, 2015).

Current Range

Populations are known only to occur on the islands of Guam, Aguiguan, and Saipan (USFWS, 2015).

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Assessment of guano on Saipan indicate Hymenoptera, especially flying ants (Formicidae), were the most common insect prey of chachaguak followed by Coleoptera (Kershner et al. n.d.) (USFWS, 2010). Swiftlets often return from foraging to roost in caves during the daytime. Although swiftlets forage over a wide variety of terrain and vegetation, they seem to favor ridge crests and open grassy areas. Here they capture small insects while flying (USFWS, 1991).

Reproduction Narrative

Adult: Chachaguak produce a single egg which is incubated for approximately 23 days with fledging occurring after 47 days (Reichel et al. 2007). Both adults care for the nestling which is, on average, fed by each adult 1.8 times a day (Morton and Amidon 1996) (USFWS, 2010). The cup-shaped nests of the Vanikoro swiftlet are composed of moss or other plant material glued together with the bird's sticky saliva. No second clutches or renesting attempts have been observed for A. v. bartschi on Guam (USFWS, 1991). On Guam, clutches consisted of single eggs laid sometime between January and July (NatureServe, 2015).

Spatial Arrangements of the Population

Adult: Colonial (NatureServe, 2015)

Site Fidelity

Adult: High (inferred from USFWS, 1991)

Habitat Narrative

Adult: Aerodramus swiftlets nest and roost in caves. For eight caves, the entrances are obscured completely by forest, including tangantangan (Leucaena leucocephala) forest. (USFWS, 1991). The number of nests in a colony varies from about 25 to more than 200 (NatureServe, 2015).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 1991; see feeding narrative)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Low (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory. Forages usually within 1-2 km of roosting cave (NatureServe, 2015).

Population Information and Trends

Population Trends:

Not available

Species Trends:

Saipan and Guam: increasing; Aguiguan: stable (USFWS, 2010)

Resiliency:

Low (inferred from USFWS, 2010; see current range/distribution)

Population Size:

~6,750 individuals (USFWS, 2015)

Population Narrative:

The current range-wide population estimate is approximately 6,750 individuals (Grimm 2008; Valdez et al. 2011; P. Radley, Commonwealth of the Northern Mariana Islands, Division of Fish and Wildlife (DFW), unpubl. data cited in Valdez et al. 2011), and a small population was introduced and currently persists on Oahu, Hawaii (Wiles and Woodside 1999) (USFWS, 2015). On both Saipan and Guam chachaguak populations have increased at the caves that have been monitored while populations appear to be fairly stable on Aguiguan (Cruz et al. 2008; A. Brooke, U.S. Navy, pers. comm. 2008). (USFWS, 2010).

Threats and Stressors

Stressor: Predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The brown treesnake (Boiga irregularis) is believed to be the main predator on Guam (USFWS 1991). However, monitor lizards (Varanus indicus) and feral cats (Felis cattus) were observed in the main chachaguak colony on Guam (Morton and Amidon 1996) and may prey on chachaguak opportunistically on all of the islands. The black drongo (Dicrurus macrocercus), a bird species introduced to Guam and Rota, was also observed preying on chachaguak on Guam (Perez 1968) and may have been a factor in their extirpation on Rota (USFWS, 2010).

Stressor: Nest disturbance (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Impacts to nesting success caused by human disturbance at nesting colonies is considered an important threat to the species (USFWS 1991). Efforts are underway to minimize this disturbance by limiting access to caves (Cruz et al. 2008). On Saipan, cockroaches have been found to reduce nesting success and efforts to control cockroaches at known caves have been undertaken over the last two decades (Rice 1993, Cruz et al. 2008). Mud-dauber wasps are also believed to be adversely affecting chachaguak nests on Guam by attaching their nests to chachaguak nests and causing them to fall due to the excess weight (Amidon and Morton 1996). Aggressive encounters between wasps and nesting chachaguak may also be affecting nesting success (USFWS, 2010).

Stressor: Climate change (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Climate change may also pose a threat to chachaguak. However, current climate change models do not allow specific predictions as to what those effects, and their extent, would be for this species (USFWS, 2010).

Stressor: Habitat disturbance and degradation (USFWS, 1991)
Exposure:
Response:
Consequence:
Narrative: Caves harboring swiftlets have remained isolated and undisturbed. Only with the advent of man has the swiftlet's sanctuary been disrupted. In their caves, swiftlets are highly vulnerable to disturbance from people. This disturbance has included: (1) occupation of swiftlet caves by the Japanese during World War II and the bombing of caves by American troops; (2)

guano mining practiced by the present indigenous population and perhaps formerly by the Japanese; (3) visits by deer hunters, collectors of old bottles and WW II memorabilia, hikers, wildlife biologists, and others; (4) vandalism, such as children swatting swiftlets with sticks; (5) feral mammals, which may use some caves as shelter and cause the same type of disturbance that guano mining or temporary camping by humans could cause. Of these types of disturbance, guano mining and vandalism are potentially a serious problem today (USFWS, 1991).

Recovery

Reclassification Criteria:

1. Minimum subpopulations of 2,000 birds on Guam, 2,000 on Rota, 1,000 on Aguiguan, and 2,000 on Saipan (USFWS, 2015). 2019 update to minimum populations: 3,000 on Guam, 2,500 on Saipan, 1,500 on Aguiguan. (USFWS, 2019).

2. Populations must be distributed among at least five caves on each island except Rota (USFWS, 2015). 2019 update does not exempt Rota, and on Guam, 2 of 5 caves should be in northern Guam. (USFWS, 2019).

3. On Guam, at least two of the five occupied caves must be in northern Guam, and two in southern Guam (USFWS, 2015).

4. Total population numbers, once increased, must be sustained over three consecutive years (USFWS, 2015).

Delisting Criteria:

Criterion 1: Over a minimum 30-year period, Mariana gray swiftlet population data on Saipan, Aguiguan, and Guam show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance or an index of abundance derived from quantitative surveys or demographic monitoring; and the average population throughout that time period is estimated to be at least 3,000 birds on Guam, 2,500 on Saipan, and 1,500 on Aguiguan. (USFWS, 2019).

Criterion 2: A self-sustaining Mariana gray swiftlet population has been established on Rota. (USFWS, 2019).

Criterion 3: Sufficient Mariana gray swiftlet roosting and nesting habitat (i.e., occupied and potentially-occupied caves) is protected and managed to achieve Criterion 1 above, with the populations distributed among at least six caves on each island, excluding Rota. On Guam, at least three of the six occupied caves should be in northern Guam. (USFWS, 2019).

Criterion 4: Threats to the species, including predation by introduced predators, nest damage, and pesticide impacts, are effectively managed so as to minimize mortality and to meet Criterion 1 above, and are expected to continue to be so for the foreseeable future. (USFWS, 2019).

Recovery Actions:

- Permanently secure and manage the 11 known active swiftlet caves, one formerly active cave on Rota, and the immediately surrounding "buffer" habitat (USFWS, 1991).
- Survey for, secure, and manage additional colonies of swiftlets and potentially usable caves (USFWS, 1991).
- Conduct specific research on population biology and suspected limiting factors (USFWS, 1991).
- Promote population expansion into suitable historical habitat (USFWS, 1991).
- Develop and implement techniques for reintroduction of swiftlets into suitable habitat, as needed (USFWS, 1991).
- Monitor populations and develop criteria for delisting (USFWS, 1991).

Conservation Measures and Best Management Practices:

- Population biology research: Identify limiting factors for species expansion in the Commonwealth of the Northern Mariana Islands (USFWS, 2015).
- Threats - predator/herbivore control research: Continue efforts to develop and refine brown treesnake control techniques to support large-scale control and/or eradication efforts. Implement large-scale brown treesnake control and/or eradication efforts on Guam (USFWS, 2015).
- Site/area/habitat protection: Permanently secure and manage the known active caves on Guam, Rota, and Saipan and the immediately surrounding buffer habitat. Secure and manage potentially usable caves, including known historic caves, not currently used by the species (USFWS, 2015).
- Captive propagation protocol development: Develop methods for translocating the species (USFWS, 2015).
- Reintroduction/translocation: Develop reintroduction plan for and reintroduce the species to Rota and northern Guam (USFWS, 2015).
- Population viability monitoring and analysis: Develop and implement plans to monitor the species populations on all islands on a regular basis; conduct a PVA to determine the minimum viable population number by island needed for recovery (USFWS, 2015).
- Population biology research / Revise recovery objectives and criteria: Conduct specific research on population biology that can be used to develop criteria for delisting and revise down listing criteria if necessary (USFWS, 2015).

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SPECIES ACCOUNT: *Agelaius xanthomus* (Yellow-shouldered blackbird)

Species Taxonomic and Listing Information

Commonly-used Acronym: YSBL (USFWS, 2018)

Listing Status: Endangered; November 19, 1976; Southeast Region (R4)

Physical Description

The mariquita is a glossy black bird with a small yellow humeral patch around its "shoulders" outlined by a white margin. Immature individuals possess a duller coloration and a brown abdomen. Although plumage coloration is indistinguishable between the sexes, sexual dimorphism is present in this species with males being larger than females. Adult mariquitas measure from 7.8 inches (in) (20cm) to 9.1 in (23 cm); and, on average, males weighs 1.45 ounces (oz) (41 grams (g)) and females 1.23 oz (35 g).

Taxonomy

The yellow-shouldered blackbird (Agelaius xanthomus), also known as “la mariquita de Puerto Rico” or “capitán”, is a diurnal blackbird endemic to Puerto Rico and its adjacent islands, and one of the eleven species belonging to the Agelaius genus of the Icteridae family.

Historical Range

The species was once commonly found in the coastal forests of the archipelago of Puerto Rico, but during the early 20th century, Puerto Rico's coastal forests were destroyed to allow for the development of sugar cane plantations. Following the decline of the sugar industry after the 1930s, the coastal areas were developed for housing.

Current Range

At present, the species is primarily limited to four areas: Mona and Monito islands, where a subspecies developed (A. x. monensis); and three populations in eastern, southern, and southwestern Puerto Rico. When the revised recovery plan was finalized and approved, the mariquita had been reported from the municipalities of Añasco, Barranquitas, Cabo Rojo, Ceiba, Cidra, Ensenada, Guánica, Guayama, Guayanilla, Lajas, Mayagüez, Mona Island, Monito Island, Naguabo, Salinas, San Germán, San Juan, Utuado, and Vieques Island (USFWS 1996). Additional localities later reported were Adjuntas, Aguadilla, Arecibo, Caguas, Carolina, Cataño, Cayey, Ciales, Coamo, Fajardo, Florida, Hormigueros, Juncos, Lares, Loíza, Peñuelas, Ponce, Rincón, Río Grande, San Sebastián, Santa Isabel, and Yauco (Lewis et al. 1999; López-Ortiz et al. 2008; PRDNER 2009). The largest population is found in southwestern Puerto Rico (Cabo Rojo and Lajas).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 9/22/1977.

Legal Description
On September 22, 1977, the U.S. Fish and Wildlife Service designated critical habitat for Agelaius xanthomus (Yellow-shouldered blackbird) pursuant to the Endangered Species Act of 1973 (42 FR 47840 - 47845).

Critical Habitat Designation
Puerto Rico. Areas of land, water, and space with the following components:

(1) All of Mona Island;

(2) that portion of main island of Puerto Rico within the following boundary: Beginning at a point where the Quebrada Boqueron joins the Bahia Boqueron, thence proceeding southwesterly along the coast to Cabo Rojo. thence eastward along the coast, including offshore to the point where Highway 332 meets Bahia de Guanica, thence northward Highway 332 to its junction with Highway 116, thence westward on Highway 116 to junction with Highway 305, thence westward on Highway 305 to its junction with Highway 303, thence northward on Highway to its junction with Highway 101, thence westward on Highway 101 to the point where it crosses Quebrada Boqueron, thence along the Quebrada Boqueron to the point where it joints the Bahia de Boqueron;

(3) a circular portion of the main island of Puerto Rico with a one mile radius, the center containing the junction of Highways 360 and in the town of San German;

(4) Roosevelt Roads Naval Station, southeast of Ceiba.

Primary Constituent Elements/Physical or Biological Features
Not available

Special Management Considerations or Protections
Critical habitat excludes structures or settlements which are not necessary to the normal needs or survival of the species.

Life History

Feeding Narrative
Adult: Mariquitas are omnivorous, but some scientists consider the species as arboreal insectivores since the majority of their diet consists of insects belonging to the orders Lepidoptera, Orthoptera, Homoptera, Coleoptera, Diptera, Dermaptera, and Hymenoptera. They also eat arachnids, unidentified mollusks, and plant matter including fruits, seeds, and nectar from various plant species. Aside from natural material, the species also consumes processed foods such as cattle ration, human food (cooked rice and sugar), dog food, and monkey chow, among others.During post-breeding season, mangroves and trees in scrub habitat (e.g., mesquite (Prosopis pallida), úcar) were more frequently used for foraging, while in the pre-breeding season the largest amount of plant species used were those found in La Parguera residential area [e.g., guayacán (Guaiacum officinale), and emajaguilla (Thespesia populnea)].

Reproduction Narrative

Egg: Eggs are incubated for 13 days by the female.

Juvenile: Rodríguez and Lewis (2006) found that, in artificial nest structures, nestlings left the nests 13 to 16 days after hatching.

Adult: The mariquita breeding season commonly spans from April to August, but breeding activity has been observed from February to November. The beginning of the species' breeding season coincides with the onset of the rainy season, which explains the fluctuation in the start and end of the breeding season. The species is believed to be monogamous with a single attempt at nesting per year, and with nesting being performed in loose colonies. Nests of both Mona and the main islands' subspecies contain from one to four eggs, with an average of three eggs. Both sexes reach sexual maturity at one year of age. In a study of the growth pattern of nestlings and reproductive biology of the mariquita, Díaz-Rodríguez and Lewis (2006) found that, overall, 1.06 chicks flew per active nest and 0.35 chicks flew per egg laid. The mariquita exhibits some degree of synchronicity at least in some breeding seasons. The species uses eight distinct nesting habitats: mud flats and salt flats; offshore red mangrove cays; black mangrove forest; lowland pastures (dry coastal forest); suburban areas; coconut plantations; and coastal cliffs but prefer black mangrove forests for nesting. Rodríguez and Lewis (2006) found that, in artificial nest structures, feeding of the young was performed by both sexes. Banding data indicates that mariquitas may reach 12 years of age in the wild (López-Ortiz et al. 2004). Natural nests of the mariquita may be found on trees in the main island, and on ledges and crevices of cliffs and caves in Mona and Monito islands (USFWS 1996; Cruz-Burgos et al. 1997; Lewis et al. 1999). The species has also been observed nesting in urban areas. Reitsma (1998) found that the two tree species most utilized by mariquitas for nesting were black mangrove (29 nests) and coconut palm (41 nests). Nesting success and fledgling output was highest for the coconut palm nests (Reitsma 1999). López-Ortiz et al. (2008) found that, although inundated black mangrove macro-habitat was less abundant, it was the most important habitat that mariquitas used for nesting in southwestern Puerto Rico; followed by suburban (developed) habitats, and red mangrove macro-habitat. Rainfall appears to be an important factor determining the onset of breeding, number of active nests, and nest-site selection (Reitsma 1999). The number of natural nests found during 1996-1997 (3 nests) decreased from 1994-1995 (18 nests); possibly as an artifact of rainfall activity (Falcón et al. 1997). The drier conditions in 1999 compared to 1998 resulted in significantly more nests in coconut palm trees than in the drier black mangrove habitat (Reitsma 1999).

Habitat Narrative

Adult: Although currently occupied locations are considered coastal subtropical dry forests, during the non-breeding season, the species has been observed as far inland as the mountain towns of Lares and Ciales, and in subtropical wet forests. Lewis et al. (1999) found mariquitas spent most of the time at Pitahaya (within the Boquerón Commonwealth Forest) during post-breeding, where scrub (88.6 percent) and mangrove (40.7 percent) were the most used habitats. During pre-breeding, mariquitas stayed at La Parguera using residential (91.9 percent) and mesquite stands (79.6 percent) habitats more frequently than these habitats were used in post-breeding (Lewis et al. 1999). Mesquite stands (67.3%) and mangrove (45.7%) were used more during the afternoon, while residential habitat was used more during mid-day (51.5%), and scrub used more during morning (39.2%) and afternoon (37.3%) (Lewis et al. 1999). When comparing habitat type used, and periods of day in post and pre-breeding seasons separately, similar differences were detected (Lewis et al. 1999). Eight months of radiotelemetry demonstrated that mariquitas in southwestern Puerto Rico spend about four months (post-breeding season: September through December) in the area of Pitahaya, and move to La Parguera residential area in the non-breeding season where they stay until the start of the breeding season in late April (Lewis et al. 1999).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Seasonal movements

Dispersal

Adult: Moderate

Dispersal/Migration Narrative

Adult: The mariquita is a non-migratory bird, but a portion of the population from the main island moves from coastal areas to inland areas during the non-breeding season to feed.

Population Information and Trends

Population Trends:

Increasing

Species Trends:

Increasing

Resiliency:

Low

Representation:

High

Redundancy:

Low

Number of Populations:

4 (See current range)

Population Size:

At least 1107

Minimum Viable Population Size:

Effective population size in SW Puerto Rico = 71 individuals. (USFWS, 2018).

Population Narrative:

Data gathered during a post-breeding census in August 2007 showed approximately 994 mariquitas in southwestern Puerto Rico (municipalities of Cabo Rojo and Lajas), an increase from 2004 (759 individuals). In Salinas (southeastern Puerto Rico), 113 individuals were observed during the post-breeding census of 2005, a slight increase from 2004 (97 individuals). The principal listing factor threatening the mariquita (nest parasitism by shiny cowbirds), is being managed or reduced. This information suggests that the status of the species is improving.

Threats and Stressors

Stressor: Habitat destruction
Exposure: Loss of roosting and nesting sites; Transition to agriculture and deforestation with loss of roosting and nest sites and increase of shiny cowbird nest parasite. (USFWS, 2018)
Response: Reduced reproductive output. (USFWS, 2018)
Consequence:
Narrative: The revised recovery plan identified the destruction of mariquita feeding, roosting, and nesting habitat as the major threat to the species (USFWS 1996); stating that destruction of mariquita foraging and nesting habitat on the mainland for residential and tourist development, as well as agricultural activities continued in southwestern Puerto Rico. It further indicates that the use of La Parguera waters, cays, and shoreline is incompatible with the needs of the species for roosting and nesting in the area.

Stressor: Parasites
Exposure:
Response:
Consequence:
Narrative: The revised recovery plan states that nest infestation by two species of blood-feeding mites (Ornithonyssus bursa and Androlaelaps casalis) may lead to nest abandonment by adult mariquitas and premature nest desertion by young birds (USFWS 1996). Lice (Philopterus agelaii, Machaerilaemus sp., and Myrsidea sp.) may also affect nesting mariquitas, particularly those in cavity (covered) nests and re-used nests from the previous breeding event (Cruz-Burgos et al. 1997).

Stressor: Avian pox
Exposure:
Response:
Consequence:
Narrative: Avian pox was identified in the revised recovery plan as a potential problem for the mariquita (USFWS 1996). Mariquitas infected with avian pox had significantly lower survival rate than uninfected birds (USFWS 1996). López-Ortiz et al. (2004) found two dead chicks in an artificial nest structure, and the preliminary necropsy report revealed avian pox as the cause of death.

Stressor: Egg failure
Exposure:
Response:
Consequence:
Narrative: Falcón et al. (1997) stated that the major causes of egg failure in artificial nest structures during 1996-1997 were disappearances (egg missing), abandonment (unpunctured

eggs more than two weeks old and without parents in the vicinity), and failure to hatch. In 1999 to 2000, the major causes of egg failure were disappearance, followed by not hatched, abandoned, and punctured (Falcón et al. 2000); and similar results were observed in 2001-2002 (Falcón et al. 2002). The reasons for disappearance, abandonment, and failure to hatch are not known, but predation and presence of avian and mammalian predators around artificial nest structures was suspected; and has been suspected (Díaz and Lewis 2006) or observed on other occasions (DeLuca et al. 2010, unpub. data).

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: The revised recovery plan indicates that the black rat (Rattus rattus) is an important predator of mariquitas; being the major cause of egg and chick loss in certain breeding areas (USFWS 1996). Rats climb artificial nest structures and either prevent mariquitas from using nest structures, remove or eat the eggs and chicks, or cause adult nest abandonment (Cruz-Burgos et al. 1997). Although rat predation is controlled in artificial structures by using rat-excluding devices (metal guards on supporting poles) (USFWS 1996), natural nests continue to be threatened by rats. Cruz-Burgos et al. (1997) believe that predation is one of the most important factors affecting natural nests, and suspected that mariquitas shape their nests in part as a response to potential predation by pearly-eyed thrashers (Margarops fuscatus). Falcón et al. (2000) suggested that Rhesus monkeys may have been responsible for the highest percentage of egg loss found in 10 years. Monkey tracks were observed in different breeding areas where eggs were lost, where active nests were found on the ground, and where chicks disappeared. Besides the previously-reported predators, López-Ortiz et al. (2002) indicated that other possible predators of eggs, fledgling, or adult mariquitas also seen near the artificial nest structures were smooth-billed ani (Crotophaga ani), mangrove cuckoo (Coccyzus minor), yellow-billed cuckoo (C. americanus), black-crowned night heron (Nycticorax nycticorax), yellow-crowned night heron (N. violaceus), osprey (Pandion haliaetus), and red-tailed hawk (Buteo jamaicensis).

Stressor: Nest invasion/parasitism
Exposure:
Response:
Consequence:
Narrative: The revised recovery plan identified invasion of nesting areas by Caribbean martins (Progne dominicensis) as one of the two most important threats to the mariquita. Caribbean martins were responsible for the loss of ten mariquita eggs in artificial nest structures, and 17 eggs of Caribbean martins were found in 18 mariquita nests (Falcón et al. 2002). Observations of mariquitas tending and caring for English sparrow (Passer domesticus) fledglings suggest that mariquitas are pre-disposed to brood and raise nestlings from other bird species; a behavior that is exploited by the shiny cowbird, Molothrus bonariensis (Ramos-Alvarez and López-Ortiz 2009).

Stressor: Competition
Exposure:
Response:
Consequence:
Narrative: Mariquitas may face competition for nest-sites with other bird species. Cruz-Burgos et al. (1997) mentioned that part of the reason for mariquitas to build nests covered by leaves in

coconut palm forests is to avoid competition for nesting space from grackles (Quiscalus niger) and rock doves (Columba livia). Because mariquitas usually select the upper fronds of palms for nesting, Reitsma (1998) indicated that pruning of the lower fronds of coconut palm trees may remove grackles and doves that nest on the lower palm fronds.

Stressor: Human activities
Exposure:
Response:
Consequence:
Narrative: Reitsma (1998) reported breeding failure of a mariquita nest at Villa La Mela, Cabo Rojo, due to pruning of coconut palm fronds. Mariquitas have been observed foraging in cultivated fields where insecticides are commonly applied to the crops. Therefore, some authors believe that mariquitas may be negatively affected by such insecticides (Lewis et al. 1999). Spotlighting of wading birds from boat tour operations are thought to cause birds to abandon nest sites. Human food waste attracts predators and presents unnatural food sources to YSBL (USFWS, 2018).

Recovery

Delisting Criteria:
1) Enhance reproductive success to = 0.96 daily survival for eggs and chicks

2) Reduce shiny cowbird (Molothrus bonariensis) parasitism to = 20 percent.

Recovery Actions:
- Conduct post- Hurricane Maria assessments of all populations in Puerto Rico and Mona Island. (USFWS, 2018)
- Improve accuracy of methodology for estimating population size. (USFWS, 2018)
- Redesign artificial nest structures to reduce nestling predation and premature fledgling. (USFWS, 2018)
- Accurately monitor YSBL nesting activity to determine nest success and quantify the effect of nest predation. (USFWS, 2018)
- Conduct a study to determine fledgling survival. (USFWS, 2018)
- Conduct a study in the Salinas YSBL population on the anti-parasitic behavior seen on site. (USFWS, 2018)
- Conduct a post hurricane assessment on the conditions of the YSBL breeding habitat. (USFWS, 2018)

Conservation Measures and Best Management Practices:
- Re-instate the color-banding program to determine fidelity to nesting areas, range expansion, and the use of natural nests in areas other than the natal sites. The color banding program and monitoring of banded birds was halted, due to changes in program priorities, and reduction of budget and work force.
- Continue to search for nests throughout the breeding season in areas were nesting has been documented in the past and in new areas.
- Monitor breeding success in natural nests. A minimum of 30% of the coconut palm nests should be monitored in order to obtain some representative data on nest success in palm trees.

- The current status of the eastern and southern mariquita populations is unknown, because sufficient monitoring of these populations has not been conducted. Therefore, additional consecutive censuses of these populations are needed to determine their status.
- Accelerate dispersal of breeding mariquitas to new areas (e.g., Bioluminescent Bay, Boquerón Commonwealth Forest, Cabo Rojo salt flats, and Montalva Bay), by attracting them using artificial nest structures. One or two of these new areas should be selected as experimental areas to locate artificial structures. The impact of predators, competitors, and parasites on the population dynamics of the mariquita at the selected areas should be evaluated, to determine if competitor and predator/parasite management techniques are necessary
- Repeat nest site characterization studies at all sites, especially eastern and southwestern Puerto Rico, to accurately determine nest site characteristics that relate to the probability of nest success (e.g., food availability).
- Effective public education and outreach programs are key to the recovery of the mariquita. For example, personnel in charge of pruning coconut palm trees should be made aware of the presence and nesting activities of mariquitas, and learn how to distinguish them from grackles. Likewise, an education campaign should be implemented for communities where nesting mariquitas have been reported (e.g., Barrio Corozo, Cabo Rojo), which may ultimately result in more information about mariquitas breeding in more developed areas.
- Avoid pruning of coconut palm trees during the mariquita breeding season. If pruning during the mariquita breeding season is necessary for safety reasons, a biologist must inspect palm trees to be pruned and ensure that active mariquita nests are not present.
- Monitor coconut palm nests using improved monitoring methods such as tree bikes that allow determining the fate of nests while avoiding the premature fledging of chicks.
- Implement agreements with land owners of the secondary forest adjacent to Pitahaya, the property in front of the Club Náutico de La Parguera, and the land of the Club Tiro de La Parguera for the protection of those important feeding grounds. Since areas dominated by scrub vegetation do not appear to be preferred habitat for mariquitas, trees such as mesquite, úcar, and rolón should be planted within these private land areas.
- Conduct study to determine food availability (i.e., insects and fruits) in the area of Pitahaya to determine at what extent that food would sustain a growing population of mariquitas, particular during breeding.
- Establish management practices at the Cabo Rojo National Wildlife Refuge to enhance food availability during drought conditions. Irrigation of mesquite woodland would attract adult moths to rear their caterpillars, producing food for the mariquitas and possibly inducing them to nest at the refuge.
- Determine the extent of primate predation on mariquita nests (possibly using hidden motion-sensing cameras), and implement management control measures to prevent predation by primates on the breeding areas.
- Conduct genetic studies to determine if genetic differentiation between mainland and Mona-Monito populations exists.
- Utilize radio-telemetry to obtain information on dispersal and inter-mixing between the small eastern and southern mariquita populations.
- PRDNER Forest Managers at Commonwealth Forests where the mariquita is found should be involved in all aspects of the mariquita Recovery Program based on resources and agency priorities; including the planning and implementation of management practices that would benefit this species.

- A revision of the species recovery plan is warranted, given the available new information on the biology of the mariquita.
- New priority in 2019, #1: Decrease egg and chick predation at nests. (USFWS, 2019).
- New priority in 2019, #2: Improve efficiency of artificial nesting structures. (USFWS, 2019).
- New priority in 2019, #3: Reduce impact of shiny cowbirds on nest success. (USFWS, 2019).
- New priority in 2019, #4: Protect YSBLs against other invasive predator disturbance. (USFWS, 2019).
- New priority in 2019, #5: Provide sufficient foraging habitat for adult YSBLs during peak breeding season. (USFWS, 2019).

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SPECIES ACCOUNT: *Akialoa stejnegeri (=Hemignathus procerus)* (Kauai akialoa (honeycreeper) (=Hemignathus procerus))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016) Presumed extinct and recommended for delisting. (USFWS, 2019) ; proposed for delisting

Physical Description

The Kaua`i `Akialoa (Kauai akialoa) measures about seven and a half inches in length and has a very long downcurved bill one third the length of its body. Adult males are bright olive-yellow above and yellow below. Throat, breast, and sides of the body are olive-yellow. Females are green-gray above and have shorter bills (USFWS, 2016).

Taxonomy

AOU (1997) defined this taxon as the Oahu and Lanai populations of H. obscurus (Hawaiian Akialoa) plus the population of H. procerus (Kauai Akialoa) on Kauai. This arrangement follows Pratt et al. (1987). Olson and James (1995) recognize all island populations as separate species (NatureServe, 2015). The scientific name of the species was officially listed as Akialoa stejnegeri effective May 17, 2016. (USFWS, 2016b).

Historical Range

See current range/distribution.

Current Range

Unknown if still extant. The species was widespread on Kaua`i and occupied all forest types above 200 meters (660 feet) elevation (Perkins 1903) (USFWS, 2006).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: The life history of the Kaua`i `akialoa is poorly known, based mainly on observations from the end of the 19th century (Wilson and Evans 1890 to 1899, Rothschild 1893 to 1900, Perkins 1903). The species used its long bill to probe for arthropods in bark crevices, decaying wood, epiphytes, and debris accumulated in the treetops. It also took nectar from `ohi`a and lobelia flowers (USFWS, 2006).

Reproduction Narrative

Adult: Nothing was ever discovered about its nesting biology (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Occurred > 660 ft. elevation (USFWS, 2006)

Habitat Narrative

Adult: See historical range/distribution.

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Not available

Species Trends:

Last confirmed sighting in 1965 (USFWS, 2009); possibly extinct (USFWS, 2006)

Number of Populations:

Presumed extinct (USFWS, 2019)

Population Size:

Presumed extinct (USFWS, 2019)

Additional Population-level Information:

Extensive time has been spent by qualified observers within the historical range of the Kauaʻi ʻakialoa, searching for the known-extant puaiohi (Myadestes palmeri), ʻakekeʻe (Loxops caeruleirostris) and ʻakikiki (Oreomystis bairdi). Hawaiʻi Forest Bird Surveys were conducted in 1981, 1989, 1994, 2000, 2005, 2007, 2008, 2012, and 2018 (Paxton et al. 2016, L. Crampton pers. comm. 2018). The Kauaʻi Forest Bird Recovery Project (KFBRP) conducted occupancy surveys for puaiohi in Kokeʻe State Park, Hono O Na Pali Natural Area Reserve, Na Pali Kona Forest Reserve and the Alakaʻi Wilderness Preserve, from 2011 to 2013 (Crampton et al. 2017), and spent over 1,500 person-hours per year from 2015 to 2018 searching for ʻakekeʻe and ʻakikiki nests. Hawaiʻi Forest Bird Surveys in 2012 and 2018, occupancy surveys, and nest searches did not yield any new detections of Kauaʻi ʻakialoa. The KFBRP conducted mist netting in various locations within the historical range for Kauaʻi ʻakialoa from 2006 through 2009, and from 2011 through 2018, and none were caught (L. Crampton pers. comm. 2018). (USFWS, 2019)

Population Narrative:

The last well-documented sighting of this species occurred in 1965 (Huber 1966) and there was an unconfirmed sighting in 1969 (Reynolds and Snetsinger 2001) (USFWS, 2009). The Kaua`i `akialoa may be extinct, but recent reexamination of the survey data for this species indicates that additional survey effort is required to confirm its status (USFWS, 2006).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Habitat loss and degradation by agriculture, urbanization, cattle (Bos taurus) grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006). Feral pigs (Sus scrofa) have had a long-term damaging effect upon native forests in the remaining Kaua`i `akialoa range by consuming and damaging understory vegetation, creating openings on the forest floor for nonnative weeds, transporting nonnative weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants. Habitat degradation resulting from the invasion of nonnative weeds has dramatically changed the forest structure and integrity. Two hurricanes in 1982 and 1992 severely disrupted portions of high quality native forest, and have made space for the germination and expansion of noxious weeds such as Hedychium flavescens (yellow ginger), Erigeron karvinskianus (daisy fleabane), Tibouchina urvilleana (glorybush), Japanese Lonicera japonica (honeysuckle), and others (USFWS, 2009).

Stressor: Disease and predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Predation by nonnative mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by nonnative mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2009).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006). Impacts of nonnative birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2009).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2009).

2. Either (a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or (b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2009).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2009).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2009).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2009).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).
- As of the 2019 5-Year review, this species is presumed extinct in the wild, and delisting is recommended. The one proposed recommendation for future action as of 2019 is captive propagation for reintroduction and genetic storage in the event the Kauaʻi ʻakialoa be rediscovered. The USFWS recommends that the Rare Bird Discovery Protocol in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006, pp. 3-17 – 3-21) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ. (USFWS, 2019).

Conservation Measures and Best Management Practices:
- Given the low survey effort for this species and the difficulty of detecting forest birds in remote mountainous habitats in Hawai`i, the species' biological status is uncertain. This determination is based on reexamination of data from the 1994 to 1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001), the Hawaiian Forest Bird Survey (Scott et al. 1986), and searches for this and other rare species by John Sincock from 1968 to 1973 (USFWS 1983). Although results of the 1994 to 1996 Hawai`i Rare Bird Search and the most recent forest bird surveys on Kaua`i in 2005 suggest the

Kaua`i `akialoa may be extinct, additional targeted searches for this species are needed to confirm this assessment (USFWS, 2009).

- Therefore, we recommend that surveyors conduct intensive searches for the Kaua`i `akialoa, using similar methodologies as those employed during the 1994 to 1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001). Specifically, studies should include areas not surveyed during the 1994 to 1996 Hawai`i Rare Bird Search in these surveys (USFWS, 2009).

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SPECIES ACCOUNT: *Amazona vittata* (Puerto Rican parrot)

Species Taxonomic and Listing Information

Listing Status: Endangered; March 11, 1967; Southeast Region (R4)

Physical Description

The Puerto Rican parrot, largely green with a red forehead and blue flight feathers, is one of nine extant Amazona parrots occurring in the West Indies (Wiley et al. 2004). Measuring about 29 centimeters (11 inches) in length and weighing about 270 grams (10 ounces), this species is one of the smallest in its genus, although it is similar in size to other Amazona parrots in the Greater Antilles. Aspects of coloration suggest that it is most closely related to either the Jamaican black-billed parrot (A. agilis) or the Hispaniolan parrot (A. ventralis) (Snyder et al. 1987).

Taxonomy

The genus Amazona (family Psittacidae) consists of 34 species distributed between South and Central America and the Antilles and Mexico (White et al. 2005b). One species (Amazona vittata) is known from Puerto Rico, and two subspecies are recognized: Amazona vittata vittata (Boddaert), from mainland Puerto Rico and possibly offshore Vieques and Mona Islands, and Amazona vittata gracilipes (Ridgway) from Culebra Island (now extinct). The gracilipes adults were similar to vittata, but smaller, and with relatively smaller, more slender feet (Forshaw 1978). Puerto Rican parrots were last recorded on Culebra Island in 1899 when A. B. Baker collected three specimens (Snyder et al. 1987). (USFWS, 2009)

Historical Range

All indications suggest that the parrot was once abundant and widespread on the Puerto Rican Archipelago's major islands (Snyder et al. 1987). The size of historical populations is highly speculative, but may have exceeded a million individuals. By the early 20th century, the species had disappeared from all of the offshore islands and was restricted to five known areas on the mainland. By about 1940, the only remaining population was in the Luquillo Mountains of eastern Puerto Rico, the largest area of native vegetation left on the island (USFWS, 2009).

Current Range

Presently, individuals survive in the wild in the El Yunque National Forest (YNF) in eastern Puerto Rico and the Río Abajo Forest (RAF) in north central Puerto Rico. There are two captive population facilities: the Iguaca Aviary and the José L. Vivaldi Aviary in eastern and westcentral Puerto Rico, respectively. (USFWS, 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Juvenile: Feeding of nestlings is accomplished by regurgitation, and is performed by both adults, often working in tandem to feed all chicks in the nest

Adult: The Puerto Rican parrot is a frugivorous (fruit eating) cavity nester seldom seen far from forests. The fruit of the sierra palms (Prestoea montana) is the primary food of the species in the breeding season. Most foraging takes place outside the nesting territory, with some pairs regularly flying as far as 1.6 kilometer (1 mile) to feeding areas. Although the most commonly eaten foods by parrots are dominant in the vegetation, they can consume a wide variety of fruits, seeds, and leaves.

Reproduction Narrative

Egg: The incubation period lasts about 26 days. Eggs hatch asynchronously, generally about 2 days apart.

Juvenile: Young parrots hatch nearly naked with their eyes closed and take food almost immediately after hatching. Chicks fledge at about 9 weeks of age, but some have taken as little as 8 weeks and as long as 11 weeks.

Adult: Puerto Rican parrots mature at 3 to 5 years of age. Parrots are dependent on large diameter trees for nesting cavities (although one former population is known to have also used cliff pot-holes; Wiley 1980, Snyder et al. 1987). Pair bonds between adult parrots are normally stable over the years, and pair members stay together at all times of the year, except when the female incubates and during the early nestling stages. The male assumes full foraging responsibilities for the pair during this time. Due to its nesting requirements, it depends on mature forests with large cavity forming trees. Incubation, performed solely by females, begins with or shortly after the laying of the first egg. Clutch size ranges from two to four eggs, but averages three eggs. Nesting is highly synchronized seasonally, with almost all clutches produced in late February or early March, the driest part of the year and also the time of peak fruiting of sierra palms (Prestoea montana), the primary food of the species in the breeding season. Replacement clutches for eggs lost early in the breeding season were observed three times and induced six times (Snyder et al. 1987). (USFWS, 2009)

Geographic or Habitat Restraints or Barriers

Adult: Requires forests (USFWS, 2009)

Environmental Specificity

Adult: Narrow (USFWS, 2009)

Habitat Narrative

Adult: The Puerto Rican parrot is a cavity nester seldom seen far from forests. The species is found within the Luquillo mountains. A large proportion of secondary forests occur in the northwestern karst region of the island (Helmer et al. 2002), and have been identified as the most suitable site for the reintroduction of the species (Trujillo 2005). Karst topography contains other types of cavities (e.g., cliff pot-holes) used in the past for nesting. Parrots currently concentrate their activities within the palo colorado (Cyrilla racemiflora) forest zone at its interface with the tabonuco (Dacryodes excelsa) forest zone. See reproduction narrative for breeding habitat. (USFWS, 2009)

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available

Population Information and Trends

Population Trends:

Decreasing (USFWS, 2009)

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Size:

50 (wild); 228 (captive) (USFWS, 2009). As of the 2017 5-year review, the population has increased from 284 to 541 individuals, both wild and captive. 53-56 wild individuals are estimated to live in the El Yunque National Forest (EYNF), 140-142 wild individual are estimated in the Rio Abajo State Forest (RAF), 141 captive individuals live at the Jose L. Vivaldi Aviary, and approximatey 40 in teh Maricao State Forest (primairly due to captive breading and release programs). (USFWS, 2017).

Population Narrative:

The wild population is around 50 individuals. Two captive population facilities hold more than 228 individuals. At present, low numbers and a limited distribution are major threats. Between 1973 and 2006, the population has increased one percent annually. Since 1996, however, there has been an annual decrease of eight percent. The number of wild parrots has never surpassed 47 birds, and currently stands at a minimum of 25 individuals. Beissinger et al. (2008) provide documentation regarding egg hatchability that might indicate inbreeding effects in the Puerto Rican parrot. (USFWS, 2009). As of 2017: Since the 2008 five-year status review for the Puerto Rican Parrot, the Service, PRDNER and U.S. Forest Service have continued to work together in the management of both wild and captive populations. The objective is to enhance and strengthen existing populations in El Yunque National Forest (EYNF) and in Rio Abajo State Forest (RAF). The total number of individuals (captive and wild) has increased from about 284 in 2008 to about 559 individuals in 2017. At present time, about 53-56 parrots have been counted in the wild in EYNF, about 140-142 parrots are in the wild in RAF, 3 currently in the wild in Maricao State Forest (MAF) and one individual still observed in Morovis Municipality. Also, about 358 parrots are currently in captivity in both aviaries. This increase has been possible due to the reproductive success of pairs in captivity, management of wild populations to ensure success breeding and hatching, and the releases every year in RAF since 2006 and the last two releases in EYNF. Efforts to establish the third wild population in Maricao State Forest began with parrots being released in November 2016, and will continue with subsequent releases in the upcoming years and management of the wild population. (USFWS, 2017).

Threats and Stressors

Stressor: Habitat modification and destruction (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Protection was afforded in view of the parrots' dramatic range contraction and population decline, particularly during the 20th century (Snyder et al. 1987). The destruction of the native forests was unquestionably a major factor influencing both parameters. By 1912, the island was more than 80 percent deforested, and of the remaining forests, only about 45,000 acres (ac) (18,220 hectares (ha)) remained in virgin condition (Murphy 1916). By 1922, only about 20,000 ac (8,097 ha) in the Luquillo Mountains remained forested, and nearly all of it had been cut to extract timber (Wadsworth 1949, 1951). Parrots are dependent on large diameter trees for nesting cavities (although one former population is known to have also used cliff pot-holes; Wiley 1980, Snyder et al. 1987). The limited availability of cavity trees was invoked to explain poor population growth and lack of new nesting areas (Snyder and Taapken 1977, Wiley 1985). (USFWS, 2009). As of 2017, the species is mostly found in a portion of EYNF located within Luquillo Mountains and in RAF in Utuado. These two forests are managed for conservation. We have also documented parrots using private areas bordering both forests. In addition, we have documented individuals who have left the forest and have settled in private areas over distances up to 36 miles. This situation has been documented in the three wild populations where the parrots moved to non-protected adjacent private lands. Efforts through the W-39 project led by PRDNER aims to enhance and create habitat corridors in areas between Rio Abajo and Maricao State Forests, within the Bosque Modelo region in Puerto Rico. The management practices will be linked to the reintroduction and conservation efforts of the PRPs. In addition, there is an ongoing project proposal to harvest wood trees at RAF. Consultation with the Service is needed to minimize possible adverse effects on parrots currently nesting in the wild. (USFWS, 2017).

Stressor: Predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Red-tailed hawks are the primary avian predator of parrots, an important cause of juvenile and adult mortality (Snyder et al. 1987, Wiley et al. 2004, Nimitz 2005). Between 2000 and 2004, 40 captive-reared parrots were released in the Luquillo Mountains. The majority (54 percent) of the documented deaths were due to predation by red-tailed hawks, which claimed at least 21 percent of all released parrots, reaffirming the contention that this raptor is a source of mortality for parrots (White et al. 2005a, USFWS unpubl. data). Major threats to this species include nest competition and predation of eggs and chicks by pearly-eyed thrashers (Margarops fuscatus). Other predators such as black rats (Rattus rattus) affect parrot demography through their impact on breeding productivity, but intense management practices have curbed their impact. Sometimes, parrot nests become infested with parasites such as the botfly (Philornis pici) and the soldier fly (Hermetia illucens). Philornis ectoparasitic larvae significantly retard development and can result in death of parrot nestlings and adults (Arendt 1985, Snyder et al. 1987, Arendt 2000). Other possible predators of parrots in the YNF and RAF are the federally listed Puerto Rican broad-winged hawk (Buteo platypterus brunnuscens), peregrine falcons (Falco peregrinus), and Puerto Rican boa (Epicrates inornatus). (USFWS, 2009). As of 2017:

Red-tailed hawks continue to be the primary avian predator of parrots, an important cause of juvenile and adult mortality. In Maricao, predation by the Red tailed hawks has been one of the main reasons for the death of the parrots released. In the past releases in EYNF and RAF predation by Red-tailed hawks has been confirmed as the direct cause of at least 50% of the parrots found dead (White et al. 2005). Other factors affecting the parrot such as pearly-eyed thrashers (Margarops fuscatus), black rats (Rattus rattus), honeybees (Apis mellifera), botfly (Phylornis pici) and soldier fly (Hermetia illucens) are controlled following management practices and they are not a factor that significantly affects the population of parrots. Although Puerto Rican boa (Epicrates inornatus) was considered as possible predator there have been no reported cases of deaths of parrots by boas. However, in the 2016 breeding season a boa attack was reported in one of the nests in the wild in Río Abajo Forest which resulted in the death of two Puerto Rican Parrot chicks. (USFWS, 2017).

Stressor: Honeybees (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Honeybees (Apis mellifera) compete with parrots for nest sites (Wiley 1980, Wiley 1985, Snyder et al. 1987, Lindsey et al. 1994). Although there is no record of honeybees evicting nesting parrots, they take over nest cavities after the breeding season. Often it has been difficult to maintain each of the modified or natural cavities available for prospecting breeding parrots, although currently nest entrances are closed as soon as possible following the nesting season to avoid usurpation by honeybees. The threat posed by bees has been exacerbated since the arrival of Africanized honeybees. (USFWS, 2009)

Stressor: Adverse weather conditions (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Weather in the Luquillo Mountains is extremely wet and humid. Exposure to rain limits the adequacy of nesting cavities as chicks and eggs can be lost due to rainwater entering nest cavities (Snyder et al. 1987). Occasionally, parrot chicks also suffer from respiratory diseases acquired in the dampened nest environment. The dependence of parrots on natural vegetation for food, shelter, and nest sites makes them particularly vulnerable to the impacts of hurricanes (Wiley and Wunderle 1993). Given the small size of the wild population, a single strong hurricane could potentially wipe out the entire current wild population. (USFWS, 2009). As of 2017, weather events (hurricanes, storms) remain as the single most important factor impeding population growth in the El Yunque National Forest. Weather in the Luquillo Mountains is extremely wet and humid causing loose of eggs, chicks and adults. (USFWS, 2017).

Recovery

Reclassification Criteria:
1) A wild population in the Luquillo Mountains exists with a population size (yet to be determined) that exhibits vital parameters consistent with a trajectory towards population maintenance. At present, population growth in the YNF could be expected if the breeding productivity is greater than or equal to 1.56 chicks per nesting attempt (average rate for the 1990s) and their survival rates should not drop below 90 percent for adults, 85 percent for

subadults, and 50 percent for juveniles. These projections assume that age of first breeding is four years old, and at least 60 percent of the adults engage in reproduction each year (Figure 6). A higher number of breeding pairs is essential for vigorous population growth and historically has been stagnant at 2-6 pairs.

2) A second wild population in the northwestern karst region exists with a population size (yet to be determined) that exhibits vital parameters consistent with a trajectory towards population maintenance.

3) The reintroduction or creation of at least a third wild population has been achieved in a suitable forested area in the island reflecting lessons and demographic expectations stemming from work with wild populations and release programs in the RAF and YNF.

4) Nesting and foraging habitats (yet to be determined) are protected to support growing populations.

Delisting Criteria:
1) At least three interacting populations exist in the wild and population growth is sustained for 10 years after downlisting has occurred. This length of time will allow monitoring the recruitment of breeding birds and other population attributes in a species that has been characterized by highly variable reproductive and survival rates, at least in the YNF (Snyder et al. 1987, Muiznieks 2003, Beissinger et al. 2008). Reviews of the recovery program prior to making a delisting determination will help define more explicitly the range of vital parameter values of a recovered population (see milestones 2 and 3).

2) Long term protection of the habitat occupied by each wild population is achieved.

3) The effects of disease and predation factors are controlled to allow for population viability.

Recovery Actions:
- 1. Protect and manage the Puerto Rican parrot wild population.
- 2. Assess and protect current and future public and privately-owned habitat for the Puerto Rican parrot.
- 3. Maintain and manage the captive flocks.
- 4. Release captive produced parrots to augment the wild population and establish additional wild populations.
- 5. Establish additional wild populations as defined in the criteria.
- 6. Continue public awareness and education programs, and enforce existing laws to promote support for the recovery program.
- 7. Refine recovery criteria.

Conservation Measures and Best Management Practices:
- Land Ownership and Management. Since the mid-1950's, when the parrot population was determined to number only 200 birds, U.S. Forest Service land management activities have included parrot recovery activities. These include locating parrot nest sites, nest improvements, parrot range determination, and ensuring that other future forest management actions do not adversely affect parrots or parrot habitats. In 1986, the YNF Land and Resource Management Plan gave direction for

long-term parrot habitat maintenance and improvement, and placed high emphasis on Puerto Rican parrot recovery based on what was considered essential and potential habitat for the species (USFWS, 2009).

- Efforts to Increase Nesting Success and Breeding Productivity. Before 1973, nesting success, defined here as a pair fledging at least one chick, ranged from 11 to 26 percent. Research and intensive management efforts soon after the recovery program started, subsequently improved this success rate to 81 percent (Snyder et al. 1987). Activities included improving the quantity and quality of available nest sites and controlling predators and competitors. Since 1976, all pairs of parrots have utilized either created or rehabilitated nest sites that were designed or modified to prevent entry of water and to discourage entry of predators and competitors. Increases in breeding productivity have also been achieved by fostering chicks from the aviary to the wild; by nurturing chicks weakened by problems in the field (e.g., disease, parasites) and returning them to the wild when healthy; and, from released birds that have joined the breeding population (i.e., recruitment; White et al. 2005a). (USFWS, 2009)
- Control of Predators and Competitors. Routine maintenance of nest cavities, habitat improvements, and nest guarding were and still are the primary techniques utilized to counter parrot predators. The use of poison baits has discouraged rate depredation. The problem of pearly-eyed thrasher takeovers of parrot nests was successfully resolved by converting nets into deep, dark structures with bottoms not visible from the entrances, characteristics repellent to thrashers, but not to parros. Constriction of nest entrances and nest guarding has reduced raptor threats. Also, thrashers were provided nest boxes attractive to them, adjacent to parrot nest sites. By virtue of their territoriality, thrasher pairs serve as parrot nest guards, excluding other thrashers prospecting for nest sites from the vicinity of parrot nests. Intensive honeybee swarm trapping efforts in breeding areas and covering nest entrances during summer, after the parrot breeding season, when most swarming takes place, reduces honeybee occupation of traditional and potential parrot nest sites. Hives, which become established in parrot nests, are routinely removed during the non-breeding season. Temporary closure of nest entrances has proved to be an effective method with no known adverse effects on the parrots. The primary method of combating the warble fly threats has been frequent inspections of parrot chicks to determine severity of parasitism and the need for medical treatment (primarily surgical removal of maggots) of affected chicks. Recent prevention methods include application of carbaryl insecticide (Sevin ®) to the nest material (USFWS, 2009).
- Population Viability Analysis (PVA). In June 1989, the Captive Breeding Specialist Group conducted a Puerto Rican parrot PVA workshop (Lacy et al. 1989). The analysis was based on the information and expert opinion of the parrot field biologists and population biology of the parrot. The aviary personnel provided information on the captive flock key to the development of a master plan for the captive population. The final report provided recommendations and identified management needs for the wild and captive populations (USFWS, 2009).
- Information and Education. The Puerto Rican parrot and its plight continue to receive both local and national publicity in newspapers and popular magazines. A film on parrot conservation efforts (with both English and Spanish versions) was produced and distributed some time ago. Snyder et al. (1987) published a monograph on the Puerto Rican parrot, covering the bird's natural history and conservation efforts between 1946 and 1985. An education plan has been developed and its initial phases implemented (USFWS, 2009).
- International Recognition: The Rio Grande Field Office of the Service has received numerous requests for re-prints of published research and technical assistance from biologists and researchers in countries such as Cuba, Guatemala, El Salvador, Jamaica, Dominica, Bolivia, Venezuela, Perú, Argentina, Brazil, Costa Rica, Spain, France, Israel, Philippines, New Zealand, and Chile. Moreover, project personnel have recently collaborated directly on ongoing and proposed research projects on

the Bahama parrot (Abaco Island, Bahamas) and the endangered slender-billed parakeet in Chile (USFWS, 2009).

- Media efforts. The Puerto Rican parrot recovery program has also been the subject of documentaries disseminated by media outlets such as Animal Planet, British Broadcasting Corporation, World of Audubon and the radio program Earth and Sky, in addition to numerous local media outlets (USFWS, 2009).
- Establishment of a second wild population in the northern karst region: Since 1996, the DNER and the Service have sponsored research to determine the best location to reintroduce parrots and develop management strategies to foster a successful reintroduction (Collazo and Groom 2000; Appendix 7). Assessments of Río Abajo, Cambalache, and Guajataca Forest Reserves (Map 3) included selected habitat features (e.g., availability of food plant species, cavity bearing trees), as well as factors such as abundance of predators (e.g., pearly-eyed thrasher, red-tailed hawks; Muizniecks 2003, Trujillo 2005). Other studies have been designed to enhance food availability for parrots through regeneration of native species and prescribed plantings (e.g., Sierra Palm, Prestoea montana, Royal Palm Roystonea borinquena; Inman 2005). These and other data singled out the RAF as the best location to reintroduce the species in the karst region (Trujillo 2005) (USFWS, 2009).
- Interagency Cooperation: The recovery program for the Puerto Rican parrot is an interagency effort between the USFWS, the Puerto Rico Department of Natural and Environmental Resources and the U.S. Forest Service. A Memorandum of Understanding (MOU) exists among these agencies outlining the management of the program. The MOU establishes three levels, or tiers, of collaboration: the operational level, the management level and the executive level. The Operational Committee is composed of the operational Project Leaders from each agency. The Operational Committee is responsible for the day to day operation and implementation of the policies and directives (USFWS, 2009).
- Monitoring the size of the wild population: Population size is used to define a recovered population and to measure progress towards that goal, and for parrots, this parameter is estimated by conducting pre- and post-breeding counts in parrot activity areas (e.g., nesting area) by multiple observers. A count coordinator keeps track of numbers and movements to minimize duplicative counts. The reliability of counts was evaluated in 2003 using a “capture-recapture” approach taking advantage of instrumented birds in the population (see Williams et al. 2001). Detection probability was high (average = 0.96 in 4 counts). Counts within the sampling area were deemed accurate. The post-breeding population size was 28 (95% CI: 26-34). Scouting trips throughout the forest and surrounding lands are conducted prior to counts to determine if all birds are present in the sampled area. The idea is to minimize a potential spatial sampling bias. The approach outlined above will be used periodically to assess the reliability of counts, both in the YNF and RAF (USFWS, 2009).

References

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SPECIES ACCOUNT: *Ammodramus maritimus mirabilis* (Cape Sable seaside sparrow)

Species Taxonomic and Listing Information

Commonly-used Acronym: CSSS (USFWS, 2019)

Listing Status: Endangered; 03/11/1967; Southeast Region (R4) (USFWS, 2016)

Physical Description

Cape Sable seaside sparrow, Emberizidae.Streaked, greenish upperparts; long spike-like bill, thick at the base and thin at the tip; short pointed tail; yellow patch before the eye (adults); dark whisker stripe separating whitish throat and broad pale stripe along the cheek; white underparts with distinct streaking; juveniles are duller and browner than are adults (NGS 1983). LENGTH:15 WEIGHT: 24 (NatureServe, 2015)

Current Range

Extreme southern and southwestern Florida. Scattered populations formerly occurred from Ochopee south to Taylor Slough, in Dade, Collier, and Monroe counties. Two remaining disjunct populations occur in marshes of Big Cypress Swamp and Taylor Slough.

Critical Habitat Designated

Yes; 11/6/2007.

Legal Description

On November 6, 2007, the U.S. Fish and Wildlife Service (Service) revised the designation of critical habitat for the endangered Cape Sable seaside sparrow (Ammodramus maritimus mirabilis) under the Endangered Species Act of 1973, as amended (Act). In total, approximately 84,865 acres (ac) (34,344 hectares (ha)) fall within the boundaries of the designation (72 FR 62736 - 62766).

Critical Habitat Designation

The five units proposed for designation as Cape Sable seaside sparrow critical habitat are: (1) Marl prairie habitats that support sparrow subpopulation B and lie exclusively within ENP in the vicinity of the Main Park Road, between Shark River Slough and Taylor Slough; (2) marl prairie habitat that supports sparrow subpopulation C within ENP along its eastern boundary in the vicinity of Taylor Slough; (3) marl prairie habitats that support sparrow subpopulation D within ENP and the State-owned Southern Glades Wildlife and Environmental Area to the east of Taylor Slough; (4) marl prairie habitats that support sparrow subpopulation E within ENP, along the eastern edge of Shark River Slough; and (5) marl prairies that support sparrow subpopulation F within the northern portion of ENP along its eastern boundary and lying to the east of Shark River Slough.

Unit 1—Subpopulation B: Unit 1—subpopulation B, consists of 39,053 ac (15,804 ha) of marl prairie and lies exclusively within ENP. The unit is bounded on the south by the longhydroperiod Eleocharis-dominated wet prairie and mangrove zone just inland of Florida Bay, on the west by the sawgrass marshes and deepwater slough communities of Shark River Slough, on the north by the pine rockland vegetation communities that occur within ENP on Long Pine Key, and on the east by the sawgrass marshes and deepwater slough vegetation community of Taylor Slough. There is a continuous elevational gradient across the site, from the high elevations of the pine rocklands north of the unit down to the mangroves in the south. The area is bisected by the Main Park Road, which serves as the primary public access route from Homestead to Florida Bay. It is also bisected by the Old Ingraham Highway, which is an abandoned and partially restored roadway that historically provided access from Homestead to Florida Bay. Much of the western portion of this roadway was removed and restored to grade, but the eastern portions of the road, with its associated borrow canal and woody vegetation, interrupt the contiguity of the prairies within the eastern portion of this unit. Besides the road, borrow canal, and woody vegetation, which are not critical habitat, the area consists of one large, contiguous expanse of marl prairie that contains all of the PCEs for the sparrow. When sparrows were first recorded in the area during 1974 to 1975 surveys, they were abundant and widespread (Werner 1975, pp. 32–33). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. Consequently, we consider the unit to be occupied at the time of listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). The area is the largest contiguous patch of marl prairie east of Shark River Slough. It is currently occupied, and has consistently supported the largest sparrow subpopulation since 1992 (Pimm et al. 2002, p. 70; Pimm and Bass 2006, p. 16). The natural characteristics of this area make it relatively immune to risk of flooding or frequent fires (Walters et al. 2000, p. 1110). Its location south of the high-elevation pine rocklands provides it a degree of protection from high water levels that do not occur within any other units. Within the southern portion of the greater Everglades watershed, water flows from north to south, with most water moving through Shark River Slough, and to a lesser extent through Taylor Slough. The pinelands block the southward flow of water across this area such that the primary influences on water levels are rainfall and overflow from the flanking sloughs. In addition, portions of the area occur on relatively high elevations and remain relatively dry. Consequently, this area is not easily flooded as a result of managed water releases or upstream events, and the high water levels that may occur within other sparrow subpopulations are dampened by its relative position and topographic characteristics. Similarly, the area is not particularly vulnerable to fires. It is not overdrained as a result of local hydrologic management actions, and the fire frequency is primarily influenced by natural ignition and managed prescribed fire. The public road that traverses the area could result in an increased likelihood of ignitions, but this has not occurred to date. In addition, the presence of both the Main Park Road and the Old Ingraham Highway within this unit provides human access greater than in any other unit and may allow better opportunities to manage both prescribed fires and wildfires such that they would pose a reduced risk to the persistence of the sparrow subpopulation.

Unit 2—Subpopulation C: Unit 2—subpopulation C consists of 7,951 ac (3,218 ha) of marl prairie habitat that lies exclusively within ENP in the vicinity of Taylor Slough, along the eastern edge of ENP. The unit consists of the prairies that flank both sides of the relatively narrow Taylor Slough. The area is bordered by the pine rocklands of Long Pine Key on the west and by isolated pine rocklands and the L–31 W canal that runs along the ENP boundary to the east. It is bordered by an area of constriction in Taylor Slough that is closely flanked on both sides by forested habitats at the southern end and by the Rocky Glades, a region of thin marl soils and exposed limestone and sparse vegetation (ENP 2005, p. 4), to the north. The area is bisected by Main Park Road in the southern portion of the unit, but the remainder of the unit consists of contiguous marl prairies. Although, sparrows were discovered in the area in 1972 (Ogden 1972, p. 852), we consider this unit to be occupied at the time of listing. At the time of discovery, sparrows were found to be widely distributed and abundant in this area (Werner 1975, p. 32). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. Following its discovery, the site was the location of some of the first intensive study of the sparrow's biology and its relationship to its habitat (Werner 1975, p. 17). This area lies entirely within the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). During the mid-1970s, sparrows were abundant at this site (Werner 1975, p. 32), and surveys in 1981 estimated 432 sparrows in this area (Pimm et al. 2002, p. 70). Since 1981, the sparrow subpopulation at this site has declined and has ranged from zero to 144 sparrows between 1995 and the present (Pimm et al. 2002, p. 70; Pimm and Bass 2006, p. 16). When sparrows were abundant in the area, the area was in a relatively dry condition, and water levels only rose above ground level for limited periods. Beginning in 1980, a pump station, which was installed along the eastern boundary of ENP at the approximate location of the historic slough, was operated to increase hydroperiods in the area resulting in extended hydroperiods within the portions of the area downstream from the pump station (ENP 2005, p. 39). Vegetation changed in this area from marl prairie to sawgrass marsh (ENP 2005, pp. 3–40), and sparrows ceased to occur in this area. At the same time, the northern portions of sparrow subpopulation C, above the pump station, continued to be overdrained as a result of the adjacent canal and a lowered water table in the agricultural lands immediately adjacent to ENP (Johnson et al. 1988, pp. 30–31; ENP 2005, p. 53). In these overdrained areas, frequent fires impacted the habitat and resulted in reduced sparrow numbers (Pimm et al. 2002, p. 77). This area provides a contiguous expanse of habitat that is largely separated from other nearby subpopulations in an area that is uniquely influenced by hydrologic characteristics. The Taylor Slough basin is a relatively small system, and much of the headwaters of the Slough are cut off by canals and agricultural development to the east of ENP. Portions of this unit near the slough have deep soils (15.7 inches (40 cm)) (Taylor 1983, pp. 151–152) and support resilient vegetation that responds rapidly following fire (Taylor 1983, p. 151–152; Werner and Woolfenden 1983, p. 62). Sparrows were reported to reoccupy burned sites in this region within 1 to 2 years following fire (Werner and Woolfenden 1983, p. 62). The unit contains the vegetation characteristics upon which sparrows rely, and most of the area currently experiences hydrologic conditions that are compatible with sparrows (one or more of the PCEs). This area remains heavily influenced by hydrologic management along the eastern boundary of ENP (ENP 2005, p. 17–18). Portions of the area are also overdrained, resulting in the possibility of high fire frequency. The location of this unit relative to other sparrow subpopulations is significant in that it occurs in the center of the five sparrow subpopulations that occur east of Shark River Slough in the vicinity of Taylor Slough (subpopulations B through F). The habitat in this area most likely plays an important role in supporting dispersal among the eastern subpopulations, acting as a ''hub'' that facilitates dispersal in the region and recolonization of local areas that are detrimentally impacted.

Unit 3—Subpopulation D: Unit 3—subpopulation D consists of 10,700 ac (4,330 ha) of marl prairie vegetation in an area that lies on the eastern side of the lower portion of Taylor Slough. The majority of this area (9,867 ac (3,993 ha)) is within the Southern Glades Wildlife and Environmental Area, which is jointly managed by the SFWMD and FWC. The remaining 883 ac (337 ha) occurs within the boundary of ENP. The area is bordered on the south by the longhydroperiod Eleocharis vegetation and mangroves that flank Florida Bay, on the west by the sawgrass marshes and deepwater vegetation of Taylor Slough, on the east by long-hydroperiod Eleocharis vegetation and overdrained areas with shrub encroachment in the vicinity of U.S. Highway 1, and on the north by agricultural lands and development in the vicinity of Homestead and Florida City. When sparrows were discovered in this area, they were widespread (Werner 1975, p. 32). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. We consequently consider this unit to be occupied at the time of listing. A portion of this area, including both Federal- and State-owned lands was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). This is the easternmost area where sparrows occur and is the only subpopulation that occurs on the eastern side of Taylor Slough. It is consequently unlikely to be affected by the same factors (e.g., large fires or extreme hydrologic conditions) that affect the other eastern subpopulations that lie primarily between Shark River Slough and Taylor Slough., because this area is separated from other sparrow subpopulations by Taylor Slough, and the area immediately north of this subpopulation consists of agriculture and urban/suburban areas around Homestead and Florida City. These discontinuities in the landscape would tend to prevent fires from spreading from the area which supports sparrow subpopulations B, C, E, and F into the subpopulation D area. Similarly, hydrologic conditions in this region are different than those that affect the other subpopulations because water levels would are attenuated by Taylor Slough and influenced by flood protection and water supply infrastructure in the urban/agricultural areas to the north. Loss of suitable habitat and the sparrow subpopulation within this area would result in a reduction in the geographic range of the sparrow. The 1981 comprehensive survey of potential sparrow habitat estimated 400 sparrows within this region (Pimm et al. 2002, p. 70). This was higher than any number of sparrows recorded in the area in recent years, and estimates have ranged from zero to 112 sparrows between 1992 and the present (Pimm et al. 2002, p. 70; Pimm and Bass 2006, p. 16). The area currently contains all PCEs, but the majority of the area is dominated by sawgrass, which indicates a wetter-than-average condition within the spectrum of conditions that support marl prairie and sparrow habitat (Ross et al. 2006, p. 16). The habitat in this area is divided by several canals that are part of the C–111 basin. This canal system results in relatively altered hydrologic conditions in the region (ENP 2005, p. 18) and causes extended hydroperiods during wet periods (Pimm et al. 2002, p. 78). These factors influencing hydrologic conditions will continue to require management in the future.

Unit 4—Subpopulation E: Unit 4—subpopulation E consists of 22,278 ac (9,016 ha) of marl prairie habitat in an area that lies along the eastern margin of Shark River Slough. This unit occurs entirely within ENP. The area is bordered to the south by the pine rocklands of Long Pine Key and by an area dominated by dwarf cypress trees. The sawgrass marshes and deepwater slough vegetation communities of Shark River Slough comprise the western and northern boundary of the area, and the Rocky Glades comprise the eastern boundary. When sparrows were discovered in this area, they were relatively widespread (Werner 1975, p. 33). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. We consequently consider this unit to be occupied at the time of listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). This area is currently occupied by sparrows and contains all of the PCEs. This area supports one of the large, relatively stable sparrow subpopulations. It is centrally located among the areas supporting other subpopulations, and its central location probably plays an important role in aiding dispersal among subpopulations, particularly movements from the eastern subpopulations to the subpopulations west of Shark River Slough. Since 1997, this area has supported the second largest sparrow subpopulation, ranging from 576 to nearly 1,000 individuals in recent years (Pimm et al. 2002, p. 70; Pimm and Bass 2006, p. 16). The centrality of this subpopulation helps to prevent it from being affected by managed hydrologic conditions because it is distant from canals, pumps, and water management structures that occur along the boundaries of ENP. The magnitude of any managed water releases is generally dampened by the time their influences reach this area. However, the proximity of this area to Shark River Slough may make the habitats and the sparrows that they support vulnerable to hydrologic effects during wet periods. The western portions of the area may become too deeply inundated to provide good habitat for sparrows under some deep water conditions. Large-scale hydrologic modifications, such as those proposed under the CERP, have the potential to influence habitat conditions in this area (e.g., PCEs), and may require special management attention. Large-scale fires may detrimentally affect this area, and there are no intervening features in the region that would aid in reducing the potential impacts on this subpopulation. While the area is relatively distant from ENP boundaries and potential sources of human-caused ignition, fires that are started along the eastern ENP boundary may rapidly spread into the area. The 2001 Lopez fire was a human-caused fire that affected a portion of this unit (Lockwood et al. 2005, p. 4). Risk from fire may also require management in this area to prevent impacts to this large sparrow subpopulation.

Unit 5—Subpopulation F: Unit 5—subpopulation F consists of 4,883 ac (1,976 ha) of marl prairie that lies along the eastern boundary of ENP, and is the northernmost of the units. This is the smallest of the units. It is bounded on the north and west by the sawgrass marshes and deep-water slough vegetation communities associated with Shark River Slough, and on the east by agricultural and residential development and the boundary of ENP. Its southern boundary is defined by the sparse vegetation and shallow soils of the Rocky Glades. When sparrows were discovered in this area, they were relatively widespread (Werner 1975, p. 33). Based on their limited mobility and dispersal capabilities and the presence and persistence of suitable habitat, we believe that the sparrows have occupied this locality since at least the time of listing. These same areas have remained occupied by sparrows since their discovery over 30 years ago. We consequently consider this unit to be occupied at the time of listing. The majority of this area was included in the 1977 critical habitat designation for the sparrow (42 FR 40685 and 42 FR 47840). This area is currently occupied by sparrows, and contains all of the PCEs. The first comprehensive surveys of potential sparrow habitat in 1981 resulted in an estimated population of 112 sparrows in this area, and most subsequent surveys have resulted in estimates lower than this, including several years when no sparrows were found (Pimm et al. 2002, p. 70; Pimm and Bass 2006, p. 16). However, sparrows were always found in the area in the year following a zero count (Pimm et al. 2002, p. 70), indicating that sparrows are consistently using the area. This area would serve to support or recolonize subpopulations C and E (in units 2 and 4) if those areas were to become unsuitable. Loss of habitat in this area would also result in a reduction in the total spatial distribution of sparrows. Its position in the landscape results in a unique set of threats that differ from those in other subpopulations. Because of its proximity to urban and agricultural areas and its relative topographic location, this area has been consistently overdrained in recent years and remains dry for longer periods than other subpopulations. The relative dryness of the area may allow the site to remain suitable as habitat for sparrows under very wet conditions, when other subpopulations may become deeply inundated for long periods. Because of its dryness and its proximity to developed areas, this area has been subjected to frequent humancaused fires during the past decade, resulting in periods of poor habitat quality. The PCEs within this unit may require special management consideration due to the threat from fire. In addition, the dry conditions have allowed encroachment of woody vegetation, including invasive exotic and native woody species. Invasive exotic trees, primarily Australian pine (Casuarina spp.), melaleuca (Melaleuca quinquenervia), and Brazilian pepper (Schinus terebinthifolius), have become established in local areas (Werner 1975, pp. 46–47), often forming dense stands. These trees have reduced the suitability of some portions of the habitat for sparrows and have reduced the amount of contiguous open habitat. Aggressive management programs have been implemented by management agencies to address this issue, and control of woody vegetation will continue to be required.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Miami-Dade County, Florida. The primary constituent elements of critical habitat for the Cape Sable seaside sparrow are the habitat components that provide:

(i) Calcitic marl soils characteristic of the short-hydroperiod freshwater marl prairies of the southern Everglades;

(ii) Herbaceous vegetation that includes greater than 15 percent combined cover of live and standing dead vegetation of one or more of the following species (when measured across an area of greater than 100 ft2 (9.3 m2)): Muhly grass (Muhlenbergia filipes), Florida little bluestem (Schizachyrium rhizomatum), blacktopped sedge (Schoenus nigricans), and cordgrass (Spartina bakeri);

(iii) Contiguous open habitat (Sparrow subpopulations require large, expansive, contiguous habitat patches with few or sparse woody shrubs or trees.); and

(iv) Hydrologic regime such that the water depth, as measured from the water surface down to the soil surface, does not exceed 7.9 inches (20 cm) for more than 30 days during the period from March 15 to June 30 at a frequency of more than 2 out of every 10 years.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, airports, roads, and other paved areas) and the land on which they are located on the effective date of this rule and not containing one or more of the primary constituent elements.

All of the areas designated as critical habitat contain one or more of the PCEs. All of the PCEs in the critical habitat may require special management considerations or protection due to threats to the species or its habitat. Such management considerations or protection include: measures to prevent damaging hydrologic conditions, control of invasive exotic plant species, and measures to prevent anthropogenic fires from spreading through Cape Sable seaside sparrow habitat.

Life History

Feeding Narrative

Adult: Eats mainly insects and other small invertebrates, also some seeds (Terres 1980). Generally picks food items off substrate or gleans them from low foliage (Ehrlich et al. 1992).; Food Habits: Invertivore (Adult, Immature), Granivore (Adult, Immature) (NatureServe, 2015)

Reproduction Narrative

Adult: Clutch size is 3-4; incubation lasts 12-13 days; nestling period is about 11 days, after which young are active but flightless on ground; after leaving nest, young are tended by both parents for up to 20 days, after which young can fly (Matthews and Moseley 1990). Nests generally are in loosely defined, often isolated colonies (Ehrlich et al. 1992).; Males defend nest-centered territories year-round (Ehrlich et al. 1992). Occasional flooding can be a major cause of nest loss (Matthews and Moseley 1990).; (NatureServe, 2015)

Habitat Narrative

Adult: Seasonally flooded, brushless, subtropical interior marshes, fresh to slightly brackish; cordgrass, rushes, sawgrass, etc. Adapted to habitat subject to periodic fires, but fires late in dry season may be detrimental to eggs and young; also, too frequent burning may prevent establishment of a vigorous sparrow population (Matthews and Moseley 1990). Nests in wetter areas in tufts of herbaceous growth.HERBACEOUS WETLAND (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: Males remain on or near breeding territory all year.; Nonmigrant: Y; Local migrant: N; Distant migrant: N; (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Males remain on or near breeding territory all year.; Nonmigrant: Y; Local migrant: N; Distant migrant: N; (NatureServe, 2015)

Dispersal

Adult: Males remain on or near breeding territory all year.; Nonmigrant: Y; Local migrant: N; Distant migrant: N; (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Males remain on or near breeding territory all year.; Nonmigrant: Y; Local migrant: N; Distant migrant: N; (NatureServe, 2015)

Additional Life History Information

Adult: Males remain on or near breeding territory all year.; Nonmigrant: Y; Local migrant: N; Distant migrant: N; (NatureServe, 2015)

Population Information and Trends

Number of Populations:

1 - 20 (NatureServe, 2015). Currently, the CSSS metapopulation is distributed among six subpopulations (A through F). Subpopulation A is located west of Shark River Slough in Everglades National Park (ENP) and Big Cypress National Preserve (BCNP) and encompasses the largest block of contiguous marl prairie habitat. Subpopulations B, C, E, and F occur east of Shark

River Slough in ENP; and subpopulation D occurs east of Taylor Slough within the Southern Glades Wildlife and Environmental Area, which is managed jointly by the Florida Fish and Wildlife Conservation Commission and the South Florida Water Management District. Helicopter surveys in 1981 and 1992 provided the baseline distribution and abundance of sparrows with an estimate of about 6,600 individuals (Bass and Kushland 1982; Curnutt et al. 1998). The majority of the birds (86 percent) occurred within subpopulations A, B, and E, with over 40 percent (more than 2,600 individuals) occurring within subpopulation A, which included an area of brackish mixed cordgrass marsh within ENP and BCNP in a region known as the Stairsteps (for its jagged park boundary). (USFWS, 2019) Currently, the two largest, relatively stable subpopulations are B and E (estimated 1,920 and 800 birds, respectively; ENP unpublished data, 2018). Subpopulations A, C, D, and F remain small (estimated 32, 144, 256, 32 birds, respectively; ENP unpublished data, 2018). Sparrow numbers were quite high in subpopulation D in 2018, where the population quadrupled in size from the previous year, though this is likely a result of increased survey effort. CSSS are known to be quite sedentary (Lockwood et al. 2001; Baiser et al. 2008; Van Houtan et al. 2010) and dispersal among subpopulations is limited (Dean and Morrison 1998; Virzi et al. 2018). Subpopulation A is especially isolated from the other subpopulations and immigration from other larger populations is likely very rare to nonexistent (Slater et al. 2014; Virzi et al. 2018). With very limited dispersal among subpopulations, the subpopulations essentially function independent of each other. This makes the smaller subpopulations especially vulnerable to extirpation from loss of genetic diversity, uneven sex and age distributions, and stochastic events (Pimm and Bass 2002; Slater et al. 2009; Factor E). (USFWS, 2019)

Population Size:

2500 - 10,000 individuals (NatureServe, 2015)

Population Narrative:

6000+ birds in 1981 census: 3700 birds in Taylor Slough, 2900 in Big Cypress National Preserve. Were sporadically distributed across range. Now occur in 2 disjunct areas, 1 of which includes 5 nearby occurrences. (NatureServe, 2015)

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Threats include agriculture (rock plowing), wild fires, hurricanes, hydroperiod alteration, invasion of habitat by brush and exotic trees, and soil salinity increases. (NatureServe, 2015)

Stressor: Altered hydrology due to the Central and Southern Florida (C&SF) Project is believed to be the reason the CSSS population has not recovered from the steep declines in the 1990s (Cassey et al. 2007; Baiser et al. 2008). (USFWS, 2019)
Exposure: Depth, duration, and timing of seasonal water flows into CSSS habitat have a significant impact of the sparrow’s breeding success (Pimm and Bass 2002; Lockwood et al. 2003; Baiser et al. 2008). CSSSs build nests in clumps of grasses 6 to 8 inches above the ground with the

height varying throughout the breeding season in response to water depth (Lookwood et al. 2001). (USFWS, 2019)
Response: Unnaturally high water during the breeding season floods breeding habitat and nests (Nott et al. 1998; Lockwood et al. 2001) and increases predator abundance leading to high rates of nest failure (Cassey et al. 2007; Baiser et al. 2008)> (USFWS, 2019)
Consequence:
Narrative: High water persisting on marl prairie for several years can make habitat unsuitable for sparrows by changing the structure and composition of the vegetation (Ross et al. 2006). Several wet years following Hurricane Andrew, a category 5 storm, in 1992 resulted in a steep decline in the CSSS population (Factors A and E). The CSSS population has remained low since 1993, fluctuating between 2,400 and 4,000 individuals. Subpopulation A experienced the steepest decline, dropping from more than 2,600 birds in 1992 to 432 birds in 1993 (Curnutt et al. 1998; Pimm and Bass 2002). Subpopulation A has never recovered since 1993 and is now one of the smallest subpopulations. While the C&SF Project resulted in unnaturally high water discharges on the prairies to the west of Shark River Slough, the shifting of water to the west also resulted in unnaturally drier conditions for the northeastern subpopulations. The habitat in these areas has been degraded by the reduced water flows which allow for encroachment of woody species and increased fire frequency (Pimm and Bass 2002; Lockwood et al. 2003; Factor A). Along the urban-wildland interface in the eastern Everglades, these fires are often human-ignited (unintentional or intentional), occur at the end of the dry season, and burn more intensely than natural, lightning-ignited fires (Slocum et al. 2007). With the CSSS being relatively short-lived (4 – 5 years; Lockwood et al. 1997), persistent years with flooding or fire that prevents successful breeding could result in extirpation. About two-thirds of the total CSSS population currently occur within subpopulation B, which has remained relatively stable. However, if a large fire or other catastrophic event were to occur in this subpopulation, there is a possibility the entire remaining CSSS population could be reduced by 60 percent or more. Unnaturally dry conditions also impact CSSS by delaying initiation of nesting, which shortens the breeding season (Boulton et al. 2011; Factor E). Alteration of the natural hydrology, from construction of the C&SF Project, remains the largest threat to the CSSS and is the focus of ongoing Everglades restoration planning. Upcoming actions are expected to provide additional flexibility in the system to address water management issues and advance Everglades restoration. (USFWS, 2019)

Stressor: Climate Change
Exposure:
Response:
Consequence:
Narrative: Climate change and sea level rise also represent significant short- and long-term threats to the CSSS and its habitat (Factors A and E). Sea level rise has been estimated by various sources to increase by as much as 1 to 8 feet (ft) by the end of the century, with the business as usual (no reductions in greenhouse gas) scenario predicting 6.6 ft (National Oceanic and Atmospheric Association [NOAA] 2017). Because the entire population of CSSS occurs in low lying areas in south Florida, the population may experience changes in habitat conditions or availability due to climate change and sea level rise over the next several decades (Service 2016). Subpopulations A, B, and D are particularly vulnerable to the effects of climate change and sea level rise (Service 2016). Based on model projections by the U.S. Army Corps of Engineers, a sea level rise of only 1-ft (0.3 m) mean higher high water (MHHW) could result in habitat loss of approximately 40 percent of subpopulation A and 60 percent of subpopulations B and D (Service 2016). If sea levels were to rise 2 ft (0.6 m) MHHW, it could result in habitat loss of almost 60

percent of subpopulation A and nearly 100 percent of subpopulations B and D (Service 2016). In the long term, all subpopulations could potentially experience major flooding effects due to sea level rise. (USFWS, 2019).

Recovery

Delisting Criteria:
1. At least two (2) populations west of Shark River Slough, including one (1) in the Stairsteps region; and at least four (4) viable populations east of Shark River Slough, including one (1) east of Taylor Slough, exhibit a stable or increasing population trend evidenced by natural recruitment and a stable age distribution (Factors A and E). Criterion 1. Populations that exhibit a stable or increasing trend, natural recruitment, and multiple age classes demonstrate that the population is secure and will be resilient to stochastic events. Having multiple, subpopulations distributed across the current and historical range of the subspecies will provide the representation and redundancy necessary to assure the subspecies as a whole is resilient to predation, shifts in distribution, climate change, and other environmental stressors. Increasing the abundance and occupancy of the current subpopulations may lead to fewer subpopulations as currently discontinuous populations will likely become continuous. The subpopulations need to be large enough and robust enough to be ecologically and demographically functional across the geographic range of the subspecies. For the CSSS, it is believed that a minimum of six populations exhibiting these traits are necessary to provide sufficient redundancy to ensure the species will no longer require protection under the Act. (USFWS, 2019).

2. Populations are connected to the extent that genetic diversity can be maintained without the need for captive breeding, translocation, or other artificial genetic augmentation (Factor A and E). Criterion 2. Having connected subpopulations will allow for gene flow between subpopulations, reduce the frequency of genetic drift, and protect the genetic diversity of the subspecies. Having a genetically robust population will maximize the fitness of the subspecies such that it is healthy, resilient, adaptive, and able to respond to biological and environmental stressors within and among subpopulations across the geographic range of the subspecies. (USFWS, 2019).

3. CSSS habitat is properly maintained with appropriate hydrologic and fire regimes and exotic and woody vegetation has been eliminated in CSSS habitat such that enough suitable habitat remains for CSSS to remain viable into the foreseeable future (Factors A and C). Criterion 3. Restoring appropriate hydrological and fire regimes is necessary to restore, expand, and maintain suitable habitat for the CSSS. Removing exotic and woody vegetation from marl prairie habitat will increase both the suitability and extent of habitat available for CSSSs. An appropriate hydrologic management regime is necessary to protect sparrow breeding habitat by reducing water flows to the western marl prairies, which are too wet, and increasing water flows to eastern marl prairies that have been over drained. Appropriate fire regimes must also be restored to achieve restoration of CSSS habitat. Fires of appropriate intensity and frequency are necessary to maintain suitable vegetation composition and structure, prevent encroachment of woody vegetation, and prevent buildup of fire fuels that can result in intense wildfires that severely degrade marl prairie habitat making it unsuitable for CSSSs. (USFWS, 2019).

4. In addition to the above criteria, it can be demonstrated that enough suitable habitat remains for CSSS to remain viable into the foreseeable future despite anticipated sea level rise (Factor E).

Criterion 4. Ensuring sufficient habitat is expected to remain despite habitat changes and habitat loss projected due to sea level rise will allow for resilient and viable CSSS subpopulations across the geographic range of the subspecies. (USFWS, 2019).

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SPECIES ACCOUNT: *Ammodramus savannarum floridanus* (Florida grasshopper sparrow)

Species Taxonomic and Listing Information

Commonly-used Acronym: FGSP

Listing Status: Endangered; 07/31/1986; Southeast Region (R4) (USFWS, 2016)

Physical Description

The FGSP is a small, short-tailed, flat-headed sparrow averaging 13 centimeters (cm) (5.1 in) in total length (Vickery 1996). The top of its head is mostly blackish with a light median stripe. The remainder of its dorsum is mainly black, edged with gray, and streaked with brown on the nape and upper back. Adult FGSP are whitish underneath, unstreaked, with a buff throat and breast. Juvenile FGSP have streaked breasts. The ventral color pattern resembles that of the Bachman's sparrow. The rectrices of the FGSP are pointed, the lores are light gray to reddish-yellow, and the bend of the wing is yellow. Its bill is thick at the base, and its feet are flesh-colored (Vickery 1996). During the breeding season, male and female FGSP can be distinguished in the hand by the presence of a cloacal protuberance in the male or a brood patch in the female. The FGSP is most easily located and identified by its song, which is among the weakest of any North American bird (Stevenson 1978). Nicholson (1936) described it as being indistinct and as having a definite insect-like quality, which gave rise to the bird's common name (Sprunt 1954). The song starts as three low-pitched notes followed by a longer, higher-pitched "buzz" (Vickery 1996).

Taxonomy

This subspecies is marked with a longer bill and longer tarsi than the northern subspecies (A. s. pratensis); it also has a darker dorsum. The Florida grasshopper sparrow also lacks the reddish streaks on its nape that are found in the northern subspecies. Adult Henslow's sparrows (A. henslowii) and Le Conte's sparrows (A. leconteii) are similar to grasshopper sparrows in size and shape; however, unlike adult grasshopper sparrows, adults of these species have ventral streaking (Stevenson and Anderson 1994). Although the juveniles of these species would be difficult to distinguish visually, only the Florida grasshopper sparrow breeds in Florida, so juveniles of these species do not overlap (Florida multi-species recovery plan)

Current Range

Based on declines in suitable habitat and population size, the National Audubon Society placed the FGSP on its blue list in 1974. The FGSP was listed as endangered by the State of Florida in 1977. The Service listed the FGSP as endangered on July 31, 1986, due to habitat degradation and loss, primarily as a result of conversion of native dry prairie vegetation to improved pasture (51 FR 27495). The current known range of the subspecies is limited to Highlands, Okeechobee, Osceola, and Polk Counties. The historic distribution of the FGSP is not known with certainty, but there are records from Collier, Miami-Dade, DeSoto, Glades, Alachua, Hendry, Highlands, Polk, Okeechobee, and Osceola Counties (Howell 1932; Delany and Cox 1985; Pranty and Tucker 2006). However, some of these records were not determined for subspecies (Howell 1932). Because the FGSP is closely associated with dry prairie habitats, trends in the amount and condition of dry prairie habitat within central Florida likely mirror the trends in the range wide FGSP population. Aerial surveys of dry prairie habitat indicated that only 156,000 ha (385,483 ac) of dry prairie habitat existed in 1995 (Shriver and Vickery 1999), an 81 percent decrease from the 0.83 million ha (2.05 million ac) estimated in 1967 (Davis 1967). FGSP habitat loss is due to conversion of dry prairie to improved pasture (Layne et al. 1977) and agricultural uses such as citrus groves (Davis 1967; Mealor 1972; DeSelm and Murdock 1993), pine plantations, exotic sod-forming grasses, row-crops, and, historically, eucalyptus (Eucalyptus spp.) plantations. A lack of burning likely degraded additional prairie habitat. Since Delany's first efforts to assess FGSP populations range wide in the early 1980s (Delany and Cox 1985), surveys have recorded a general decline in the distribution and occurrence of FGSP. Of the 14 sites where FGSP have been documented to occur, only four are known to remain occupied. Despite several survey efforts, there have been no records of FGSP outside of the upper Kissimmee River basin since the early 1990s, and this represents a large reduction in the subspecies' distribution. At present, the range of the FGSP is generally restricted to three management units under public ownership –APAFR, KPPSP, and TLWMA – and one known private ranch. Surveys for FGSP have been conducted regularly at KPPSP since 1999 (Mulholland and Small 2001) at TLWMA since 1991 (Dean and Glass 2001b) and at APAFR since 1982 (Delany et al. 2001). Monitoring efforts from 1999 to 2004 indicated that the total population size at these three primary sites ranged from approximately 340 to 640 individuals, though the population sizes were variable among years. In 2003, surveys estimated the population size at these three sites at under 350 individuals, largely due to declines at APAFR and KPPSP. APAFR is located in Highlands and Polk counties, east of Avon Park, Florida, and is owned and managed by the Department of Defense. With approximately 10,378 ac of dry prairie habitat, APAFR once supported perhaps the largest of the FGSP populations. Since 1997, the FGSP population has declined sharply at APAFR (Pranty and Tucker 2006; Delany et al. 2007), and has not recovered. In 2014, only a single male was observed there. But, in 2015, two breeding pairs of FGSP were observed, with young produced, which has not been observed since 2009. Populations at the two major extant breeding sites, TLWMA (7,413 ac dry prairie; Osceola County) and KPPSP (46,950 ac dry prairie; Okeechobee County) are also declining rapidly. At these two public lands, the subpopulations, though fluctuating somewhat from year to year, remained relatively steady until around 2004, when the KPPSP population began a steady decline. The decline at TLWMA began in 2009, at which time the decline at KPPSP became more precipitous. FGSP were translocated in 2001 and 2002 at TLWMA (Dean and Glass 2001a) to another disjunct patch of suitable habitat (2,128 ac) where FGSP did not occur, but they did not persist. The last 4 years of annual point-count surveys detected record low numbers of singing males (75-90) on the public lands that support FGSP, representing a 75 percent decline since 1998 (FGSP Working Group, unpublished data). FGSP are known to occupy private lands, often in semi-improved or improved condition with some native vegetation. While 33 percent of the remaining dry prairie habitat exists on private lands (Delany et al. 2007); small patch size, fragmented distribution, and a lack of active habitat management (i.e., prescribed fire, tree removal) currently limit its role in FGSP recovery. Over 19,000 acres of private lands (5 sites) were surveyed for FGSP and FGSP habitat in 2014 and 2015. Surveys at one private ranch documented a small population of FGSP (approximately 25 males), and successful breeding (Service 2014, unpublished data). The site is about 12 miles from the population at TLWMA. Detection probabilities for FGSP males using the point count index method are low (0.04-0.10; Delany et al. 2013), likely leading to an underestimation of males at the three monitored populations. Still, the total FGSP population size on public and private lands combined is estimated at only a few hundred individuals, and the subspecies is nearing extinction.

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: FGSP forage on the ground or just above it. An examination of the contents of 10 stomachs of FGSP from the Kissimmee prairie region found 69 percent "animal matter" (insects) and 31 percent vegetation (Howell 1932). Identified insects included grasshoppers, crickets, beetles, weevils, and moths and their larvae, with a few flies and bugs. Sedge seeds, as well as some star grass (Hypoxis spp.) seeds, composed most of the vegetation found in the diet (Service 1988). FGSP switch to a seed-dominated diet during the non-nesting season, but still consume some animal matter (Vickery and Dean 1997).

Reproduction Narrative

Adult: Reproduction – FGSP form pair bonds during the breeding season, but remain solitary for the remainder of the season, and rarely interact with other FGSP outside of the breeding season. During the breeding season, FGSP form breeding aggregations within suitable habitat (Delany 1996), and individual male sparrows set up territories within the breeding aggregations. Delany et al. (1995) found mean breeding territory size for FGSP at APAFR to be 1.8 ha (4.5 ac), with a maximum size of 4.8 ha (12 ac). As the time since last fire increases, territories are reported to be established less frequently (Walsh et al. 1995), and FGSP home ranges become larger (Delany et al. 1992). Male FGSP defend their territory boundaries from the time territories are established through incubation (Delany et al. 1995). After the young hatch, territory defense becomes less rigorous (Smith 1968). Adult FGSP exhibit strong site-fidelity to nesting territories, although individuals have been observed traveling as far as 24.4 (15.1 mi) from their previous season's nesting territory (E. Ragheb, personal communication, 2015). The great majority of males (86 percent [Delany et al. 1995]; 100 percent [Dean 2001]) remain on the same territory in consecutive years. An ongoing study at TLWMA found that only 24 percent of banded males moved greater than 400 meters (m) (1,312 ft) between seasons, with a mean distance of 236 m (774 ft) between seasons (FWC 2014, unpublished report). Male FGSP generally begin singing in mid-March. Their singing usually diminishes by late June, although they continue to sing through August (M. Peterson, Service, personal observation 2014). FGSP begin nest-building activities approximately 4 weeks after the onset of territorial singing (Vickery 1996). Nests are located on the ground in shallow (<3.2 cm [1.3 in] deep) excavations in the sand substrate (Delany and Linda 1998a; Delany and Linda 1998b); the rims are level or slightly above the ground. The nests are dome-shaped and constructed of narrow-leaved grasses and grass-like monocots, such as wiregrass (Aristida stricta), bluestems (Andropogon spp.), and yellow-eyed grass (Xyris spp.). Egg-laying is reported to begin as early as late March (McNair 1986) and breeding activities may extend into September (Vickery and Shriver 1995; Perkins 1999). Most nests contain three to five eggs with a mean of 3.71 (Smith 1968; McNair 1986). Perkins et al. (2003) report mean clutch sizes of 3.47 (n = 17) at APAFR, 3.56 (n = 9) at TLWMA, and 3.75 (n = 4) at KPPSP. A recent study at TLWMA reports a mean clutch size of 3.20 (n = 58; FWC 2014, unpublished report). Female FGSP incubate their eggs for 11 to 12 days (Nicholson 1936). Perkins et al. (1998) reported that it takes an average of 13.5 days between the fledging of a successful nest and the first egg of a new attempt. If a nest is destroyed, the female may make a new one in approximately 10 to 12 days (T. Dean, Service, personal communication, 2003). Multiple clutches are common (Vickery 1996). FWC (2014, unpublished report) estimated a mean number of nest attempts at 3.69 (n = 56). One male FGSP monitored at TLWMA during the 2014 breeding season produced three successful broods, and another male produced two successful broods (FWC, 2014, unpublished report). Considering the number of potential nesting attempts and the potential productivity per nest, the average productivity per pair could hypothetically be expected to exceed 11 young per pair each year, though this level of productivity is likely rare. During the non-breeding season, FGSP appear to expand their range of movements. As determined by radio telemetry, the average home range size during the non-breeding season is 29 ha (72 ac), with individual home ranges varying from 1 to 174 ha (3 to 429 ac) (Dean 2001). In addition, nearly 40 percent of individuals use more than one spatially distinct home range during the course of the non-breeding season. These home ranges are not mutually exclusive, however, and home ranges of many different individuals overlap (Dean 2001).

Habitat Narrative

Adult: FGSP are endemic to dry prairie habitats within central and southern Florida, and are strongly habitat-specific, occupying native, fire-maintained dry prairie vegetation communities and some semi-improved pasture sites that were presumably dry prairie prior to conversion to pasture. Restrictions to movement include forested edges and even sparsely stocked pine flatwoods. Habitat characteristics that are important for FGSP include a high percentage of bare ground cover and low vegetation height (30-70 cm) (12-28 in) (Delany et al. 1985). Both of these characteristics are maintained by frequent fire. Large areas of prairie habitat, possibly greater than 4,000 hectares (ha) (9,884 acres [ac]), are needed to maintain self-sustaining populations of FGSP (Perkins 1999; Perkins and Vickery 2001).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migrant

Dispersal/Migration Narrative

Adult: During the non-breeding season, FGSP appear to expand their range of movements. As determined by radio telemetry, the average home range size during the non-breeding season is 29 ha (72 ac), with individual home ranges varying from 1 to 174 ha (3 to 429 ac) (Dean 2001). In addition, nearly 40 percent of individuals use more than one spatially distinct home range during the course of the non-breeding season. These home ranges are not mutually exclusive, however, and home ranges of many different individuals overlap (Dean 2001).

Population Information and Trends

Population Trends:

Decreasing

Number of Populations:

1 - 5 (NatureServe, 2015)

Population Size:

1 - 250 individuals (NatureServe, 2015)

Population Narrative:

Populations at the two major extant breeding sites, TLWMA (7,413 ac dry prairie; Osceola County) and KPPSP (46,950 ac dry prairie; Okeechobee County) are also declining rapidly. At these two public lands, the subpopulations, though fluctuating somewhat from year to year, remained relatively steady until around 2004, when the KPPSP population began a steady decline. The decline at TLWMA began in 2009, at which time the decline at KPPSP became more precipitous. FGSP were translocated in 2001 and 2002 at TLWMA (Dean and Glass 2001a) to another disjunct patch of suitable habitat (2,128 ac) where FGSP did not occur, but they did not persist. The last 4 years of annual point-count surveys detected record low numbers of singing males (75-90) on the public lands that support FGSP, representing a 75 percent decline since 1998 (FGSP Working Group, unpublished data). As of 2019, the range of the FGSP is generally restricted to three management units under public ownership – Avon Park Air Force Range (APAFR), Kissimmee Prairie Preserve State Park (KPPSP), Three Lakes Wildlife Management Area (TLWMA) – and two known private ranches. This is a decline from the eight occupied locations documented by Delany et al. (2007) during their 2000 – 2004 surveys, which is around the time the FGSP began declining at most sites. Populations have declined to historic lows at all known sites, and as of 2018, there were only 23 estimated wild breeding pairs at sites were FGSP are being monitored (Florida Fish and Wildlife Conservation Commission [FWC], unpublished data). (USFWS, 2019). In 2015 due to the severe population decline, a captive propagation program was intiated with the goal of ultimately releasing captive-reared FGSP to supplement the wild population. At the end of the 2018 breeding season, there were 81 FGSP in captivity. The Service, FWC, and conservation partners are aiming to release captive-reared birds to the wild as early as the spring of 2019. (USFWS, 2019).

Threats and Stressors

Stressor: Habitat loss and degradation
Exposure:
Response:
Consequence:
Narrative: FGSP require relatively large tracts of native prairie, as habitat suitability can shift radically – annually, seasonally, and even within seasons – largely due to variability in fire history and hydroperiod. Loss of habitat was certainly a factor in the subspecies' decline to endangered status, as less than 10 percent of the Florida native prairie habitat remains. However, habitat availability is not believed to currently limit population growth, as populations are so low and large areas of seemingly high quality habitat are not currently occupied. Nevertheless, it remains possible that the quality of the current available habitat is suboptimal for the sparrow; further research is necessary to reveal subtleties of habitat quality, its past and present land management, and their effects on sparrow habitat selection and recruitment.

Stressor: Fire
Exposure:
Response:
Consequence:

Narrative: Frequent fire is necessary to maintain an open vegetative community and prevent the invasion of pines and hardwoods into dry prairie habitat. FGSP densities decline 2 or more years following fire (Delany and Cox 1986; Vickery and Shriver 1995; Dean 2001; Shriver and Vickery 2001). Endangered species burn exemptions are frequently needed; otherwise prescribed burning in what is probably the most ecologically appropriate season (i.e., the dry-wet transition) is often precluded. Habitat on public lands is frequently managed using prescribed fire, but with large tracts of land and limited resources, these fire regimes can be difficult to sustain. Using fast-moving, high-intensity fires allows more acreage to be burned in a given time; however, this approach can result in less favorable habitat conditions than the preferred habitat mosaic from slow, low-intensity fires. Lightning fires, which are often also fast-moving, usually result in more heterogeneous burns than typical prescribed fires (where managers intentionally burn all patches that might escape fire). The value of a mosaic (heterogeneous) burn to FGSP is hypothetical, but has been demonstrated for other taxa.

Stressor: Livestock grazing
Exposure:
Response:
Consequence:
Narrative: The effect of cattle grazing on dry prairie habitat and FGSP populations is not fully known. The FGSP likely evolved with large herbivores; however, these animals were free to move through the landscape, unlike cattle which are restricted by fences. Fence posts, altered fire regimes, disturbance or trampling of nests, and increased RIFA density, which are potentially associated with grazing, have been identified as factors affecting sparrow survival and reproductive success. Conversely, some degree of grazing may be beneficial to sparrows by creating areas of bare ground. The FGSP Recovery Plan (1999) states that one animal per hectare appears to be a level at which prairie species are not negatively affected, though additional studies suggest this figure may be too high (Tucker et al. 2010). Regardless, most grazing currently occurs at an even higher density, and an upper “limit” has not been established. Grazing does not occur at TLWMA and KPPSP. Grazing continued in FGSP habitat at APAFR until 2013, but ended permanently in all dry prairies habitats there after the summer of 2013. At this point, on public lands, the only effects of grazing in FGSP habitat is from grazing infrastructure (e.g., fences, fence posts) and recent land use regime (i.e., vegetation composition and structure).

Stressor: Flooding
Exposure:
Response:
Consequence:
Narrative: As FGSP are ground-nesters, flooded nesting areas during the breeding season reduce or prohibit reproductive efforts and success, and can alter vegetative composition. High water levels at KPPSP and TLWMA severely affected nesting during several breeding seasons in the mid-1990s (Service 1999). Improper hydrological management on adjacent properties was identified as the cause of the inundation. While some local water management issues have been addressed, future water management may result in high water levels in FGSP habitat. Flooding was the most common known cause of nest failure for 41 nests monitored at KPPSP over four breeding seasons (2005-2008; Noss et al. 2008), albeit the cause of failure for most nests was unknown and probably was due to predation.

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Nest predation is the cause of most nest failures (Perkins et al. 2003; FWC 2014, unpublished report); however, nearly all predators are native animals with which the sparrow has evolved. FGSP have lower nest success than other grasshopper sparrows, but their breeding season is substantially longer. Predators known to take eggs or nestlings in FGSP habitat include the striped skunk, spotted skunk, raccoon, feral hogs, box turtles, snakes, small mammals, and armadillos (Vickery 1996; Fletcher et al. 2010; FWC 2014, unpublished report). Non-native RIFA may be the most prevalent potential predator in FGSP habitat (Fletcher et al. 2010).

Stressor: Demographics
Exposure:
Response:
Consequence:
Narrative: The last known vertebrate species to go extinct in Florida, the Dusky Seaside Sparrow, exhibited a rapid decline similar to the FGSP. When the decision was made to bring Dusky Seaside Sparrow individuals into captivity, only unmated male sparrows were found. Potential causes for the Dusky's ultimate decline include a male-biased sex ratio, disrupted behavioral mechanisms, low female survival rates, or dispersal limitations of females. Given the recent near extirpation at APAFR and record low counts of FGSP at KPPSP and TLWMA, there is growing concern a similar phenomenon could be occurring in FGSP.

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: According to the Intergovernmental Panel on Climate Change Report (IPCC 2007), warming of the earth's climate is "unequivocal," as is now evident from observations of increases in average global air and ocean temperatures, widespread melting of snow and ice, and rising sea level. The 2007 IPCC report describes changes in natural ecosystems with potential wide-spread effects on many organisms, including marine mammals and migratory birds. The potential for rapid climate change poses a significant challenge for fish and wildlife conservation. Species' abundance and distribution are dynamic, relative to a variety of factors, including climate. As climate changes, the abundance and distribution of fish and wildlife will also change. Highly specialized or endemic species are likely to be most susceptible to the stresses of changing climate. Based on these findings and other similar studies, the Department of the Interior (DOI) requires agencies under its direction to consider potential climate change effects as part of their long-range planning activities (Service 2007). Climate change at the global level drives changes in weather at the regional level, although weather is also strongly affected by season and local effects (e.g., elevation, topography, latitude, proximity to the ocean, etc.). Temperatures are predicted to rise from 2o Celsius (C) (3.6o Fahrenheit [F]) to 5oC (9oF) for North America by the end of this century (IPCC 2007). Other processes to be affected by this projected warming include rainfall (amount, seasonal timing and distribution), storms (frequency and intensity), and sea level rise. However, the exact magnitude, direction, and distribution of these changes at the regional level are not well understood or easy to predict. Seasonal change and local geography make prediction of the effects of climate change at any location variable. Current models offer a

wide range of predicted changes. Climatic changes in south Florida could amplify current land management challenges involving habitat fragmentation, urbanization, invasive species, disease, parasites, and water management (Pearlstine 2008). Global warming will be a particular challenge for endangered, threatened, and other "at risk" species. It is difficult to estimate, with any degree of precision, which species will be affected by climate change or exactly how they will be affected. The Service will use Strategic Habitat Conservation planning, an adaptive science-driven process that begins with explicit trust resource population objectives, as the framework for adjusting our management strategies in response to climate change (Service 2006). For the FGSP, sea level rise may result in the loss of suitable habitat through inundation or vegetative species composition changes. The general effects of sea level rise within the range of the FGSP will depend on rate of rise and landform topography. However, the specific effects across the landscape within the range of the FGSP will be dependent upon complex interactions between geomorphology, tides, and fluctuations in energy and matter. Sea level rise will also focus development farther inland and potentially within the range of the FGSP. As the majority of the known range of the FGSP is on public lands, and little is known about the future management regimes on private lands without development, effects of development on the FGSP in this area in relation to sea level rise are not known.

Recovery

Delisting Criteria:
The FGSP will be considered for delisting when the following criteria are met: 1. Twelve (12) FGSP populations are maintained, established, or discovered, that exhibit a stable or increasing trend evidenced by natural recruitment and a stable age distribution. At least six (6) of those populations must be on lands protected via a conservation mechanism. 2. Populations are connected to the extent that genetic diversity can be maintained without the need for captive breeding or translocation. 3. Predation has been reduced to a level such that nest protection is not necessary. 4. When, in addition to the above criteria, it can be demonstrated that loss of dry prairie habitat associated development, fire suppression, lack of natural disturbance, and woody vegetation encroachment are diminished or reversed such that enough habitat of suitable quality is protected for the species to remain viable for the foreseeable future. (USFWS, 2019).

Recovery Actions:

- FGSP are known to occupy private lands, often in semi-improved or improved condition with some native vegetation. While 33 percent of the remaining dry prairie habitat exists on private lands (Delany et al. 2007); small patch size, fragmented distribution, and a lack of active habitat management (i.e., prescribed fire, tree removal) currently limit its role in FGSP recovery. Over 19,000 acres of private lands (5 sites) were surveyed for FGSP and FGSP habitat in 2014 and 2015. Surveys at one private ranch documented a small population of FGSP (approximately 25 males), and successful breeding (Service 2014, unpublished data). The site is about 12 miles from the population at TLWMA.

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SPECIES ACCOUNT: *Amphispiza belli clementeae* (San Clemente sage sparrow)

Species Taxonomic and Listing Information

Listing Status: Threatened; Proposed for delisting

Physical Description

The San Clemente sage sparrow (Amphispiza belli clementeae) is a small songbird with a round head and a short, thick beak. They are neutral grayish-brown in color, having a white underbelly with a small dark breast spot, unstreaked backs, a dark face with complete white eye rings, a white spot before the eye, distinctive white and black malar stripes, and a relatively long, dark tail. Juveniles lack the grey head and have a streaky underbelly. Both sexes range from 13 to 15 centimeters (cm) (5.1 to 5.9 inches [in.]) in length and weigh between 15 and 22 grams (0.5 and 0.7 ounce), with an average of 16.8 grams (0.6 ounce) (NatureServe 2015; USFWS 2009; Cornell University 2015).

Taxonomy

San Clemente sage sparrows are a small monogamous passerine, endemic to western North America (specifically, San Clemente Island, California), and are placed in the Family Emberizidae, in Order Passeriformes. The San Clemente sage sparrow was first recognized as a subspecies in 1897, because of observed morphological differences, such as smaller body and larger bill size, compared to the mainland species (A. b. belli) (USFWS 2009). An application of Amadon's 75 percent rule conducted in 2002 found no significant difference between the two subspecies, but this was later found to be inconclusive due to poor specimen choices. Another study reevaluating subspecies of A. belli, conducted in 2006, found them to be diagnosable as separate under Amadon's 75 percent rule (USFWS 2009). Because of separation from the mainland and resultant geographic isolation, this subspecies presumably evolved enhanced morphological divergence from the mainland lineage, comparable to other island species (USFWS 2009). To date, there have been no analyses of genetic variation of the nonmigratory San Clemente sage sparrow contrasted with both migratory and nonmigratory mainland subspecies of sage sparrow (USFWS 2009).

Historical Range

San Clemente sage sparrows historically occurred on San Clemente Island, in the Channel Islands of Los Angeles County, California. The San Clemente sage sparrow is a nonmigratory island endemic; it was historically common throughout the 14,500-hectare (ha) (35,830-acre [ac.]) San Clemente Island, one in the chain of the Channel Islands archipelago, 80 kilometers (49 miles) from the California coastline. It has the smallest distribution of any subspecies of sage sparrow, because it occurs only on San Clemente Island (USFWS 2009).

Current Range

Currently, San Clemente sage sparrows occupy fewer than 100 to 250 square kilometers (40 to 100 square miles) on San Clemente Island (NatureServe 2015), and are distributed primarily in the lower marine terraces along the northwestern portion of San Clemente Island. Recent estimates of potential available habitat include approximately 14 percent of San Clemente Island, which includes 2,098 ha (5,184 ac.) of xeric maritime desert scrub and canyon shrub woodland (USFWS 2009). Historically, San Clemente Island supported a unique conglomerate of maritime sage scrub, coastal salt marsh, and island grassland flora and fauna. Many of these were endemic to the Channel Islands, but declined after the introduction of sheep, cattle, and goat ranching, which drastically converted the habitat (USFWS 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The San Clemente sage sparrows are primarily insectivores, but switch to a primarily plant-based diet in the nonbreeding season, consuming various grass seeds (Poaceae), prickly pear (Opuntia sp.), cholla cactus fruits (Cylindropuntia sp.), and moths (Lepidoptera) (USFWS 2009). During the breeding season, they eat invertebrates such as grasshoppers, caterpillars, and spiders (NatureServe 2015). Invertebrates are a seasonally important food source for this species; sage sparrows become primarily insectivorous during the breeding season, when hatchlings and fledglings depend strongly on insect protein for growth and development (BLM 2004). They have a high bioenergetic requirement, running along the ground, stopping to forage and glean seeds and insects from foliage and branches (NatureServe 2015). Little is known about the feeding competition of this subspecies.

Reproduction Narrative

Adult: San Clemente sage sparrows are monogamous and oviparous. Both sexes reach sexual maturity at 1 year of age; however, because of a lack of sexual dimorphism, it can be difficult to observe all aspects of breeding behavior (BLM 2004). The species breeding season is from mid-March to mid-June. During the breeding months, the sparrow's distribution is correlated with vegetative zones covered by maritime desert scrub, primarily consisting of boxthorn (Lycium californicum) (USFWS 2009). Most breeding territories are on flat or rolling habitat that hosts cactus, saltbush, and maritime scrub, found between 10 and 30 m (32.8 and 98.4 ft.) ASL (up to 150 m [492 ft.] ASL) (USFWS 2009). Open nest cups are constructed of grass, lichen, and twigs, and are lined with feathers, flower heads, hair, and grasses. The nests are built in low spiny vegetation approximately 25 cm (9.8 in.) above the ground. Sparrow nest placement has shown a relatively narrow range of height (USFWS 2009). Asynchronous hatching occurs after 12 to 13 days of incubation, conducted mostly by the female (USFWS 2009), although males may incubate eggs when the female leaves the nest (BLM 2004). The San Clemente sage sparrow produces one to three broods per year. Each brood produces one to five eggs, with an average of two successful fledglings per nesting event. The hatchlings are born altricial, blind, naked, and uncoordinated (PRBO Conservation Science 2002). Bell's Sparrow (Artemisiospiza belli) parents may feed young for approximately 2 weeks after fledglings leave the nest (BLM 2004). Bell's Sparrow have been observed to be greater than 9 years in the wild (Cornell University 2015). Hatchlings and fledglings depend strongly on insect protein for growth and development. The species sex ratio is 1:1, with a lifespan of approximately 9 years (USFWS 2009).

Spatial Arrangements of the Population

Adult: Clumped according to resources, primarily in the lower marine terraces along the northwestern portion of San Clemente Island (USFWS 2009).

Environmental Specificity

Adult: Community with key requirements common.

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High; return to same nesting site each breeding season (USFWS 2009).

Habitat Narrative

Adult: San Clemente sage sparrows are found exclusively in xeric (low moisture) habitat associated with lower marine terraces along the northwestern portion of San Clemente Island (USFWS 2009). They are ground-dwelling sparrows, using shrub canopy for feeding, cover, song perching, roosting, and nesting (NatureServe 2015). The species is spatially arranged in clumps, and is closely tied to the maritime desert scrub plant communities where boxthorn (Lycium californicum) is present (USFWS 2009). They are also known to use prickly pear and cholla cactus (Opuntia and Cylindropuntia sp.) and saltbush (Atriplex sp.) components of the San Clemente Island for protective coverage and food/prey resources (USFWS 2009). Suitable habitat is located along the western shore, an area of the island that has experienced less over-grazing than other areas (USFWS 2009). They have high site fidelity and return to the same nesting site each breeding season. High-quality habitat includes any area on the island free from nonnative grazing animals such as sheep and hogs (USFWS 2009). High-quality habitat is also closely related to high productivity of territories with more resources. Moderate habitat is occupied during drought years. Low-quality habitat, 30 percent of the available habitat, contains some sage sparrow breeding territories, but expresses low productivity (USFWS 2009). Habitat quality and resulting productivity generated from areas with varied quality provide an understanding of continued threats to the subspecies (USFWS 2009). Key resources for the San Clemente sage sparrow include ungrazed, undisturbed habitat for nesting, roosting, song perching, and foraging (USFWS 2009). Ground foraging and gleaning of low-hanging branches allows the sage sparrow to remain low to the ground and concealed by vegetation (USFWS 2009).

Dispersal/Migration

Motility/Mobility

Adult: High motility; low mobility.

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory (NatureServe 2015).

Dispersal

Adult: Low

Immigration/Emigration

Adult: No

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: Most sage sparrow races do not exhibit strong migratory tendencies; coastal forms, including the San Clemente sage sparrows, are nonmigratory (USFWS 1984). The species is highly motile, with low mobility and a small home range (USFWS 2009). Their dispersal is limited to the northwestern coast of the San Clemente Island, due to limitations of suitable habitat and geographic isolation (USFWS 2009). They express site fidelity each nesting season, and juveniles disperse from natal area during their first winter (USFWS 2009).

Additional Life History Information

Adult: Express site fidelity each nesting season; juveniles disperse from natal area during their first winter (USFWS 2009).

Population Information and Trends

Population Trends:

Stable (USFWS 2009)

Species Trends:

Stable (NatureServe 2015)

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Growth Rate:

Declining; juvenile survivorship has decreased since 2001 (USFWS 2009).

Number of Populations:

One (NatureServe 2015)

Population Size:

Ninety individual sage sparrows were known at listing (1977); the population further declined to 38 individuals in 1984. Contemporary population estimates have ranged from a low of 452 individuals in 2000 to a high of 1,519 individuals in 2002 (USFWS 2009). Current populations (2008) were estimated to be 539 adults, or nearly 270 pairs assuming 1:1 sex ratio for 2008.

Resistance to Disease:

Low

Adaptability:

Low

Additional Population-level Information:

The San Clemente sparrow population continues to be affected by habitat destruction and modification; however, low juvenile survivorship has continued to decrease and remains a concern (NatureServe 2015). Ecological complexities pertaining to San Clemente sage sparrow still exist. Population fluctuations are also correlated to annual precipitation levels and the effect of habitat quality, but survivorship may be underestimated due to variability in population monitoring (USFWS 2009). Populations started to improve when habitat quality started to change after nonnative grazers were removed in 1991. However, effects persist from past habitat conversion of the native plant ecosystem, caused by nonnative animals (USFWS 2009).

Population Narrative:

San Clemente sage sparrow populations show a stable trend. Currently, there is one extant population on the San Clemente Island. Ninety individual sage sparrows were known in 1977, and 38 individuals in 1984. Contemporary population estimates have ranged from a low of 452 individuals in 2000 to a high of 1,519 individuals in 2002. Current populations (2008) were estimated to be 539 adults or nearly 270 pairs, assuming 1:1 sex ratio for 2008 (USFWS 2009).Ecological complexities pertaining to San Clemente sage sparrow still exist. Populations started to improve when habitat quality started to change after nonnative grazers were removed in 1991. However, effects persist from past habitat conversion of the native plant ecosystem, caused by nonnative animals (USFWS 2009). Population densities are highest at lower elevations, and decrease with increasing elevation along the moisture gradient (USFWS 2009). Population fluctuations are correlated to annual precipitation levels and the effect of habitat quality, but survivorship may be underestimated due to variability in population monitoring (USFWS 2009). The San Clemente sparrow population continues to be affected by past and present habitat destruction and modification; low juvenile survivorship has continued to decrease, and remains a concern (USFWS 2009, NatureServe 2015).

Threats and Stressors

Stressor: Presence of nonnative grazers
Exposure: Indirect; trampled resources, introduction of invasive grasses, defoliation of native vegetation, and soil compaction caused by nonnative grazing animals.
Response: Reduced forage, less dispersal potential, decreased access to nesting resources.
Consequence: Reduced reproductive success.
Narrative: Effects of past habitat conversion caused by nonnative animals on San Clemente Island's native plant ecosystem has left the island with trampled resources, increased invasive grasses, compacted soil, and defoliated vegetation. This has led to reduced forage, reduced dispersal, and a decrease in reproductive success (USFWS 2009).

Stressor: Ranching
Exposure: Indirect; overgrazed areas reduce quality coverage. Changes in herb/forb vegetation, low shrubs, and California boxthorn used for nest and perch sites by the sage sparrow.
Response: Diminished quality of available forage, reduced coverage, and reduced resource availability.
Consequence: Death of individuals and greatly reduced populations.

Narrative: Reduced nesting and roosting resource availability has been caused by both nonnative grazers and landscape manipulation from human disturbance. Diminished availability of quality forage and nesting resources, and increased human presence, has greatly reduced San Clemente sage sparrow populations (USFWS 2009).

Stressor: Human disturbance/military activities
Exposure: Indirect; military activities, development of an assault vehicle maneuver area, and fires resulting from military activities.
Response: Decreased dispersal of populations, habitat destruction, and decreased access to necessary resources.
Consequence: High mortality rates.
Narrative: Human disturbance such as high-impact bombing, weapons training, and the development of an assault vehicle maneuver area has occurred throughout the range of the San Clemente sage sparrow. This limits the areas of the island to access resources, and causes significant habitat destruction. These factors cause high mortality rates in the subspecies (USFWS 2009).

Stressor: Predation from introduced and native predators, potential for disease
Exposure: Direct; nonnative species acting as predators or disease vector hosts.
Response: Increased predation.
Consequence: Increased mortality.
Narrative: Increased predation, due to lack of quality coverage, from introduced (feral cats, rodents, feral hogs) and native (raptors) predators has caused an increase in mortality (USFWS 2009).

Stressor: Climate change
Exposure: Indirect; droughts, increased temperatures, and decrease of necessary resources.
Response: Inability to adapt to climate changes, and decrease in nesting potential.
Consequence: During the breeding months, the population fluctuations are correlated to annual precipitation levels and the effect of habitat quality (USFWS 2009).
Narrative: Periodic and successive droughts, prolonged seasonal drought, and rainfall coming at unusual periods and in different amounts are considered ecological stress and selection factors that impact the small population on San Clemente Island. During the breeding months, the population fluctuations are correlated to annual precipitation levels and the effect of habitat quality (USFWS 2009).

Stressor: Small population size, low juvenile survivorship, and limited distribution
Exposure: Direct; inbreeding, reduced genetic diversity.
Response: Reduced population size, less dispersal potential.
Consequence: Less genetic diversity and greatly reduced populations.
Narrative: Small population size, low juvenile survivorship, and limited distribution can lead to inbreeding, which limits genetic diversity and causes reduced population size (USFWS 2009).

Stressor: Stochastic events
Exposure: Direct and indirect; floods, fires, or drought can substantially reduce or eliminate small populations and increase the likelihood of extinction.
Response: Small populations are more vulnerable to natural catastrophes and stochastic demographic, genetic, and environmental events.

Consequence: Increased likelihood of extinction.
Narrative: Small populations are more vulnerable to decline after natural disasters. The random occurrences of stochastic events such as floods, fires, and droughts can increase the likelihood of extinction (USFWS 2009).

Recovery

Reclassification Criteria:
The recovery plan for the species does not specifically identify reclassification criteria. The plan was written for multiple endangered and threatened plant and animal species. Because the species is listed as threatened, no downlisting criteria were identified.

Delisting Criteria:
No recovery criteria were delineated for the San Clemente sage sparrow in the recovery plan (USFWS 1984; USFWS 2009). The plan was written for multiple plant and animal species, and broadly indicated that "recovery of these endangered and threatened taxa will be dependent upon the restoration, enhancement, and management of respective island ecosystems on San Clemente, Santa Barbara, and San Nicolas Islands" (USFWS 2009).

Recovery Actions:
- Habitat restoration. To restore habitat to provide a more suitable environment for the species, revegetation, control of erosion, and removal of exotic species will be necessary (USFWS 1984).
- Implement management recommendations for the species. Numerous actions have been proposed to maintain and restore populations for the species (USFWS 1984).
- Habitat protection. Survival and eventual recovery of the species is dependent on adequate protection of their habitat. Regardless of other management actions to conserve the species, if habitat is not properly managed, recovery will not be possible (USFWS 1984).
- Develop delisting criteria (i.e., the size of populations and amount of suitable habitat necessary before reclassification can be considered). Before consideration can be given for reclassifying a species (either upgrading to threatened status or delisting), it is necessary to determine the number of organisms, the size of the secure habitat, or the number of such populations/habitats required to support viable, self-sustaining populations. To obtain this information and to properly manage these taxa, additional research studies are necessary (USFWS 1984).
- Evaluate success of management actions. All species must be monitored throughout the course of the recovery program to assess its success, and determine whether additional actions or modifications of activities are necessary. (USFWS 1984).
- Increase public support. Public support for the conservation of the species can be enhanced by increasing the public's awareness of the sensitivity and uniqueness of the island's ecosystems (USFWS 1984).
- Use existing laws and regulations protecting the species. All federal and state laws pertaining to the protection and conservation of the species should be used to further the recovery effort (USFWS 1984).
- Work with the Navy to remove all cats, black rats, and other nonnative mammals from San Clemente Island (USFWS 2009).

- Develop and provide for peer review: a) a threats-based recovery plan using recent published and unpublished empirical data; and b) threats-based criteria for recovery under the Endangered Species Act (USFWS 2009).
- Complete telemetry study to provide additional information regarding adult and juvenile survivorship. Determine the accuracy of current juvenile survivorship estimates (USFWS 2009).
- Complete appropriate population-based wildlife health and mortality studies on all life stages, based on current diseases and conditions known to adversely impact wild bird populations in Southern California, to assess whether mortality causes can be reduced (USFWS 2009).
- Assess sage sparrow response to adjacent training activities as new weapons ranges become operational, to better understand effects/threats associated with military disturbances, such as activities and potential fires (USFWS 2009).
- Increase emphasis on vegetation restoration at other locations of the island, to support expansion of the sage sparrow population throughout San Clemente Island. Increase the quantity of high quality habitat on the island (USFWS 2009).
- Evaluate the potential need and feasibility for controlled propagation that would not adversely impact the current wild population, and determine how it will effectively contribute to the recovery of the San Clemente sage sparrow. Develop a capture framework, species survival plan, species action plan, and controlled propagation plan reflective of U.S. Fish and Wildlife Service policy for a captive breeding program (USFWS 2009).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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SPECIES ACCOUNT: *Anas laysanensis* (Laysan duck)

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

A small, dark, reddish-brown duck. Teal-sized brown duck with prominent white around the eye. Bill relatively short and decidedly spatulate; yellowish green with variable black blotching. Some males show what appears to be faint greenish iridescence on head or neck, and usually have slightly upturned central tail feathers. Otherwise sexes very similar. In both sexes, speculum green to greenish purple, and legs and feet pale orange, usually brighter in males (Moulton and Marshall 1996) (NatureServe, 2015).

Taxonomy

The Laysan duck (Anas laysanensis), also known as the Laysan teal, is one of six extant waterbird taxa that are endemic to Hawai`i. The Laysan duck is a taxonomically distinct species in the waterfowl family (Anatidae: tribe Anatini) (USFWS, 2009).

Historical Range

It was extirpated across the Hawaiian archipelago with an extant population persisting only on the island of Laysan (USFWS, 2014). To date, Laysan duck bones have been found on six islands where the species no longer occurs: Hawai`i, Maui, Moloka`i, O`ahu, Kaua`i, and Lisianski (USFWS, 2009).

Current Range

Resident on Laysan Island, northwestern Hawaiian Islands. Subfossils and ancient DNA indicate that this duck formerly was widespread in the Hawaiian Islands (Cooper et al. 1996) (NatureServe, 2015). A second population was established via translocation of wild birds from Laysan Island to Midway Atoll in 2004 and 2005 (USFWS 2009) (USFWS, 2014).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

<u>Adult:</u> Adults and immatures are invertivores. Feeds and drinks at inland water at night; attracted to freshwater seeps. Eats mainly insects, including caterpillars, larvae and pupae of flies and beetles around seabird carcasses, and especially Neoscatella flies around saline lake; also crustaceans and other invertebrates in shallow tide pools. It is most active at twilight and at night (NatureServe, 2015). The ducks feed on wetland and terrestrial invertebrates, seeds, and succulent plants. The Laysan duck is primarily insectivorous, but feeds opportunistically on seeds, leaves, and algae (Reynolds et al. 2006b). Ducklings have more restrictive requirements than adults because of their high nutritional needs for growth and initial inability to process salt

water. Duckling activities therefore are concentrated near sources of fresh water with nearby cover and high prey densities (USFWS, 2009).

Reproduction Narrative

Adult: Nests on ground in or under vegetation, mainly in clumps of grass (Eragrostis). Eggs are laid mainly in spring and early summer, though timing of breeding may vary annually; most eggs laid May - late July according to Matthews and Moseley (1990). Clutch size is usually about 4 - 6. Young are tended by female. About half of adults switch mates from one year to next. Apparently reproductive rate is low and adult survival rate is high (Moulton and Weller 1984) (NatureServe, 2015). It is a relatively long lived species (12 years in the wild, 18 in captivity; Moulton and Weller 1984; Reynolds and Kozar 2000a). Monogamous pairing and female-only parental care characterize the mating system of the Laysan duck. Incubation lasts 28 to 29 days (Marshall 1992a). Seven percent of marked hens in 2000 produced a second brood after losing the first one. The sex ratio of Laysan ducks on Laysan Island often is skewed toward males. The estimated sex ratio was even in 1998, 53:47 in 1999, 52:48 in 2000, and even in 2001 (Reynolds 2002) (USFWS, 2009).

Environmental Specificity

Adult: Broad (inferred from USFWS, 2009)

Site Fidelity

Adult: High (USFWS, 2009)

Habitat Narrative

Adult: Usually occurs in the island's lagoons, tidal pools, and marshes (Matthews and Moseley 1990). Seeks shelter in vegetation (Pluchera, Ipomoea, and Sicyos) during heat of day (NatureServe, 2015). On Laysan Island and at Midway Atoll, the ducks use all available habitats: upland vegetation, ephemeral wetlands, freshwater seeps, mudflats, the hypersaline lake, and coastal areas. Most of the birds showed strong site fidelity and evidence of selective habitat use by time of day (USFWS, 2009).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Low (USFWS, 2009)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015). It is very sedentary and terrestrial for a waterfowl species (USFWS, 2009).

Population Information and Trends

Population Trends:

Decline of > 70% (NatureServe, 2015)

Resiliency:

Low (inferred from USFWS, 2009)

Redundancy:

Very low (inferred from USFWS, 2009)

Number of Populations:

2 (USFWS, 2009)

Population Size:

Laysan: 339; Midway: 231 - 330 (USFWS, 2014). As of 2017 5-year review, Laysan population is approximately 154 individuals, Midway's population is 314-435, and Kure's population (established from captive breeding and release program in 2014), is approximatley 30-35 individuals. (USFWS, 2017).

Population Narrative:

This species has experienced a long term decline of > 70%. It has undergone two major declines in the last century. 1996). Several hundred are in breeding facilities throughout the world (NatureServe, 2015). In 2012, the population estimate of Laysan ducks on Laysan Island was 339 (95% CI 265-413) (Reynolds et al. in prep.; U.S. Geological Survey [USGS]/USFWS unpubl. data 2014). Preliminary analysis of the Midway population from limited data collected after a tsunami overwash event in 2011 ranged between 231 - 330 in 2012 (USGS publ. data 2014). (USFWS, 2014). There is a single naturally occurring population on Laysan Island in the Northwestern Hawaiian Islands, and a small but growing population at Midway Atoll founded by birds translocated from Laysan (USFWS, 2009).

Threats and Stressors

Stressor: Disease (USFWS, 2014 and 2009)
Exposure:
Response:
Consequence:
Narrative: A new type of epizootic, avian botulism C, has occurred on an annual basis on Midway Atoll since 2008, resulting in high mortality and population declines and is a threat to the species persistence on small islands (M. Reynolds, in litt. 2014) (USFWS, 2014). Laysan ducks are known to experience mortality from infection by a parasitic nematode and population-level effects from epizootics involving this parasite (see below), but the threat of other diseases has not been evaluated. Avian malaria, a disease devastating to Hawaiian passerines (songbirds), may have been introduced to the Hawaiian Islands by migratory waterfowl (Warner 1968) (USFWS, 2009).

Stressor: Climate change (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Climate change is a threat to this species as it currently occurs only on low lying islands vulnerable to sea level rise, storm surge, and tsunamis. New digital elevation models (Reynolds et al., in litt. 2010; Reynolds et al. 2011) indicate the mean elevation of Midway Atoll is

2.5 meters (8.2 feet) and the mean elevation of Laysan is 4.3 meters (14.8 feet) (Berkowitz et al. 2012; Krause et al. 2012) (USFWS, 2014).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The small total number of Laysan ducks and the species' distribution in two isolated locations with limited carrying capacity are the greatest ultimate threats to this species. The Laysan Island duck population experiences periodic declines in response to chance events, and given the small populations on Laysan and at Midway, such events pose a significant threat to the species' existence. The most recent major population declines were in 1993, when Laysan Island suffered a severe drought and the ducks experienced an epizootic of echinuriasis (Work et al. 2004), and in 2008 when more than 150 ducks succumbed to botulism at Midway (Klavitter and Laniawe 2008) (USFWS, 2009).

Stressor: Nonnative species (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Introduced plants displace native vegetation, destroying preferred nesting habitat and cover for birds, and may reduce foraging habitat for native arthropods. At least 150 nonnative invertebrates have found their way to Laysan (Morin and Conant 1998; Nishida 1999). Alien invertebrates can directly alter habitat by feeding on native plants that are not adapted to herbivory. Other Northwestern Hawaiian islands have experienced recent invasions of exotic plants, ants, grasshoppers, mosquitoes, spiders, reptiles, mice, and rats, any of which could have severe impacts on the native flora and fauna of Laysan (Conant and Rowland 1994; Morin and Conant 1998). Recovery of the Laysan duck will require reestablishment of the species on at least two of the Main Hawaiian Islands, nearly all of which are inhabited by numerous alien predators, including cats, dogs (Canis lupus familiaris), pigs (Sus scrofa), mongooses, and several species of rats. Such alien predators have devastating effects on ground-nesting birds (Berger 1981, Scott et al. 1986, Burney et al. 2001), and adult ducks are vulnerable to predation as well. Ants, which are not native to Hawaiian ecosystems, are extremely destructive to native species and may pose a threat to Laysan ducks, especially to eggs and newly hatched ducklings. Researchers believe big-headed ants (Pheidole megacephala) may have caused mortality of nestling Laysan finches (Conant and Rowland 1994) (USFWS, 2009). 2017 Updates: Big-headed ant (Pheidole megacephalus). Big-headed ants were widespread on Green Island and regularly observed attacking adult seabirds and chicks. An eradication program began in 2014 (C. Vanderlip, 2017, in litt.). • Rats (Rattus rattus) were first observed in August of 2016 and are suspected to have been released on the island during PCB remediation project by a contractor (C. Vanderlip, 2017, in litt.). Following trapping, eradication is believed completed in 2017. • Mosquitos (Culex quinquefasciatus) were first observed on Kure mid-July 2016 and are believed to have been introduced from Midway by winds (C. Vanderlip, 2017, in litt.). A larvicide was applied in April 2017 and no mosquitoes were observed after May (C. Vanderlip, 2017, in litt.).Yellow crazy ants (Anoplolepis gracilipes) are present at the Hawai`i base yard where packing for trips to the Northwestern Hawaiian Islands occurs (Plentovich, pers. comm. 2017). (USFWS, 2017).

Stressor: Filling of lakes and seeps (USFWS, 2009)

Exposure:
Response:
Consequence:
Narrative: Laysan's interior lake and surrounding freshwater seeps have undergone sedimentation exacerbated by the rabbit-caused devegetation and shifting shorelines (Bailey 1919; Wetmore 1925 in Ely and Clapp 1973). A similar process took place on Lisianski. Drifting sands have caused the lake to shrink since the beginning of the 20th century. Recent observations show that ducks spend a lot of time foraging at the lake in areas with lower salinity or at freshwater seeps, which have the highest prey densities and are an important source of fresh water for ducklings. Lower salinity favors the growth and emergence of brine flies, an important prey source for the ducks (USFWS, 2009).

Stressor: Contaminants (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Pacific Ocean currents often carry debris to Laysan's shores. In 1988 a contaminated site (known informally as the "dead zone") was discovered on the island's northern coast. Dead insects, crabs, and birds were recorded within the zone's perimeter (Morin and Conant 1998), including one Laysan duck in 1987 (B. Becker, National Marine Fisheries Service, pers. comm. 2002). A container of the pesticide carbofuran was identified as the cause. Oil from spills has also washed up on the island. The most recent known spill was in the winter of 2000, when numerous tar balls were seen on the western coast. Future contaminants washing ashore could pose a serious threat to the Laysan duck. Even small amounts of contaminants can affect vital rates through decreased egg production, reduced fertility and hatchability, and lower sperm counts (USFWS 1987) (USFWS, 2009).

Stressor: Human disturbance (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Activities associated with refuge management and infrastructure maintenance at Midway Atoll may pose a threat to Laysan ducks. Some habitat restoration projects in the atoll involve the use of herbicides or other toxicants that may adversely affect ducks if they are exposed. Heavy equipment and other vehicles are used on a regular basis, especially on Sand Island, for a wide range of projects, and mortality from vehicle strikes is possible, although to date such mortality has not been observed. Activities involving foot traffic as well as vehicle traffic have the potential to disturb ducks that are incubating eggs or tending young broods, which can result in abandonment (USFWS, 2009).

Recovery

Reclassification Criteria:
1. The Laysan Island population must be stable or increasing when monitoring data are averaged over a period of 15 consecutive years and should average roughly 500 ducks over this period (believed to be the carrying capacity of the island) (USFWS, 2014).

2. A total of at least 1,800 potentially breeding ducks should exist on a combination of Northwestern Hawaiian Islands (including Laysan and Midway) and at least one predator-controlled site in the higher elevation Main Hawaiian Islands. Each of these populations must be stable or increasing when monitoring data re averaged over a period of at least 10 consecutive years (USFWS, 2014).

3. Island- or site-specific management plans for Laysan ducks must be created and implemented (USFWS, 2014).

Delisting Criteria:
1. A total of at least 3,000 potentially breeding adult birds exists in five or more stable or increasing populations on a combination of predator-free Northwestern Hawaiian Islands (including Laysan and Midway) and at least two predator-controlled sites in the Main Hawaiian Islands (USFWS, 2009).

2. Population viability analysis projects that under current conditions the species will persist for at least 100 years (USFWS, 2009).

3. Management plans for each island or site are evaluated on a regular basis and updated to include monitoring to detect demographic or new environmental threats to Laysan ducks (USFWS, 2009).

Recovery Actions:
- Management and research to reduce risks and stabilize the existing populations (USFWS, 2009).
- Creation and management of additional self-sustaining populations on other islands through translocation and habitat restoration (USFWS, 2009).
- Captive propagation if necessary to provide sufficient stock for reintroductions of the Laysan duck in the Main Hawaiian Islands (USFWS, 2009).
- Public outreach to ensure that the recovery program for the species especially in the Main Hawaiian Islands is accepted and supported by local communities (USFWS, 2009).
- New in 2017: Habitat and natural process management and restoration - Continue restoration activities for Laysan Duck habitat on Laysan, Midway, and Kure. (USFWS, 2017).
- New in 2017: Threats – Recently, quarantine measures have not been entirely successful. Review quarantine measures for the northwestern Hawaiian Islands, revise and implement as needed. (USFWS, 2017).
- New in 2017: Threats – Improve monitoring for new introductions of alien species throughout the Northwestern Hawaiian Islands. (USFWS, 2017).

Conservation Measures and Best Management Practices:
- Population viability monitoring and analysis: o Monitor population status and reproduction on Laysan Island to determine trends, identify limiting factors that can be addressed through management, and monitor numbers and condition of juvenile ducks in years when translocations are planned. o Monitor survival and reproduction in Midway population (and any other populations initiated through translocation) to determine vital rates for comparison with Laysan population and identify limiting factors that can be addressed through management. o Study survival, reproduction, and other aspects of Laysan duck ecology at Midway (and any future release sites) to compare with

data from Laysan Island and assess management requirements. This information will provide a basis for adaptive management of Laysan ducks in new environments as well as add to our baseline knowledge of the species (USFWS, 2014).

- Reintroduction / translocation: o Conduct an "immigration" translocation of individuals from Laysan to Midway to supplement genetic diversity in the recently established population. o Conduct translocation of Laysan ducks to Kure Island. Continue restoration activities for Laysan duck habitat on the island. o Develop translocation plans for moving Laysan ducks to Lisianski Island from Laysan and establish fresh water guzzlers necessary to support ducks at this site (USFWS, 2014). 2017 update: 28 hatch-year Laysan Ducks were translocated to Kure from Midway in 2014 (USGS 2014). (USFWS, 2017).
- Strategic planning – Draft emergency contingency plans for Laysan ducks to address the potential threat of catastrophes such as hurricanes, tsunamis, and epizootics (USFWS, 2014).
- Disease monitoring and control – Continue to monitor for botulism and if detected, implement actions to minimize the threat to other ducks. Research and develop new tools to prevent botulism related mortality on Laysan, Midway and any future reintroduction sites (USFWS, 2014).
- Alliance and partnership development – Revisit partnerships with the Kahoolawe Island Restoration Committee and other stake holders for faunal restoration at Kahoolawe, including habitat restoration and mammalian predator removals for Laysan duck translocations (USFWS, 2014).
- Habitat and natural process management and restoration – Additional guzzlers have been installed on Midway Atoll. (USFWS, 2017).
- Habitat and natural process management and restoration – Planning efforts underway to eradicate the house mouse (Mus musculus) from Midway Island. (USFWS, 2017).
- Climate change degradation of habitat – Climate change may pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs in the near future. Hurricanes may be the main threat to this species as a result of climate change. Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity (5.4%), frequency (2.8%) and duration (1.4%) by 2100, and continue to increase further into the future (Emanuel et al. 2008). (USFWS, 2017).

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SPECIES ACCOUNT: *Anas wyvilliana* (Hawaiian (=koloa) Duck)

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Hawaiian duck is one of two extant endemic duck species (Family: Anatidae) found in Hawaii from at least 13 species of endemic Hawaiian waterfowl known from the fossil record, including extinct giant flightless ducks (Olson and James 1991, Burney et al. 2001), descendants of migratory ducks that evolved here in the islands over hundreds of thousands to millions of years and became unique Hawaiian species (Rhymer 2001). The Hawaiian duck is closely related to but genetically and morphologically distinct from the mallard (A. platyrhynchos) (Fowler et al. 2008). Both sexes of the Hawaiian duck are mottled brown and may resemble a small female mallard. Adult males have darker heads, with distinctive brown chevrons on the breast, flank and back feathers, and olive-colored bills (Engilis et al. 2002). Adult females are similar but are smaller than males on average and slightly lighter in color, with plainer, buff colored chin and back feathers.

Taxonomy

New DNA evidence indicates that the koloa is descended from an ancient hybridization event between the mallard and the Laysan duck (Anas laysanensis) (Lavretsky et al. 2015) (USFWS, 2015).

Current Range

RESIDENT in Hawaii (formerly all main islands except Lanai and Kahoolawe) (Berger 1981). At present occurs naturally only on Kauai, but has been reintroduced and reestablished on Hawaii (Hawi south to Paauilo) and in several areas on Oahu; small numbers have been released on Maui (Engilis and Pratt 1993); occurs also on Niihau; unconfirmed sighting from Molokai. In the early 1900s, Hawaiian ducks were common in the coastal marshes of all the main Hawaiian Islands except for Lanai and Kahoolawe (Munro 1944). By the mid-1900s, the species had been reduced to 500 birds on the island of Kauai and a few isolated pairs on other islands (Schwartz and Schwartz 1953). In the mid-1950s, the State of Hawaii began a captive propagation and release program for the Hawaiian duck. From 1958-1990, 757 captive-bred Hawaiian ducks were released on the islands of Oahu (326), Maui (12), and Hawaii (419) to re-establish the species within its former range (Giffin 1983). The Hawaiian duck release program was complicated by the problem of interbreeding with feral mallards (ornamental or farm ducks that escaped or were released into the wild). Recent genetic sampling indicates the Kauai population to be predominantly true Hawaiian ducks, and Oahu and Maui populations to be predominantly mallards and mallard-Hawaiian duck hybrids, elevating the importance of Kauai in persistence of the species (Fowler et al. 2009).

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: The Hawaiian duckling diet has never been studied. However, mallard ducklings eat mainly animal foods for the first 25 days of life (aquatic insects especially chironomids, small crustaceans, and mollusks) spending 65-80 percent of daylight feeding. After 20-30 days, seeds become more prominent in the mallard duckling diet (Drilling et al. 2002).

Adult: Adults and immatures are invertivores, herbivores, and granivores. Eats green algae, rice, grasses, grass seeds, earthworms, insects, snails, etc. (Berger 1981). (NatureServe, 2015). The species typically forages in water less than six inches deep. Hawaiian ducks are opportunistic and their diet includes snails, aquatic insects, earthworms, grass seeds, green algae, and seeds and leaves of wetland plants.

Reproduction Narrative

Adult: Nests on ground near water in well concealed site, primarily on small islets (AOU 1983). May breed any time, but main nesting season apparently December - May. Clutch size averages about 8. Incubation lasts 4 weeks. Most hatching occurs April - June. Sexually mature in 1 year (Berger 1981, Matthews and Moseley 1990). The Hawaiian duck is one of the least studied of the Hawaiian birds. Its breeding ecology is largely unknown. Although some pairs nest in lowland habitats on the island of Kauai, Hawaiian ducks have also been observed nesting along stream banks and in the upper Alakai swamp (USFWS 2011). Nesting occurs year round, but most activity occurs between March-July on Hawaii Island (Giffin 1983) and December-May on the island of Kauai (Swedberg 1967). The Hawaiian duck usually nest on the ground in herbaceous and/or woody vegetation in wetland-associated uplands. Generally six to ten eggs are laid, precocial ducklings hatch after 26-30 days of incubation, and ducklings attain flight after 65-70 days of protection and rearing usually by the lone female (Swedberg 1967, Giffin 1983).(NatureServe, 2015).

Spatial Arrangements of the Population

Adult: Solitary, pairs; sometime grouped near food sources (NatureServe, 2015)

Environmental Specificity

Adult: Very broad (inferred from NatureServe, 2015)

Habitat Narrative

Adult: Typically occurs solitary or in pairs, though larger numbers may congregate at rich food sources. Inhabits lowland marshes, reservoirs, taro patches, pastures, drainage ditches, agricultural lands below 300 m, stream and river valleys in densely wooded areas at higher elevations (Berger 1981); mountain pools, mountain bogs, forest swamps (Matthews and Moseley 1990). Uses natural and human-made ponds and wetlands. From Englis et al. (2002): Wide range of habitats, from sea level to 3000 m elevation. (NatureServe, 2015). Hawaiian ducks are found from sea level to 9,900 feet elevation. The Hawaiian duck occurs in a wide variety of natural and artificial wetland habitats including freshwater marshes, flooded grasslands, montane stock ponds, streams, forest swamplands, taro loi, lotus (Nelumbo nucifera) farms, irrigation ditches, reservoirs, and mouths of larger streams (USFWS 2011). Since 2006-2007, significant wetland habitat improvements have been made for Hawaiian ducks at Hanalei and Huleia NWRs on the island of Kauai with the intent of providing optimal foraging, loafing, and breeding habitat. Watershed protection and management is beneficial to the Hawaiian duck because of the species' elevational range and use of wetland habitats from the coastal plain to mountain top. Hawaiian ducks move between feeding and breeding habitats, and are known to fly between the islands of Kauai and Niihau. The species typically forages in water less than six inches deep. Hawaiian ducks are opportunistic and their diet includes snails, aquatic insects, earthworms, grass seeds, green algae, and seeds and leaves of wetland plants. The Hawaiian duckling diet has never been studied. However, mallard ducklings eat mainly animal foods for the first 25 days of life (aquatic insects especially chironomids, small crustaceans, and mollusks) spending 65-80 percent of daylight feeding. After 20-30 days, seeds become more prominent in the mallard duckling diet (Drilling et al. 2002). Hawaiian ducks are usually found alone or in pairs and are wary, especially when nesting or molting, although during the winter they may gather in larger numbers to exploit abundant food resources (USFWS 2011).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Seasonal movements (NatureServe, 2015)

Dispersal

Adult: Low to moderate (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is relatively sedentary. Rarely moves between islands (Matthews and Moseley 1990), however Hawaiian ducks migrate between Kauai and Niihau in response to above-normal precipitation, and the flooding and drying of Niihau's ephemeral lakes. Some may move to the lowlands during early winter to exploit ephemeral wetlands, return to montane breeding areas in early spring (Engilis and Pratt 1993). This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Increasing on Kauai, decreasing elsewhere

Population Size:

~2,200

Population Narrative:

Although the Hawaiian duck population is estimated to be about 2,200 individuals, with 2,000 true Hawaiian duck on the islands of Kauai and Niihau and 200 on parts of the island of Hawaii; this was based on State biannual count data which do not include remote wetlands and streams (Engilis et al. 2002, p. 11) where an estimated 50-80 percent of Hawaiian duck are believed to reside on the island of Kauai (Schwartz and Schwartz 1953, Swedberg 1967). State biannual counts may provide an index for wetlands, and long-term trends suggest Hawaiian duck are increasing on the island of Kauai but decreasing on other islands due to hybridization with feral mallards (USFWS 2011). However, count data have peaked at 524 for the all-island survey and 459 for Kauai in January 2004 (DOFAW unpublished data 1986-2006), and recent banding activities over a 13 month period at the Hanalei NWR have resulted in 675 Hawaiian ducks banded, and resighting activities indicate that >75 percent of birds on the Refuge are not currently banded (C. Malachowski unpublished data). Together, these data indicate the State count data is biased seriously low. Furthermore, counts on Oahu, Maui, and Hawaii Island are confounded by the difficulty in distinguishing Hawaiian ducks from mallards and hybrids in the field. There is currently no credible population estimate for Hawaiian ducks at any scale.

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: The Hawaiian duck was listed as an endangered species in 1967 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978 and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. A species review has not yet been initiated pursuant to section 4(c)(2) of the ESA which requires five-year review after listing (USFWS 2011). Critical habitat has not been designated for the Hawaiian duck (USFWS 2011). The threats to, and conservation needs of, Hawaiian waterbirds outlined above in the "Status of the Species" section for the Hawaiian moorhen apply to the Hawaiian duck. However, the greatest current threat to the Hawaiian duck is hybridization with non-native mallards introduced to Hawaii for farming, sport hunting, and pond beautification (USFWS 2011, Uyehara et al. 2007). This is especially problematic on the islands of Oahu and Maui where most of the individuals are mallard-Hawaiian duck hybrids. In addition to the overall conservation needs outlined below, recovery of the Hawaiian duck includes removing the threat of hybridization with feral mallards on the islands of Kauai, Niihau, Oahu, and Hawaii; and reestablishing Hawaiian duck populations on the islands of Maui and Molokai (USFWS 2011). It is likely that feral pigs and goats (Capra hircus) significantly reduce the suitability of nesting habitat for Hawaiian ducks along montane streams. A variety of conservation measures have been implemented to protect Hawaii's endangered waterbirds. Efforts directly benefitting the Hawaiian duck include a long-term hunting ban, protection of habitat through establishment and management of federal and State refuges and sanctuaries, predator control, release of captive-bred Hawaiian ducks, and restrictions on importation of mallards. Additional conservation actions include public service announcements and an outreach and communications plan to raise public awareness about the hybridization issue facing the Hawaiian duck. Actions that inform conservation of the species includes population monitoring, refinement of a field key to distinguish Hawaiian ducks from mallard-Hawaiian duck hybrids (Fowler et al. 2009), and research on movements and habitat use (USFWS 2011).

Recovery

Reclassification Criteria:
1. All core wetlands and at least 50 percent of supporting wetlands must be protected and managed in accordance with management practices outlined in the 2011 recovery plan (USFWS, 2015).

2. A population viability analysis (PVA) has been conducted incorporating survey data from both montane streams and lowland wetlands, to determine the population size necessary for long-term viability of the species (USFWS, 2015).

3. The statewide surveyed number of koloa has shown a stable or increasing trend and has not declined below 2,000 birds (or an alternative target based on the PVA) for at least 5 consecutive years (USFWS, 2015).

4. There are multiple self-sustaining breeding populations, including multiple populations present on at least Kauai/Niihau, Oahu, Maui, and Hawaii (USFWS, 2015).

5. The threat of hybridization with feral mallards must be removed from all islands (USFWS, 2015).

Delisting Criteria:
1. All core wetlands listed in the recovery plan on the islands of Kauai, Oahu, Maui, and Hawaii are protected and managed in accordance with the management practices outlined in the recovery plan (USFWS, 2009).

2. Of the supporting wetlands listed in the recovery plan on the islands of Kauai, Oahu, Maui, and Hawaii, 75 percent are protected and managed in accordance with the management practices outlined in the recovery plan (USFWS, 2009).

3. The statewide Hawaiian duck population shows a stable or increasing trend at a number greater than 2,000 birds for at least 10 consecutive years (USFWS, 2009).

4. There are multiple self-sustaining breeding populations, with populations present on Kauai, Oahu, Maui, and Hawaii (USFWS, 2009).

5. The threat of hybridization with feral mallards is removed from all islands (USFWS, 2009).

Conservation Measures and Best Management Practices:

- Habitat and natural process management and restoration – Protect all core and at least 50 percent of supporting wetlands. Develop management plans for core and supporting wetlands (USFWS, 2015).
- Other threat monitoring and control – Develop and implement a Statewide humane feral mallard and hybrid duck removal plan (USFWS, 2015).
- Outreach and education – Conduct a public information and awareness program regarding the mallard-koloa hybridization problem and the need for a feral mallard and hybrid duck removal program. Incorporate outreach and public education efforts to generate interest in saving the koloa (USFWS, 2015).
- Biosecurity legislation – Strengthen quarantine rules and regulations to restrict instate production and commerce of mallards and closely related ducks that threaten the persistence of the koloa. Ensure new stocks of mallards and closely related ducks are not brought into the state (USFWS, 2015).
- Predator / herbivore monitoring and control – Continue predator control and implement improved methods as they become available (USFWS, 2015).

- Invasive plant monitoring and control – Remove nonnative, invasive plants and improve altered wetland hydrology as appropriate (USFWS, 2015).
- Disease monitoring and control – Continue to monitor for botulism and if detected, implement actions to minimize the immediate threat. Research and develop new tools to prevent botulism related mortality (USFWS, 2015).
- Surveys / inventories – Continue annual statewide waterbird counts. These data are not analyzed for other than basic status of the species. Directed analysis of the waterbird count data could identify correlations, including use of specific wetlands, time of year, and state of the wetlands, that could improve our ability to manage for the koloa as well as the endangered waterbirds (USFWS, 2015).
- Habitat quality monitoring – Research and survey montane stream habitat for koloa. Determine the best way to accurately estimate koloa use of montane stream habitats and incorporate this methodology into the state-wide waterbird surveys (USFWS, 2015).

References

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NatureServe. 2015. NatureServe Central Databases. Arlington, Virginia, U.S.A.

USFWS 2015. Hawaiian Duck (Anas wyvilliana). 5-Year Review Short Form Summary. Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii.

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SPECIES ACCOUNT: *Aphelocoma coerulescens* (Florida scrub-jay)

Species Taxonomic and Listing Information

Listing Status: Threatened; June 3, 1987; Southeast Region (R4)

Physical Description

The scrub jay is a 12-inch (30-centimeter) crestless jay, totally lacking the white-tipped wing and tail feathers of the common and widespread blue jay (Cvanocitta cristata). The nape, rump, and wings are dark sky-blue; the tail indigo blue; the back and the underparts smoke gray. A necklace of blue feathers separates the white throat from the gray underparts, and a white line over the eye often blends into a whitish forehead. The tail is long and loose in appearance (Sprunt 1954, Woolfenden 1978). Immature Florida scrub jays are much like adults in appearance, but the colors are duller with less blue on the breast, and the top of the head is lighter. The sexes are alike in all plumages (Sprunt 1946). Average weight is 77 g. (USFWS, 2019)

Taxonomy

At the time of listing, the scrub-jay was considered a subspecies (A. c. coerulescens). In 1995, it regained recognition as a full species (Florida scrub-jay, A. coerulescens) from the American Ornithologists Union (AOU 1995) because of genetic, morphological, and behavioral differences from other members of this group: the western scrub-jay (A. californica) and the island scrub-jay (A. insularis) (AOU 1995). The group name is retained for species in this complex; however, it is now hyphenated to “scrub-jay” (AOU 1995).

Historical Range

They formerly were known from Duval, Clay, Gilchrist, and Taylor Counties in the north, to Monroe and Collier Counties in the south (Cox 1984). They were locally distributed on the Florida east coast from the mouth of the St. Johns River south to Rockdale in Dade County. On the west coast they occurred from Piney Point, Taylor County, and Wannee, Gilchrist County, south to Naples in Collier County. In the interior, they were known from Micanopy, Alachua County, south to Inmiokalee, Collier Counties (Sprunt 1954).

Current Range

Today, scrub jays are restricted to scattered and often small, isolated patches of scrub in peninsular Florida (Woolfenden 1978) (Figure 1). They occur in Alachua, Brevard, Charlotte, Citrus, Clay, Collier, Flagler, Glades, Hardee, Hendry, Hernando, Highlands, Hillsborough, Indian River, Lake, Lee, Levy, Manatee, Marion, Martin, Okeechobee, Orange, Osceola, Palm Beach, Pasco, Polk, Putnam, Sarasota, Seminole, St. Lucie, Sumter, and Volusia counties. As of 2015, Florida scrub-jays are considered extirpated from Alachua, Broward, Dade, Duval, Gilchrest, Pinellas and St. Johns counties, and likely from an additional 15 counties, including Collier, Flagler and Palm Beach. Only 9 counties have groups of >30 individuals on public conservation lands. (USFWS, 2019).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Florida scrub jays are omnivorous, consuming about 60 percent animal matter. Insects, principally orthopterans and lepidopteran larvae, form the bulk of the diet over most of the year. Other insects consumed include: grasshoppers, locusts, crickets, termites, burrower-bugs, squash bugs, leafhoppers, earwigs, bettles, weevils, butterflies, moths, cutworms, bees, wasps, ants, anglewings, and flies. Millipedes, centipedes, spiders, scorpions, ticks, mites, and snails are also eaten. Jays most frequently seek food by hopping along bare sand under scrub oaks, or by jumping from shrub to shrub within the oak foliage, or palmetto fronds, examining leaves and darting after startled animals that attempt to escape. When encountered, a variety of small vertebrates are also taken. Vertebrate prey at the Archbold Biological Station include frogs, toads, lizards, small snakes, small rodents, downy chicks of bobwhite, and eggs and fledglings of small birds. Carrion is also occasionally eaten.Acorns form the principal plant food. In late summer and fall jays spend a considerable part of their day gathering ripening acorns. Many are eaten immediately, but the majority are cached in the sand, husks intact. These are recovered, husked, and eaten throughout the rest of the year. Woolfenden and Fitzpatrick suspect that acorns form a necessary and year-round vegetable staple for Florida scrub jays. Other small nuts, fruits, and seeds are taken occasionally, most notably: hickory nuts, palmetto seeds, tread softly, briars, Smilax, blueberies, gallberries, and rosemary seeds. Weed and grass seeds are rarely, if ever, eaten. Corn, peanuts, sunflower seeds, and many other human-offered foods are readily taken when jays are introduced to them.

Reproduction Narrative

Egg: Incubation lasts 15 to 17 days (Sprunt 1946).

Adult: Florida scrub jays are monogamous and remain mated throughout the year (Sprunt 1946, Woolfenden 1978). They are cooperative breeders. Nonbreeding adults, called “helpers”, often help raise offspring which are not their own. Most helpers are yearling offspring of the resident breeding pair. At the Archbold Biological Station, the breeding season for scrub jays spans about 90 days. Eggs are laid from early March to late June, with the majority laid in late March. One clutch was laid in late February. Scrub jays normally are single brooded, but can lay three, or rarely, four clutches a season. Clutch size varies from two to five eggs, averaging 3.4. Breeding rarely occurs before 2 years of age, and often not until 3 or 4 years (Woolfenden 1978). Females older than 5 years produce over one-half the offspring. Reproductive value peaks at 4 years, but remains high through age 14. Breeder survival is 82 percent annually. Senescence occurs after 15 years.Florida scrub jays nest gregariously, gathering in small, scattered colonies. Myrtle, sand pine, and various oaks (rather than wild olive) are the most commonly used trees for nesting. Breininger (pers. comm. 1988) reported that most scrub jays on Merritt Island nest in oak trees. Both parents gather nest material, construct the nest, incubate, brood, feed, and attend the young. The female does the major part of the incubating, but the male obtains food for her while she is sitting.

Geographic or Habitat Restraints or Barriers

Adult: Occurs only in penisular Florida (see current distribution)

Spatial Arrangements of the Population

Adult: Scattered (see current distribution)

Environmental Specificity

Adult: Narrow

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High (see dispersal/migration narrative)

Dependency on Other Individuals or Species for Habitat

Adult: Oak (predominantly myrtle, sand live, and Chapman)

Habitat Narrative

Adult: The condition, or value, of scrub habitat to Florida scrub-jays is largely dependent on the successional stage of the xeric plant community and its relative size and juxtaposition in the landscape in relation to other xeric plant communities. In general, scrub-jays only persist long-term in early successional scrub communities that are relatively large or in close proximity to other scrub communities. Such scrub habitat occurs only on fine, white, drained sand. This scrub occurs along the coastlines in Florida, and in dunes deposited during the Pleistocene when sea levels were much higher than at present (Laessle 1958, 1968). Scrub comes in a variety of forms. The type most commonly occupied by scrub jays is oak scrub. It consists of a single layer of evergreen shrubs, usually dominated by three species of oak -- myrtle oak, sand live oak, and Chapman oak. Large trees and herbaceous vegetation are lacking in oak scrub, which some authorities refer to as “scrubby flatwoods.” Sand pine scrub and slash pine scrub have shrub layers like that of oak scrub, plus a canopy of either sand pine or slash pine (Pinus elliottii). Scrub jay use of microhabitats show obligatory reliance on oaks. Open sand pine or slash pine scrub has less than 50 percent canopy cover by trees over 3 meters tall. Scrub jays are rarely found in habitats with more than 50 percent canopy cover over 3 meters tall.Thus, high quality or optimal habitat will be in early succession and large or close to adjacent scrub habitat patches. Habitat condition (quality) declines with vegetative height (mid- to late-succession) and degree of fragmentation (distance between habitat patches).Historically, scrub vegetative communities were affected by, and responded to, periodic lightning-generated wildfires (Myers 1985, Robbins and Myers 1989). Wildfires burned scrub communities when adequate fuel loads were present. Natural fire return intervals varied between scrub vegetative communities and probably ranged from 5 to 60 years (Fitzpatrick et al. 1991, Woolfenden and Fitzpatrick 1996). Territory-scale habitat conditions are largely unknown throughout much of the range of the scrub-jay. Optimal Florida Scrub-Jay habitat has greater than 50% of the shrub layer comprised of scrub oaks, a mosaic of oak scrubs that occur in optimal height (1.2-1.7 m, 4-5.5 ft), numerous patches of bare sand or sparse herbaceous vegetation, less than 15% pine canopy cover, and greater than 300 m (984 ft) from a forest edge. Predation is a primary factor influencing the Florida Scrub-Jay’s preference for landscapes dominated by frequently burned scrub. Vegetation that characterizes open (recently burned) scrub is short enough to allow Florida Scrub-Jays to monitor a large area for predators but tall enough to provide refuge and acorns. (USFWS, 2019).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal/Migration Narrative

Adult: Scrub jays are non-migratory and extremely sedentary (Woolfenden 1978).

Population Information and Trends

Population Trends:

Unknown

Species Trends:

Declining

Resiliency:

Moderate

Representation:

High

Redundancy:

Moderate

Population Size:

8,000 New in 2019: Based on a comparison survey conducted in 2009-10 of 198 managed conservation lands to 1992-93 survey results (excluding Ocala National Forest), the population was estimated at 1,253 Florida Scrub-Jay groups (Boughton and Bowman 2011). Surveys indicated a 25% decline on managed conservation lands during the 17-year timeframe. Incorporating private lands (unmanaged and suburban habitats) and assuming an estimated overall population decline between 35-40%, the range- wide population was projected between 2,400-2,600 Florida Scrub-Jay groups (excluding Ocala National Forest). Currently, the population estimates for the entire Ocala National Forest are very crude and are possibly overestimated. Extrapolating data from limited known forest management area population densities to all currently suitable habitat in the forest, the estimate is roughly 1,000 Florida Scrub-Jay groups (pers. com. FFWCC and USFS). (USFWS, 2019).

Population Narrative:

Although a complete survey for this species has not been conducted since 1993, there have been numerous local surveys done. In addition, numerous section 7 consultations and section 10 permit applications confirm that habitat loss is continuing. These indicate a continuing decline is likely. A statewide scrub-jay survey was conducted in 1992-1993, at which time there were an estimated 4,000 pairs of scrub-jays in Florida (Fitzpatrick et al. 1994). Comprehensive rangewide sampling of scrub-jays has been conducted for the last three years by Cornell University. Preliminary results indicate that genetic variation between populations and/or metapopulations of this species may be greater than any other known species of bird in North America (Fitzpatrick 2006). Data are not currently available to assess whether this new information will be informative about genetic variation or trends in genetic variation.

Threats and Stressors

Stressor: Habitat destruction
Exposure:
Response:
Consequence:
Narrative: At the time of listing, it was estimated that 40 percent of occupied scrub habitat had already been destroyed due to land use changes, and the total population of scrub-jays had declined by at least half. Fernald (1989), Fitzpatrick et al. (1991), and Woolfenden and Fitzpatrick (1996a) noted that habitat losses due to agriculture, silviculture, and commercial and residential development continued to play a role in the decline in numbers of scrub-jays throughout their range. More recently, Burns (2006) compared 1989 and 2003 sand pine scrub, xeric oak scrub, and coastal strand land cover classifications, as defined by land cover data sets produced by the FWC. The sand pine scrub and xeric oak scrub land classifications, both potentially suitable scrub-jay habitats, decreased 19 percent from 1989 to 2003, suggesting contemporaneous habitat loss. In total, 36 permits are currently pending that, if issued, have the potential to result in the loss of about 15,013 acres of scrub-jay habitat. Of this total, one project accounts for 14,928 acres; a habitat conservation plan developed to address take of scrub-jays due to urban development on small parcels in urban landscapes (Service 2006b). Additional future destruction of scrub-jay habitat can be expected in the foreseeable future if human population increases occur as projected.

Stressor: Fire suppression/Habitat degradation
Exposure:
Response:
Consequence:
Narrative: Habitat degradation due to fire suppression may exceed habitat destruction as the single most important limiting factor (Woolfenden and Fitzpatrick 1991, 1996a; Fitzpatrick et al. 1994). Fire is important in the cyclical maintenance of scrub habitat (Nash 1895; Harper 1927; Webber 1935; Davis 1943; Laessle 1968; Abrahamson et al. 1984). Nearly all scrub-jay habitat that is on private property is susceptible to further degradation in the future unless active management is undertaken by landowners. Most scrub habitats become overgrown and unsuitable for scrubjays if not managed (burned) at least every 20 years (Fitzpatrick et al. 1991). Habitat degradation can also be expected on some public lands, even where active management programs are in place. Successful restoration of all scrub-jay habitat on many large parcels will take several years to achieve (Stevens and Knight 2005). Elsewhere, some public land managers do not currently have the resources to implement effective habitat management programs (Howell et al. 2003, Service 2006a).

Stressor: Habitat fragmentation
Exposure:
Response:
Consequence:

Narrative: Habitat fragmentation results from habitat loss and degradation. When habitat is destroyed or becomes unsuitable for scrub-jays, the distance between occupied patches of scrub-jay habitat increases.

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Scrub-jays are also vulnerable to predation by feral and free-ranging domestic cats (Fitzpatrick et al. 1991; Bowman and Averill 1993; Bergen 1994; Breininger et al. 1995, 2001; Woolfenden and Fitzpatrick 1996a, 1996b; Breininger 1999; Toland 1999; Christman 2000).

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: Woolfenden and Fitzpatrick (1996b) noted three episodes of elevated mortality (especially among juveniles) in 26 years at Archbold Biological Station. During the most severe of these presumed epidemics (August 1979 through March 1980), all but one of the juvenile cohort and almost half of the breeding adults died (Woolfenden and Fitzpatrick 1984, 1990). The 1979-1980 incident coincided with an outbreak of eastern equine encephalitis among domestic birds in central Florida (J. Day pers. comm., cited in Woolfenden and Fitzpatrick 1996b). From the fall of 1997 through the spring of 1998, the continuing population decline of scrub-jays along the Atlantic coast and in central Florida may have been augmented by an epidemic of unknown origin (Breininger 1999).

Stressor: Road mortality
Exposure:
Response:
Consequence:
Narrative: Scrub-jays forage along roadsides and are susceptible to being killed by passing cars. Mumme et al. (2000) indicated that scrub-jay territories found next to a two-lane road experienced adult mortality that was higher than recruitment. Road mortality is a known mortality source but current data are insufficient to assess its impact on overall population viability.

Stressor: Supplemental food
Exposure:
Response:
Consequence:
Narrative: Scrub-jays may persist locally in otherwise marginal or unsuitable areas in or adjacent to urban areas because they can obtain supplemental food from bird feeders (R. Bowman unpublished data, cited in Woolfenden and Fitzpatrick 1996a; Bowman 1998). However, recruitment in these scrub-jay populations appears to be lower than in populations occupying native habitat. Local densities of scrub-jays during nonbreeding seasons are sometimes elevated by supplemental food, even though breeding densities may not be elevated. Therefore, artificial feeding may cause certain areas to act as population sinks.

Stressor: Changes in habitat
Exposure:
Response:
Consequence:
Narrative: Scrub-jays in suburban settings often nest high in tall shrubbery. During March, these nests tend to be susceptible to destruction by seasonal wind storms (R. Bowman and G.E. Woolfenden unpublished data, cited in Woolfenden and Fitzpatrick 1996b; Bowman 1998). In addition, daily ambient temperatures differ between suburban and wildland sites in south central Florida (Aldredge et al. 2005). The higher ambient temperatures in suburban sites decrease the viability of first-laid scrub-jay eggs.

Stressor: Exotic species
Exposure:
Response:
Consequence:
Narrative: The invasion of some scrub habitat within Indian River, St. Lucie, and Martin counties by exotic plants and animals, including Brazilian pepper (Schinus terebinthifolius), cypress pine (Callitris sp.), and Australian pine (Casuarina equisetifolia), has degraded scrub-jay habitat locally. Other human-induced impacts identified by Fernald (1989) include the introduction of domestic dogs (Canis familiaris) and cats, black rats (Rattus rattus), greenhouse frogs (Eleutherodactylus planirostris), giant toads (Bufo marinus), Cuban tree frogs (Osteopilus septentrionalis), brown anoles (Anolis sagrei), and other exotic animal species. These exotic species may compete with scrub-jays for both space and food, although scrub-jays opportunistically feed on small exotic vertebrates.

Recovery

Delisting Criteria:
1. The population must be stable or increasing from the current population level at the three existing, large population sites (Ocala National Forest, Merritt Island/Cape Canaveral, and Archbold Biological Station). Each site must have an approved management plan. New in 2019: Populations much exhibit a stable or increasing ternd including natural recruitment and multiple age classes. (USFWS, 2019)

2. There must be documented evidence of scrub-jays recolonizing restored or uninhabited areas throughout their historic range.

3. Establishment of several scrub preserves with sufficient acreage to sustain viable scrub-jay populations.

4. Use of scrub-jay habitat management guidelines by developers when proposing development in scrub habitat.

5. New in 2019: Subpopulations are connected to the extent that genetic diversity can be naturally maintained without translocations. (USFWS, 2019)

6. New in 2019: When in addition to the above criteria, it can be demonstrated that the threats particularly habitat loss and degradation associated with sea level rise, development, and

inadequate habitat management are diminished such that sufficient habitat remains for the species to remain viable for the foreseeable future. (USFWS, 2019)

Recovery Actions:

- 1. Habitat Management and Restoration – appropriate fire return intervals, optimal vegetative structure, sufficient sandy openings, increasing connectivity, eliminating dispersal barriers, promoting mosaic within habitat. Priority Level 1. (USFWS, 2019).
- 2. Work with Federal, State, and private organizations to establish protected scrub preserve through acquisition, landowner agreements, or easements. Modified in 2019 to read: Habitat Protection and Acquisition – protect existing public lands, conservation easements on private lands, limited acquisitions to promote connectivity of landscapes, optimum boundaries, eliminate inholdings. Priority Level 1. (USFWS, 2019).
- 3. Population Management – translocations: population augmentations, genetic rescues, maintenance of genetic diversity, re-introductions. Priority Level 1. (USFWS, 2019).
- 4. Population Monitoring – annual post-breeding surveys range-wide, surveys and long-term monitoring in all large population centers and following any restoration/translocation operations. Priority Level 1. (USFWS, 2019).
- 5. Research – population viability analyses, demographic monitoring in response to habitat management, translocation effects on populations, allee effects, genetic studies to investigate degrees of and inbreeding in all populations and its effects on fitness and viability. Priority Level 1. (USFWS, 2019)
- 6. Regulatory – incorporate conservation strategy in conservation measures, mitigation, mitigation banking, safe harbor agreements. Priority Level 2. (USFWS, 2019).
- 7. Incentives – Partners for Fish and Wildlife, Legacy Landowners Program, Working Lands for Wildlife Program. Priority Level 3. (USFWS, 2019)
- 8. Outreach – promote large connected landscapes, facilitate scrub working groups, educate public and increase public support for prescribed fire applications, engage partners and stakeholders in strategic conservation. Priority Level 3. (USFWS, 2019).

Conservation Measures and Best Management Practices:

- Encourage the State of Florida to revise regulations to establish protection of scrubjay habitat.
- Encourage the State of Florida to develop a scrub-jay management plan.
- Evaluate whether public land management actions in areas where jays exist are achieving stated land management plan objectives and goals beneficial to scrubjays.
- Revise metapopulation viability analysis for the Florida scrub-jay.
- Current scrub-jay distribution and abundance data are needed for the development of a revised metapopulation viability analysis.
- Update the Florida scrub-jay recovery plan to include measurable recovery criteria that are related to reducing and/or eliminating threats.
- Monitoring and research are needed to distinguish among conservation alternatives, and science and management need to be better integrated.
- Provide technical and financial assistance to land managers to ensure scrub-jay habitat is effectively managed on public lands.
- Use Safe Harbor Agreements, Partners for Fish and Wildlife grants, and U.S. Department of Agriculture's Farm Bill programs such as the Wildlife Habitat Incentives, Environmental Quality Incentives, and Farm and Ranchland Protection Programs to encourage private landowners to protect and/or manage scrub-jay habitat.

- Encourage the development of scrub-jay conservation banks on large, privately owned and managed tracts of land with high quality scrub habitat.

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SPECIES ACCOUNT: *Brachyramphus marmoratus* (Marbled murrelet)

Species Taxonomic and Listing Information

Listing Status: Threatened; October 1, 1992 (57 FR 45328).

Physical Description

Marbled murrelets (Brachyramphus marmoratus) are a chunky robin-sized seabird with a black bill, black tail, and notably short neck. Male and female marbled murrelets have identical plumage, but breeding and wintering plumages are distinct. During the breeding season, it has dark brown to blackish upper parts and a white belly and throat that are greatly mottled. In winter, plumage is white below, with white scapular streak on otherwise dark upper parts. During the winter, the upper parts become grey to brownish grey, dark marks form on the sides of the breast, and a white ring develops around the eye. Juveniles resemble winter adults, but with dusky mottling on the underparts; if observed carefully, they can be distinguished for some time after fledging from winter adults (NatureServe 2015; USFWS 1997).

Taxonomy

Marbled murrelets are endemic to western coast of North America (specifically, California, Oregon, Washington, Alaska, and British Columbia) and are placed in the Family Alcidae, in Order Charadriiformes. The family Alcidae is characterized as wing-propelled diving birds, because they use their wings to swim underwater. The six species of murrelets are divided into two subgroups: Synthliboramphus and Brachyramphus. The murrelets in the genus Brachyramphus can be distinguished by morphology and genealogy (USFWS 1997). The marbled murrelet resembles the Kittiltz's murrelet (Brachyramphus brevirostris), but can be differentiated because summer plumage lacks buff speckling on the upper parts and lacks white-tipped secondaries and white outer tails feathers. The marbled murrelet is morphologically distinct because it has a larger bill size and a pronounced breast band (NatureServe 2015). Juveniles differ from juvenile Kittlitz's murrelet in having a longer bill and darker face, and by lacking pale outer tail feathers (NatureServe 2015). The marbled murrelet was first described in 1789 by Gmelin as Colymbus marmoratus; in 1837, Brandt placed it under the genus Brachyramphus. Two subspecies of the marbled murrelet were recognized: the North American murrelet (Brachyramphus marmoratus marmoratus) and the Asiatic murrelet (Brachyramphus marmoratus perdix). However, since 1997, the long-billed murrelet (=Asiatic murrelet) (B. perdix) and the marbled murrelet (B. marmoratus) have been recognized as distinct species. Long-billed, or Asiatic murrelets, have been recorded as accidentals at various locations in North America (USFWS 1997).

Historical Range

The breeding range of the marbled murrelet extends along the coast of North America—from Bristol Bay, Alaska, to Monterey Bay, California. Wintering birds occur in small groups in southern California and can be found throughout the breeding range. Most murrelets nest in forested areas throughout their range. Marbled murrelets are found on land and at sea in portions of six geographic zones, especially during the breeding season, but also throughout the winter. Older coastal forests, historically used by murrelets, have been loss to deforestation. Due to this significant loss of habitat, current murrelets are no longer found continuously throughout forested portions of California, Oregon, and Washington (USFWS 1997).

Current Range

Within their current range, marbled murrelets are found on land and at sea in portions of six geographic zones, especially during the breeding season, but to some extent throughout the winter as well. These geographic zones (Puget Sound, Western Washington Coast Range, Oregon Coast Range, Siskiyou Coast Range, Mendocino, and Santa Cruz Mountains) are generally in the vicinity of large tracts of older forests in proximity to the coast. Areas that were historically used by marbled murrelets, but no longer support these birds, are at (or near) the former sites of coastal older forests. Currently, breeding populations are not distributed continuously throughout the forested portions of the Washington, Oregon, and California (USFWS 1997), and marbled murrelet occupy less than 200,000 to 2,500,000 square kilometers (km2) (about 80,000 to 1,000,000 square miles [sq. mi.]) (NatureServe 2015).

Distinct Population Segments Defined

Yes: Washington, Oregon, and California Distinct Population Segment (USFWS 2009).

Critical Habitat Designated

Yes; 5/24/1996.

Legal Description

On August 4, 2016, the U.S. Fish and Wildlife Service (Service) determined critical habitat for the marbled murrelet (Brachyramphus marmoratus), as designated in 1996 and revised in 2011, meets the statutory definition of critical habitat under the Endangered Species Act of 1973, as amended (Act). The current designation includes approximately 3,698,100 acres (1,497,000 hectares) of critical habitat in the States of Washington, Oregon, and California.

Critical Habitat Designation

All 101 subunits designated as critical habitat in 1996, as revised in 2011, are within the geographical range occupied by the species at the time of listing, and all 101 subunits contain the physical or biological features and PCEs essential to the conservation of the species.

Unit OR–07–d: Curry and Josephine Counties, Oregon. From United States Fish and Wildlife Service 1:100,000 map; Gold Beach and Grants Pass, Oregon; 1995. Critical habitat includes only Federal lands designated as Late Successional Reserves described within the following areas: T.38S., R.11W. Willamette Meridian: S 1/2 SE 1/4, NE 1/4 SE 1/4, SE 1/4 NE 1/4 Section 31. T.39S., R.11W. Willamette Meridian: SW 1/4, SW 1/4 SE 1/4 Section 4; S 1/2, 1/2 NW 1/4 Section 5; E 1/2, E 1/2 W 1/2 Section 6; Section 7 except NW 1/4 NW 1/4; Section 8 except SW 1/4 SW 1/4; Section 9; W 1/2 W 1/2, E 1/2 SW 1/4 Section 10; NW 1/4, SW 1/4 SW 1/4 Section 15; Section 16 except NW 1/4 SW 1/4, SW 1/4 NW 1/4; N 1/2 NE 1/4, SE 1/4 SW 1/4, S 1/2 SE 1/4 Section 17; Section 18 except N 1/2 NE 1/4; Sections 19–20; Section 21 except SE 1/4 SE 1/4; W 1/2 NW 1/4 Section 22; NW 1/4 NW 1/4, W 1/2 SW 1/4, SE 1/4 SW 1/4, SW 1/4 SE 1/4 Section 29; Sections 30–32; SW 1/4, S 1/2 NW 1/4, W 1/2 SE 1/4 Section 33. T.39S., R.12W. Willamette Meridian: S 1/2 S 1/2 Section 1; S 1/2 S 1/2, N 1/2 SE 1/4 Section 2; S 1/2 Section 3; Section 10 except SE 1/4 SE 1/4; Section 11 except S 1/2 SW 1/4; Section 12; Section 13 except SW 1/4, SW 1/4 NW 1/4; NE 1/4 NE 1/4 Section 14; W 1/2, W 1/2 E 1/2, E 1/2 SE 1/4 Section 19; S 1/2, E 1/2 NE 1/4 Section 20; Section 21; S 1/2 S 1/2, NW 1/4 SW 1/4, W 1/2 NW 1/4, NE 1/4 SE 1/4 Section 22; S 1/2, S 1/2 N 1/2 Section 23; Sections 24–36. T.39S., R.13W. Willamette Meridian: Section 33. T.40S., R.10W. Willamette Meridian: SE 1/4, S 1/2 SW 1/4, E 1/2 NE 1/4 Section 2; S 1/2 SW 1/4 Section 3; SE 1/4 SE 1/4 Section 4; SE 1/4, S 1/2 NE 1/4 Section 8; Section 9 except N 1/2 NW

1/4; Section 10; Section 11 except E 1/2 NW 1/4, NE 1/4 SE 1/4, S 1/2 SE 1/4; NW 1/4 NW 1/4 Section 14; Section 15 except SE 1/4 SE 1/4; Section 16; Section 17 except N 1/2 NW 1/4, SW 1/4 NW 1/4; Section 19 except NW 1/4, NW 1/4 SW 1/4, NW 1/4 NE 1/4; Section 20; Section 21 except SE 1/4 SE 1/4; N 1/2 NW 1/4, SW 1/4 NW 1/4 Section 22; N 1/2 NW 1/4, SW 1/4 NW 1/4 Section 28; Section 29; Sections 30–31; Section 32 except SE 1/4 SE 1/4. T.40S., R.11W. Willamette Meridian: N 1/2 NW 1/4, SW 1/4 NW 1/4, NW 1/4 NE 1/4 Section 4; Sections 5–8; W 1/2 NW 1/4, S 1/2 SE 1/4, SW 1/4 Section 9; Section 16 except E 1/2 E 1/2; Sections 17–21; E 1/2 SE 1/4, SW 1/4 SE 1/4 Section 25; Section 27 except E 1/2, NE 1/4 NW 1/4; Sections 28–33; W 1/2 Section 34; SE 1/4 SE 1/4, SE 1/4 NE 1/4 Section 35; Section 36. T.40S., R.12W. Willamette Meridian: Sections 1–30; Section 31 except W 1/2 SW 1/4, SW 1/4 NW 1/4; Sections 32–36. T.40S., R.13W. Willamette Meridian: Section 4 except SE 1/4 SE 1/4; W 1/2, NW 1/4 NE 1/4, S 1/2 SE 1/4, NE 1/4 SE 1/4 Section 9; W 1/2, NE 1/4 Section 10; SE 1/4 SW 1/4 Section 12; N 1/2 NW 1/4 Section 13. T.41S., R.10W. Willamette Meridian: Section 5 except E 1/2 E 1/2; Sections 6– 7; Section 8 except E 1/2 E 1/2; Section 17 except E 1/2 E 1/2; Section 18. T.41S., R.11W. Willamette Meridian: Section 1; Section 2 except NW 1/4 NE 1/4, NE 1/4 NW 1/4; Sections 3–15; Sections 17–18. T.41S., R.12W. Willamette Meridian: Sections 1–4; Section 5 except W 1/2, SW 1/4 SE 1/4; Section 7 except NW 1/4, W 1/2 SW 1/4, NW 1/4 NE 1/4; W 1/2, S 1/2 SE 1/4 Section 8; Section 9 except S 1/2 S 1/2, NW 1/4 SW 1/4; Section 10; Section 11 except SE 1/4 SW 1/4, W 1/2 SW 1/4; Sections 12–13; Section 14 except NE 1/4 NW 1/4, NW 1/4 NE 1/4; Section 15; Section 17; Section 18 except W 1/2 W 1/2.

Unit OR–07–f: Curry and Josephine Counties, Oregon. From United States Fish and Wildlife Service 1:100,000 map; Port Orford, Canyonville, Gold Beach and Grants Pass, Oregon; 1995. Critical habitat includes only Federal lands designated as Late Successional Reserves described within the following areas: T.32S., R.09W. Willamette Meridian: Section 34. T.32S., R.10W. Willamette Meridian: Section 25; E 1/2, NE 1/4 NW 1/4, SE 1/4 SW 1/4 Section 26; Section 35 except W 1/2 NW 1/4; Section 36 except SE 1/4 SW 1/4, SW 1/4 SE 1/4. T.33S., R.09W. Willamette Meridian: NW 1/4 SW 1/4 Section 2; Sections 3–4; Section 5 except SE 1/4 NW 1/4, E 1/2 SW 1/4; Section 6 except SE 1/4; Section 7 except E 1/2 NW 1/4, W 1/2 NE 1/4; Section 8 except NE 1/4 NW 1/4; Section 9 except S 1/2 SE 1/4; NW 1/4 NE 1/4, N 1/2 NW 1/4, SW 1/4 NW 1/4 Section 10; NW 1/4, N 1/2 NE 1/4, SW 1/4 NE 1/4, N 1/2 SW 1/4 Section 17; Section 18; NW 1/4 NE 1/4, N 1/2 NW 1/4, SW 1/4 NW 1/4 Section 19. T.33S., R.10W. Willamette Meridian: Section 1 except NE 1/4, N 1/2 SW 1/4, S 1/2 NW 1/4; Section 2 except NE 1/4 SE 1/4; Section 3 except NW 1/4, N 1/2 NE 1/4, SW 1/4 SW 1/4, N 1/2 SW 1/4; Section 9 except W 1/2, N 1/2 NE 1/4, SW 1/4 SE 1/4; Section 10; Section 11 except NE 1/4 NW 1/4; Section 12 except NW 1/4, SE 1/4 NE 1/4; Sections 13–14; Section 15 except W 1/2 SW 1/4; Section 21 except W 1/2; Sections 22–23; Section 24 except S 1/2 SE 1/4, SE 1/4 SW 1/4; Section 26 except SE 1/4, E 1/2 NE 1/4, SE 1/4 SW 1/4; Section 27; Section 28 except N 1/2 NW 1/4; Section 29 except NW 1/4 SW 1/4; SE 1/4 SE 1/4 Section 30; Section 31 except W 1/2, W 1/2 SE 1/4; Sections 32–33; Section 34 except SE 1/4, SE 1/4 NE 1/4, SE 1/4 SW 1/4. T.34S., R.10W. Willamette Meridian: NW 1/4, NW 1/4 NE 1/4, NW 1/4 SW 1/4 Section 4; Section 5; Section 6 except NW 1/4 NE 1/4, N 1/2 NW 1/4, SW 1/4 NW 1/4; Section 7; NW 1/4, NW 1/4 NE 1/4, NW 1/4 SW 1/4 Section 8; N 1/2 NW 1/4, NW 1/4 NE 1/4, SW 1/4 NW 1/4 Section 18. T.34S., R.10 1/2 W. Willamette Meridian: S 1/2 Section 7; Section 18 except NW 1/4 NW 1/4; Section 19; N 1/2 NW 1/4, W 1/2 SW 1/4 Section 30; W 1/2 NW 1/4, SW 1/4 Section 31. T.34S., R.11W. Willamette Meridian: E 1/2 SE 1/4, SE 1/4 NE 1/4 Section 11; Section 12 except E 1/4; Section 13 except NE 1/4; E 1/2 E 1/2, SW 1/4 SW 1/4 Section 14; SE 1/4 SE 1/4 Section 15; Section 21 except N 1/2, E 1/2 SE 1/4, NW 1/4 SW 1/4; Section 22 except NW 1/4, W 1/2 NE 1/4, NW 1/4 SE 1/4, N 1/2 SW 1/4, SW 1/4 SW 1/4; Section 23 except NE 1/4 NW

1/4, NW 1/4 NE 1/4; Sections 24–28; S 1/2 NE 1/4, SE 1/4 Section 31; Section 32 except N 1/2 NW 1/4; Sections 33–36. T.35S., R.10 1/2 W. Willamette Meridian: Section 6 except E 1/2 E 1/2; Section 7 except E 1/2 E 1/2, W 1/2 SE 1/4, NE 1/4 SW 1/4; Section 18 except E 1/2, E 1/2 SW 1/4; NW 1/4, W 1/2 SW 1/4, NW 1/4 NE 1/4 Section 19; W 1/2 SW 1/4 Section 30. T.35S., R.11W. Willamette Meridian: Sections 1–4; Section 5 except SW 1/4 SW 1/4; E 1/2 NE 1/4 Section 6; E 1/2 E 1/2 Section 7; Sections 8–15; Section 17; E 1/2 NE 1/4, NW 1/4 NE 1/4 Section 18; Section 20 except SW 1/4 NW 1/4, W 1/2 SW 1/4; Section 21 except SW 1/4 NE 1/4; Sections 22–28; NE 1/4 NW 1/4, E 1/2 E 1/2 Section 29; Section 33 except W 1/2 SW 1/4; Section 34–36. T.36S., R.11W. Willamette Meridian: NW 1/4, NW 1/4 NE 1/4, N 1/2 SW 1/4, SW 1/4 SW 1/4 Section 2; Section 3; N 1/2 N 1/2, SE 1/4 NE 1/4, E 1/2 SE 1/4 Section 4; NE 1/4 NW 1/4, N 1/2 NE 1/4 Section 5; E 1/2 E 1/2 Section 9; Section 10 except S 1/2 SE 1/4, NE 1/4 SE 1/4; NW 1/4 NW 1/4 Section 11; NW 1/4 NW 1/4 Section 15; E 1/2 NE 1/4 Section 16.

Unit CA–01–d: Siskiyou County, California. From United States Fish and Wildlife Service 1:100,000 map; Happy Camp California; 1995. Critical habitat includes only Federal lands designated as Late Successional Reserves described within the following areas: T.18N., R.04E. Humboldt Meridian: SE 1/4 SW 1/4, SW 1/4 SE 1/4 Section 33; E 1/2 SE 1/4 Section 35; SW 1/4, SW 1/4 SE 1/4, S 1/2 NW 1/4 Section 36. T.18N., R. 05E. Humboldt Meridian: S 1/2 SW 1/4 Section 31. T.17N., R.03E. Humboldt Meridian: NE 1/4, E 1/2 SE 1/4 Section 24; E 1/2 NE 1/4, SE 1/4, Section 25; N 1/2, E 1/2 SE 1/4 Section 36. T.17N., R.04E. Humboldt Meridian: Section 1 except SW 1/4, SW 1/4 NW 1/4; Section 2 except NE 1/4 NE 1/4, N 1/2 NW 1/4, E 1/2 SE 1/4; Section 3 except N 1/2 N 1/2; Section 4; SE 1/4 NE 1/4, SE 1/4 Section 5; Section 8 except NW 1/4; Sections 9–10; NE 1/4, NW 1/4, NW 1/4 SW 1/4 Section 11; NE 1/4 Section 12; Sections 16–17; W 1/2, W 1/2 E 1/2 Section 20; SE 1/4, NE 1/4 SW 1/4 Section 21; S 1/2, S 1/2 N 1/2 Section 22; S 1/2, S 1/2 N 1/2 Section 23; W 1/2 SW 1/4 Section 24; W 1/2 NW 1/4, NW 1/4 SW 1/4 Section 25; Section 26; Section 27 except SW 1/4; NE 1/4, SW 1/4, SW 1/4 SE 1/4 Section 28; Section 29 except E 1/2 NE 1/4; SW 1/4, W 1/2 SE 1/4 Section 32; Section 33; N 1/2 NE 1/4, SW 1/4, SE 1/4 Section 34; N 1/2, N 1/2 SE 1/4, SW 1/4 SW 1/4 Section 35. T.17N., R.05E. Humboldt Meridian: W 1/2 except NE 1/4 NE 1/4 Section 4; Section 5; Section 6 except NE 1/4 NE 1/4; Sections 7–8; W 1/2 NW 1/4 Section 9. T.16N., R.03E. Humboldt Meridian: S 1/2 SW 1/4, SE 1/4, NE 1/4 SW 1/4 Section 1; E 1/2 E 1/2 Section 11; Section 12; Section 13 except W 1/2 SW 1/4, SW 1/4 NW 1/4; NE 1/4, E 1/2 NW 1/4, E 1/2 SE 1/4 Section 24; SE 1/4, SE 1/4 NE 1/4 Section 25; Section 36 except SW 1/4, NW 1/4 NW 1/4, W 1/2 SE 1/4. T.16N., R.04E. Humboldt Meridian: S 1/2 SW 1/4, W 1/2 SE 1/4 Section 1; Section 2 except NE 1/4; Sections 3–4; Section 5 except N 1/2 NW 1/4; Section 8; W 1/2 W 1/2, NE 1/4 NE 1/4 Section 9; Section 10 except W 1/2 SW 1/4; Section 11 except SE 1/4, S 1/2 SW 1/4; S 1/2 Section 12; E 1/2 E 1/2 Section 17; E 1/2 E 1/2 Section 20; Section 29 except SE 1/4, E 1/2 NE 1/4; W 1/2 Section 32. T.15N., R.03E. Humboldt Meridian: E 1/2 E 1/2 Section 1; E 1/2, SE 1/4 Section 12. T.15N., R.04E. Humboldt Meridian: W 1/2 Section 6; W 1/2 NW 1/4 Section 7.

Unit CA–01–e: Del Norte County, California. From United States Fish and Wildlife Service 1:100,000 map; Grants Pass, Oregon; Happy Camp, California; 1995. Critical habitat includes only Federal lands designated as Late Successional Reserves described within the following areas: T.18N., R.03E. Humboldt Meridian: W 1/4 Section 1; SE 1/4, E 1/2 NE 1/4, NE 1/4 NE 1/4, SE 1/4 SW 1/4 Section 2; SE 1/4 SE 1/4 Section 10; Section 11 except NW 1/4 NW 1/4; W 1/2 NW 1/4; NW 1/4 SW 1/4 Section 12; W 1/2 NW 1/4 Section 14; E 1/2, E 1/2 SW 1/4 Section 15; W 1/2, NW 1/4 SE 1/4, N 1/2 NE 1/4, SW 1/4 NE 1/4 Section 22; W 1/2 Section 27; SE 1/4, S 1/2 NE 1/4, NE 1/4 NE 1/4, E 1/2 SW 1/4 Section 28; E 1/2 SE 1/4, SE 1/4 NE 1/4 Section 32; Section 33; W 1/2

Section 34. T.17N., R.03E. Humboldt Meridian: NW 1/4, NW 1/4 SW 1/4 Section 3; Section 4 except S 1/2 S 1/2, NW 1/4 SW 1/4; NE 1/4 NE 1/4 Section 5.

Unit CA–11–b: Humboldt County, California. From United States Fish and Wildlife Service 1:100,000 map; Hayfork, California; 1995. Critical habitat includes only Federal lands designated as Late Successional Reserves described within the following areas: T.03N., R.02E. Humboldt Meridian: SE 1/4 NE 1/4, SW 1/4 NW 1/4, N 1/2 N 1/2 Section 1; NE 1/4, E 1/2 NW 1/4, N 1/2 SE 1/4 Section 2. T.03N., R.03E. Humboldt Meridian: N 1/2 NE 1/4, SE 1/4 NW 1/4, NE 1/4 SW 1/4, W 1/2 SE 1/4, Section 6. T.03N., R.04E. Humboldt Meridian: W 1/2 NE 1/4, NW 1/4 Section 1; Section 2 except SE 1/4 SE 1/4; E 1/2 NE 1/4, SE 1/4 SW 1/4, SE 1/4 Section 3; W 1/2 NE 1/4, NW 1/4 Section 5; E 1/2 NE 1/4 Section 6. T.03N., R.05E. Humboldt Meridian: NE 1/4, N 1/2 SE 1/4 Section 6; SW 1/4 NW 1/4, N 1/2 SW 1/4, SW 1/4 SW 1/4 Section 7; NW 1/4 NW 1/4 Section 18. T.04N., R.02E. Humboldt Meridian: S 1/2 SE 1/4 Section 25. T.04N., R.03E. Humboldt Meridian: S 1/2 NW 1/4, NW 1/4 SE 1/4, SE 1/4 SE 1/4 Section 31. T.04N., R.04E. Humboldt Meridian: NE 1/4 Section 1; E 1/2 E 1/2 Section 12; S 1/2 Section 25; SE 1/4 NW 1/4, NW 1/4 SW 1/4, SE 1/4 Section 26; S 1/2 NE 1/4, NW 1/4, N 1/2 SE 1/4 Section 27; N 1/2, S 1/2 S 1/2, NE 1/4 SW 1/4, NE 1/4 SE 1/4 Section 28; SW 1/4 NW 1/4 Section 29; S 1/2 NE 1/4, SW 1/4, W 1/2 SE 1/4 Section 30; W 1/2 NE 1/4, NW 1/4, N 1/2 SE 1/4, NW 1/4 SW 1/4 Section 31; SE 1/4 NW 1/4, SW 1/4 Section 32; N 1/2 N 1/2, SE 1/4 NE 1/4, SE 1/4 NW 1/4, NE 1/4 SE 1/4 Section 33; Section 34 except N 1/2 NE 1/4, S 1/2 SW 1/4; Section 35 except N 1/2 N 1/2. T.04N., R.05E. Humboldt Meridian: NW 1/4, W 1/2 SW 1/4, NE 1/4 SW 1/4, Section 3; Sections 4–7; S 1/2 S 1/2 Section 8; Section 9; W 1/2 NW 1/4, NW 1/4 SW 1/4, Section 10; NE 1/4 NW 1/4, NW 1/4 NE 1/4 Section 16; NW 1/4 SW 1/4 Section 17; N 1/2, N 1/2 SE 1/4 Section 18; Section 19 except W 1/2 W 1/2; Section 20; NE 1/4 NW 1/4, SW 1/4 Section 21; NW 1/4 NW 1/4 Section 28; Section 29 except S 1/2 NE 1/4, N 1/2 SE 1/4, SE 1/4 SE 1/4; Section 30; Section 31 except SW 1/4 SW 1/4; NW 1/4, W 1/2 SW 1/4 Section 32. T.05N., R.04E. Humboldt Meridian: Sections 1–3; E 1/2 NE 1/4 Section 4; NE 1/4, N 1/2 NW 1/4, E 1/2 E 1/2 Section 10; Sections 11–13; Section 14 except SW 1/4, SW 1/4 NW 1/4; Section 23 except W 1/2 SW 1/4, W 1/2 SE 1/4; Section 24; N 1/2 NW 1/4, S 1/2 SE 1/4 Section 25; E 1/2 NW 1/4 Section 26. T.05N., R.05E. Humboldt Meridian: Section 4 except E 1/2; Sections 5–8; Section 9 except E 1/2; Section 16 except E 1/2 E 1/2; Sections 17–20; Section 21 except E 1/2 NE 1/4; W 1/2 SW 1/4 Section 22; Section 27, except NE 1/4 NE 1/4, E 1/2 SE 1/4; Sections 28–33; Section 34 except E 1/4. T.06N., R.04E. Humboldt Meridian: Sections 13–15; Sections 21–27; Section 28 except SW 1/4 NW 1/4, NW 1/4 SW 1/4; Section 33 except W 1/2 NW 1/4, SW 1/4; Sections 34–35. T.06N., R.05E. Humboldt Meridian: W 1/2, W 1/2 SE 1/4 Section 18; Section 19 except E 1/2 NE 1/4; SW 1/4 SW 1/4 Section 29; Sections 30– 31; Section 32 except NE 1/4, NE 1/4 SE 1/4, NE 1/4 NW 1/4.

Primary Constituent Elements/Physical or Biological Features

As described in the designation of critical habitat for the marbled murrelet (61 FR 26256; May 24, 1996), and further supported by more recent information (81 FR 51348 - 51370), the following PCEs are specific to the marbled murrelet:

(1) Individual trees with potential nesting platforms, and

(2) forested areas within 0.5 mile (0.8 kilometer) of individual trees with potential nesting platforms, and with a canopy height of at least one-half the site-potential tree height. This includes all such forest, regardless of contiguity.

Special Management Considerations or Protections

Areas that provide the essential physical or biological features and PCEs for the marbled murrelet may require special management considerations or protection. Because succession has been set back or fragmentation has occurred due to either natural or anthropogenic disturbance, those essential features may require special management considerations or protections to promote the development of the large, contiguous blocks of unfragmented, undisturbed coniferous forest with old-growth characteristics (i.e., nest platforms) required by marbled murrelets. Areas with these characteristics provide the marbled murrelet with suitable nesting habitat, and reduce edge effects, such as increased predation, resulting in greater nest success for the species. Areas that currently provide suitable nesting habitat for the marbled murrelet may require protection to preserve those essential characteristics, as the development of old-growth characteristics may take hundreds of years and thus cannot be easily replaced once lost.

Activities that may affect critical habitat, when carried out, funded, or authorized by a Federal agency, should result in consultation for the marbled murrelet. These activities include, but are not limited to: (1) Forest management activities that greatly reduce stand canopy closure, appreciably alter the stand structure or reduce the availability of nesting sites; (2) land disturbance activities such as mining, sand and gravel extraction, construction of hydroelectric facilities and road building; and (3) harvest of certain types of commercial forest products (e.g. moss).

These activities may have the following effects on marbled murrelet critical habitat: (1) Removal or degradation of individual trees with potential nesting platforms, or the nest platforms themselves, that results in a significant decrease in the value of the trees for future nesting use. Moss may be an important component of nesting platforms in some areas. (2) Removal or degradation of trees adjacent to trees with potential nesting platforms that provide habitat elements essential to the suitability of the potential nest tree or platform, such as trees providing cover from weather or predators. (3) Removal or degradation of forested areas with a canopy height of at least one-half the site-potential tree height and, regardless of contiguity, within 0.8 km (0.5 mi) of individual trees containing potential nest platforms. This includes removal or degradation of trees currently unsuitable for nesting that contribute to the structure/integrity of the potential nest area (i.e., trees that contribute to the canopy of the forested area). These trees provide the canopy, stand conditions, and protection from predators important for marbled murrelet nesting.

Life History

Feeding Narrative

Adult: Marbled murrelets have an invertivorous and piscivorous diet. They are opportunistic foragers, dieting primarily on fishes such as sandlance (Ammodytidae sp.), capelin (Mallotus villosus), herring (Clupea sp.), crustaceans, mysids (Mysida spp.), euphausiids (Euphausiacea sp.), and mollusks (Mollusca). In British Columbia, adult diet during the breeding season is mostly fishes, primarily Pacific sandlance and Pacific herring (Clupea pallasii); euphausiids are important in spring at Langara Island; sandlance are the prey most frequently fed to nestlings (NatureServe 2015).Marbled murrelets feed on a variety of small fish and invertebrates; however, very little information is available on food habits of marbled murrelets in Washington, Oregon, or California, and systematic stomach content analyses have never been conducted in the tristate area (USFWS 1997). Murrelet diets appear to reflect what is most abundant and/or of the highest quality of prey available at the time (USFWS 2009).Modern marbled murrelet populations (1998 to 2002) eat at a lower trophic level than historic marbled murrelet populations (1895 to 1911). Change in available prey is linked to fishing pressures, suggesting that cooler ocean temperatures support increased availability of krill and juvenile rockfish, and that this improves successful reproduction (USFWS 2009). Foraging occurs mainly in waters up to 80 meters (m) (262 feet [ft.]) deep and up to 2 kilometers (km) (1.2 miles [mi.]) from shore. Foraging dives may be up to about 30 m (98 ft.) below surface (NatureServe 2015). Age-1 herring are the optimum prey resource for raising murrelet chicks in Alaska, because a herring weighing about 23 g delivers about 1.37 kilojoules per fish. If chicks are fed smaller herring or other fish species, more of those fish need to be delivered per day to get a similar energy delivery, putting adult murrelets at greater risk for predation (USFWS 2009).

Reproduction Narrative

Adult: Marbled murrelet breeding occurs between mid-March and August in California. Murrelet nests have been located in mature/old growth coniferous forest near the coast, with dense protective cover and large mossy horizontal branches (e.g., Douglas fir [Pseudotsuga menziesii] and mountain hemlock [Tsuga mertensiana]). Nesting occurs at a variety of elevations from sea level to 1,530 m (5,020 ft.); however, most nests have been found below 1,067 m (3,500 ft.) (NatureServe 2015; USFWS 2009). Nesting may be semi-colonial (NatureServe 2015). They generally lay a single egg on a horizontal limb of an old-growth conifer tree (USFWS 2016a). During the 30-day incubation, breeding adults alternate incubation duties in 24-hour shifts. Marbled murrelet chicks are helpless at hatching and rely completely on parental care. The adults feed the chick up to eight times daily (averaging four times a day), and is usually fed only one fish at a time. Flights by adults are made from ocean feeding areas to inland nest sites at all times of the day, but most often at dusk and dawn (USFWS 1997). Activity in forest nesting areas is highest from mid-April through late July in California and Oregon, early May through early August in Washington, and mid-May through early August in Alaska (NatureServe 2015). The young fledge from the nest about 28 days after hatching, and appear to fly directly to the sea. Murrelets have a naturally low reproductive rate because they lay one egg per nest, and not all adults nest successfully (USFWS 2016a). Breeding success is a function of nest predation, timing, foraging conditions, prey availability, and adult survival during the breeding season. The marbled murrelet's relatively long life span (15 years) and low annual reproductive effort allow them to survive and reproduce successfully despite periodic adverse prey conditions (USFWS 1997).A lack of high-quality forage at the appropriate time of year may explain the low nest initiation rates and nesting success. Low juvenile ratios indicate poor reproductive success that could be due to high nest failure rates from predation—or to a low proportion of adults attempting to breed, most likely due to the inability to find suitable, old-growth nest sites (USFWS 2009). The historic decline of murrelet reproduction is likely caused by a shift to a reduced trophic level of available prey. Change in available prey is linked to fishing pressures (USFWS 2009).

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Feeding: broad/generalist. Breeding: narrow/specialist.

Tolerance Ranges/Thresholds

Adult: High; requires high-quality old-growth forests, and thriving marine communities.

Site Fidelity

Adult: High

Habitat Narrative

Adult: Marbled murrelets feed in coastal marine waters within 1 to 2 km (0.6 to 1.2 mi.) of shore. It is not uncommon to observe a murrelet up to 5 km (3.1 mi.) offshore. Occasionally, they have been observed on rivers and lakes, usually within 20 km (12.4 mi.) of ocean (especially during breeding season) (NatureServe 2015; USFWS 1997).Although marbled murrelets feed primarily on fish and invertebrates in nearshore marine waters, they fly inland to nest on large limbs of mature conifers. The marbled murrelet is the only alcid known to nest in trees. Throughout the forested portion of the species' range, marbled murrelets have been known to use forest stands with old-growth trees, generally within 80 km (50 mi.) of the coast. Nest stands are composed of low-elevation conifers, including Douglas fir (Pseudotsuga menziesii), western red cedar (Thuja plicata), Sitka spruce (Picea sitchensis), western hemlock (Tsuga heterophylla), and coastal redwood (Sequoia sempervirens) (USFWS 1997).The current estimate of marbled murrelet suitable habitat within the species range is 890,308 ha (2.2 million ac.). This is likely an overestimate of suitable habitat due to the rapid deforestation along coastal habitat, and the use of northern spotted owl (Strix occidentalis caurina) habitat definitions as a surrogate for murrelet habitat in some administrative units. Extrapolating from survey results, it is estimated that about 332,153 ha (820,768 ac.), or 34 percent of the estimated suitable habitat, is likely to be occupied by marbled murrelets (USFWS 2009).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory, but locally migrant (NatureServe 2015).

Dispersal

Adult: Low

Immigration/Emigration

Adult: Immigrates and emigrates locally between habitats.

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: The marbled murrelet does not migrate, but instead makes local migrations between breeding and foraging territories. The seasonal movements of marbled murrelets are poorly known, and little information is available from studies in the continental United States (USFWS 2009).Daily flights to incubate an egg or feed young were assumed to limit the distance murrelets can travel away from nesting habitat (USFWS 2009). In California, the home range size during breeding season is variable. In California, the mean home range size was 655 km2 (253 sq. mi.) for non-nesters and 240 km2 (93 sq. mi.) for nesters. Mean shore movement was 69 km (43 mi.) for nesting females and 78 km (48 mi.) for nesting males. Mean offshore was within 1.4 km (0.9 mi.) regardless of sex or nesting status. In Washington, home range size during breeding season was more variable, with the average home range size in 2005 (2,098 km2 [810 sq. mi.]) being five times larger than the home range size in 2004 (469 km2 [181 sq. mi.]). This annual variation is likely a response to poor oceanographic conditions (USFWS 2009).

Additional Life History Information

Adult: The home range size during breeding season is variable; the average home range during breeding season in 2005 was 2,098 km2 (810 sq. mi.), compared to 469 km2 (181 sq. mi.) in 2004 (USFWS 2009).

Population Information and Trends

Population Trends:

Declining; population has declined significantly since 2002 (USFWS 2009). In 2016, while there continue to be significant declines in the murrelet population in Washington State, there does not appear to be a trend (negative or positive) at the listed-range scale. This is a change from information reported in our 2009 5-year status review. (USFWS, 2019).

Species Trends:

Declining; despite the urgent need for an assessment of the demographic state of populations, the species is so secretive that reliable estimates of the required vital rates are rare (NatureServe 2015).

Resiliency:

Low

Representation:

Low

Redundancy:

Moderate

Population Growth Rate:

Declining: 2.4 to 4.3 percent for Conservation Zones 1 to 5 from 2000 to 2008; about 15 percent for Conservation Zone 6 between 2003 and 2008 (USFWS 2009; NatureServe 2015).

Number of Populations:

Three; murrelets appear to comprise three genetic units: (1) western and central Aleutian Islands; (2) eastern Aleutian Islands to northern California; and, (3) central California (USFWS 2009).

Population Size:

Total population size is about 388,000, with about 18,000 in Washington-Oregon-California, 54,000 to 92,000 in British Columbia, and around 271,000 in Alaska (NatureServe 2015). For 2016, the estimated population of murrelets in the 5-Conservation Zone area was 22,600 (95 percent confidence interval of 18,200 to 27,100; Pearson et al. 2018). Using distance sampling estimation techniques (same method as Conservation Zones 1 through 5), 2016 estimates of Conservation Zone 6 population is 657 birds (95 percent confidence interval: 406-1063) (Henry and Tyler 2017). See 2019 5-Year recovery plan for a map of conservation zones (USFWS, 2019)

Resistance to Disease:

Low

Adaptability:

Low

Additional Population-level Information:

Murrelet population numbers are lower in the United States (less than one-third of the Canadian population), productivity is lower, the loss of old-growth forests has been more severe, and the amount of remaining habitat is lower (USFWS 2009).

Population Narrative:

There are three genetically distinct population units of marbled murrelets: (1) western and central Aleutian Islands; (2) eastern Aleutian Islands to northern California; and (3) central California. The continental United States has a substantially smaller population of murrelets (approximately 18,000) than does Canada (approximately 66,000) (USFWS 2009). Conservation Zones for the marbled murrelet start with Zone 1 at the northern most tip of Washington and are divided into six nonuniform segments, ending with Zone 6 at Monterey Bay, California. At the Conservation Zone scale, murrelets at-sea density estimates from Conservation Zones 1 to 5 in 2008 ranged from 0.14 birds per km2 (0.05 birds per sq. mi.) in Conservation Zone 5 to 4.14 per km2 (1.6 sq. mi.) in Conservation Zone 4 (USFWS 2009).In 2000, the population of marbled murrelets was estimated to be 18,600 individuals. Between 2001 and 2005, populations monitored in the NWFP increased to an average of 21,780 individuals. By 2008, populations trends were used to evaluate declining trends. This evaluation concluded that the 2000 estimate was unusually low, considering pattern of estimates from subsequent years. The trend analysis for 2001 through 2008 provides an estimate of rate of decline without the inclusion of 2000 data. Based on the 9-year range of data, the estimated decline was 490 birds per year, or about 3,900 birds over the 9-year period (USFWS 2009).With declines documented separately for Conservation Zones 1 through 5 and Conservation Zone 6, the listed population has declined significantly since 2002. For Conservation Zones 1 through 5 combined, population estimates from monitoring for 2000 through 2008 indicate an annual rate of decline in the range of 2.4 to 4.3 percent. For Conservation Zone 6, new data indicate an annual decline of about 15 percent between 2003 and 2008. Based on the tri-state estimate of about 24,400 birds used in the analysis for the 2004 5-year review, the 2008 population estimate of about 18,000 birds represents a decline of about 26 percent across the listed range from that estimate (USFWS 2009).

Threats and Stressors

Stressor: Habitat loss and fragmentation
Exposure: Timber harvest, wildfire, insect outbreaks, landslides, and windthrow.
Response: Reduction in and degradation of nesting habitat.
Consequence: Population decline and reduced fitness.

Narrative: The principal factor affecting the marbled murrelet in the three-state area, and the main cause of population decline, has been the loss of older forests and associated nest sites. Due primarily to extensive timber cutting over the past 150 years, at least 82 percent of the old-growth forests existing in western Washington and Oregon prior to the 1840s have been harvested. In California, old-growth coastal redwood forests had been reduced by about 85 to 96 percent at the time of listing. The past harvest of old-growth forests in the Washington, Oregon, and California range of the murrelet has significantly contributed to a commensurate decline in the number of murrelets (USFWS 2004; USFWS 2009). Although the Northwest Forest Plan (NWFP) has reduced the rate of habitat loss due to timber harvest on federal lands, the threat of continued loss and degradation of suitable nesting habitat remains on federal and nonfederal lands through timber harvest and natural events such as wildfire, insect outbreaks, and windthrow. In addition, insects and disease can kill complete stands of habitat and can contribute to hazardous forest fire conditions (USFWS 2009). The murrelet's terrestrial and marine environments are not used independently and both environments need to be healthy for the continued existence of this species. Murrelets use the marine environment year-round and commute to terrestrial habitat for nesting. Terrestrial habitat is also visited outside of the nesting season. In Washington, a study found that murrelets are traveling a mean distance of 33.2 mi (53.5 ± 28.4 km) (range 10.4 to 90.2 mi (16.8 to 145.3 km)) between their nest and foraging areas (Lorenz et al. 2017, p. 314). The murrelets in this study did not forage in the marine waters closest to their nest, they commuted on average another 13.3 mi (21.4 km), with the longest one-way marine commute being 91 mi (133.1 km) by a murrelet nesting on Vancouver Island, Canada that foraged at times in the San Juan Islands, Washington (Lorenz et al. 2017, p. 314). In many cases, the nests associated with the murrelets making these long marine commutes failed (Lorenz et al. 2017, p. 314). (USFWS, 2019)

Stressor: Habitat degradation and marine environment
Exposure: Algal blooms, dead zones, and overfishing.
Response: Reduced prey availability and quality, and habitat degradation.
Consequence: Reduced fitness and fecundity, and mortality.
Narrative: Changes in the food web and prey availability can have profound effects on marbled murrelets; however, the effects are difficult to quantify. There are commercial and recreational fisheries for some prey species stocks, and the Pacific herring in Puget Sound are carrying high body loads of polychlorinated biphenyls. Prey quality has declined over the last decade, and murrelets are now feeding at lower trophic levels in central California and Puget Sound, and possibly throughout the tri-state area, but information is not currently available for the Washington and Oregon coast areas (USFWS 2009).Murrelets are exposed to harmful algal blooms and dead zones throughout the tri-state area, although the potential effects may be more pronounced in specific areas, such as the Oregon coast, Monterey Bay, and Puget Sound. These events result in significant mortality of fish and invertebrates; they may be contributing to low food availability during the murrelet breeding season, thereby contributing to low murrelet reproductive success. In addition to the impacts to prey resources, harmful algal blooms from certain algae species produce biotoxins that result in domoic acid poisoning or paralytic shellfish poisoning, causing murrelet mortality. Harmful algal blooms and dead zones may have been occurring all along and have just begun to be studied; however, scientists predict the scope and length of these events are likely to increase (USFWS 2009).

Stressor: Habitat loss and degradation
Exposure: Climate change.

Response: Exacerbate some existing threats associated with habitat loss and degradation.
Consequence:
Narrative: Though considerable uncertainty exists with respect to any regional-scale impacts of climate change due to the differences in trajectories of climate change scenarios, modeling results underscore the potentially large impacts on the Pacific Northwest and California ecosystems. Generally, adverse consequences to forest ecosystems are predicted to increase as a result of climate change, potentially negatively impacting habitat for many species, including the marbled murrelet.Climate change is likely to result in changes to the murrelet's marine environment. Limitations on our knowledge of murrelet prey, and of how global warming could affect those prey, constrain the ability to forecast effects. The predicted direction of change for most variables considered suggests that few changes are likely to benefit murrelets, with many more having the potential to be neutral or adversely affect murrelets. It appears most likely that the murrelet prey base will be adversely affected to some degree. Although seabirds such as the marbled murrelet have life-history strategies adapted to variable marine environments, ongoing and future climate change could present changes of a rapidity and scope outside the adaptive range of the species. The reduced distribution of nesting habitat also constrains the ability of the species to respond to shifts in prey conditions, because nesting birds are limited to foraging in waters relatively near their inland nest sites. Also, the limited evidence available indicates substantial nest site fidelity; it does not suggest that individual murrelets will abandon a nesting area that becomes unsuitable and move to a new, distant nest site.Climate change is likely to further exacerbate some existing threats, such as the projected potential for increased habitat loss from drought-related fire; mortality; insects and disease; and increases in extreme flooding, landslides, and windthrow events in the short term (10 to 30 years). However, although it appears likely that the marbled murrelet will be adversely affected, adequate information to quantify the magnitude of effects to the species from the climate change projections is not available (USFWS 2009). Climate change is also linked to decreased precipitation and increased wildfires affecting terrestrial habitat. Ocean acidification is increasing, affecting marine habitat. Since the 2009 5-year status review, more information has been published regarding ocean acidification. While the conclusions provided in our 2009 review remain the same, there is more information available to inform that conclusion. Acidification results when carbon dioxide in the air dissolves in surface water, and is the direct consequence of increasing carbon dioxide emissions (IPCC 2014, pp. 41, 49). Marine waters are projected to continue becoming more acidic, although if carbon emissions are stringently and immediately curtailed, this trend may reverse during the late 21st century (IPCC 2014, pp. 8-9, 49). Both the surface and upwelled waters of North Pacific Ocean have become more acidic due to carbon dioxide emissions (Feely et al. 2008, pp. 1,491-1,492; Murray et al. 2015, pp. 962-963), and this trend is expected to continue (Byrne et al. 2010, p. L02601; Feely et al. 2009, pp. 40-46). Linked to reductions in dissolved oxygen (Riche et al. 2014, p. 49), acidification has important biological consequences and also responds to biological activity. For example, local areas of eutrophication are likely to experience additional acidification beyond that caused directly or indirectly by carbon dioxide emissions (Newton et al. 2012, pp. 32-33). Changes in temperature, carbon dioxide, and nutrient levels are likely to affect primary productivity by phytoplankton, macroalgae, kelp, eelgrass, and other marine photosynthesizers (Mauger et al. 2015, p. 11-5). In general, warmer temperatures, higher carbon dioxide concentrations, and higher nutrient levels lead to greater productivity (Gao and Campbell 2014, pp. 451, 454; Newton and Van Voorhis 2002, p. 10; Roberts et al. 2014, pp. 11, 22, 108; Thom 1996, pp. 386-387), but these effects vary by species and other environmental conditions, such as sunlight levels or the ratios of different nutrients (Gao and Campbell 2014, pp. 451, 454; Krembs 2012, p. 109; Low-Decarie et al. 2011, p. 2,530). (USFWS, 2019)

Stressor: Overutilization for scientific purposes
Exposure: Issued Section 10(a)(1)(A) recovery permits, climbing nest trees, handling, and tagging.
Response: Take and harassment.
Consequence: Unlikely to affect populations; mortality.
Narrative: The U.S. Fish and Wildlife Service USFWS has issued Section 10(a)(1)(A) recovery permits to four individuals for scientific research on murrelets in Washington, Oregon, and California. Through 2008, these permits authorized the lethal take of one marbled murrelet; the number of murrelets authorized to be harassed per year ranged from 55 to greater than 145; and one permit authorized the harassment of murrelets associated with 11 trees per year. Recovery permits for future years (through 2013) have been issued to four individuals. All of the harassment authorized by these permits is for climbing nest trees or the capture/handling/tagging of marbled murrelets at sea. Although individual murrelets are affected by telemetry and tree-climbing projects, these disturbances are relatively small-scale, occur infrequently, and are unlikely to affect murrelet populations. The greatest impact to murrelet populations is the removal of adults.

Stressor: Predation
Exposure: Proximity to humans, abundance of avian predators, and proximity to forest edge.
Response: Nest predation and loss of adults.
Consequence: Nest failure, mortality/predation, and reduced fitness.
Narrative: Predation has two primary components: losses of adults or fledged juveniles, and nest predation (eggs or chicks). Adult/juvenile predation may occur at sea or inland. Nest failure rates due to predation are between 68 percent and 100 percent in real nests and between 81 percent and 86 percent in artificial nests. Corvids are the predator with the likely greatest impact on murrelets. The factors affecting rates of predation on murrelet nests (suspected to be the primary type of predation, though adult predation does occur) are not fully clear, but key elements seem to be proximity to humans, abundance of avian predators, and proximity and type of forest edge to the nest (USFWS 2004; USFWS 2009).

Stressor: Inadequacy of existing regulatory mechanisms
Exposure: See narrative.
Response: See narrative.
Consequence: See narrative.
Narrative: The current threat posed by the inadequacy of existing regulatory mechanisms has been reduced since the listing, but not eliminated, by the federal and subsequent state listings (i.e., as threatened in Washington and Oregon), the implementation of the NWFP in 1994, implementation of Habitat Conservation Plans on private lands, and gill-netting restrictions in Washington and California (USFWS 2009). As of the 2019 5-year review, the threat posed by this factor seem to be reduced since listing. (USFWS, 2019). Various regulatory mechanisms include: BLM Western Oregon Plan, National Forest Management Act, Habitat Conservation Plans and Safe Harbor Agreements, City of Everett Lake Chaplain Tract, protected murrelet habitat (under Natural Resource Damage Assessment funds, conservation agreements, cooperative endangered species conservation funds, national coastal wetlands conservation grants), National Monuments, Wilderness Area designations, Outer Continental Shelf Lands Act, and the Oil Pollution Act. (USFWS, 2019)

Stressor: Oil spills

Exposure: Oil tanker, large ocean-going vessels, offshore oil wells, onshore and offshore facilities.
Response: Oiled birds, reduced prey base, and marine habitat disturbance.
Consequence: Mortality and reduced fitness.
Narrative: Oil spills result in severe localized impacts—including direct mortality through oiling, and impacts to reproductive success through changes in prey base, marine habitat, and disturbance (USFWS 2009). Oil pollution has been highlighted as a significant threat or conservation problem for marbled murrelets in southern Alaska, southern British Columbia, Washington, and California. Large oil spills result periodically from oil tanker mishaps (groundings, collisions, explosions, and accidental spillages), similar mishaps by other large oceangoing vessels and offshore oil wells (well blow-outs and accidental spillages), unloading and loading cargo from onshore and offshore facilities, and onshore facility spills that enter the ocean. Small oil spills occur frequently and are chronic in many areas due to tank cleaning at sea, bilge pumping, seeps, etc. All types of boats and marine transportation vessels may be involved (USFWS 1997).In addition to large and medium oil spills, chronic oil pollution (e.g., small oil spills, bilge dumping, or seeps) has occurred in coastal areas throughout this century. There are sporadic reports of oiled marbled murrelets separate from known large and medium spills, especially in California (USFWS 1997).

Stressor: Gillnets
Exposure: Commercial gillnet fishing.
Response: Entrapment
Consequence: Mortality
Narrative: Gill nets may be responsible for direct mortality of murrelets, but the impacts continue to be localized to the Puget Sound area and northern Washington coast. Fishing effort appears to have risen in some portions of Puget Sound, and this threat may be locally increasing. Gill nets are not a threat in Oregon or California (USFWS 2004; USFWS 2009).

Stressor: Derelict fishing gear
Exposure: Fishing nets and crab pots.
Response: Entanglement
Consequence: Mortality
Narrative: Entanglement in derelict fishing nets has been identified as a threat to marine mammals, seabirds, shellfish, and fish in Puget Sound and the Straits of Juan de Fuca. Derelict fishing gear consists of nets and crab pots that have been lost, abandoned, or discarded in the marine environment. This gear can persist in the marine environment and continue "fishing" (capturing sea life) for decades. Not only does derelict gear result in direct mortality of species, it destroys and degrades marine habitat by accumulating sediment, scouring bottom substrate, impeding plant and sessile animal growth, and blocking access to habitat used for foraging and escaping predators. A recent survey estimated that there are 3,900 derelict nets and 14,000 to 20,000 derelict crab pots in Puget Sound. Derelict fishing gear also occurs along the Washington coast and the outer Straits of Juan de Fuca; however, in this high-energy environment, the time a derelict net remains suspended may be shorter when compared to a lower-energy environment like inner Puget Sound. More than 50 percent of the derelict nets in Puget Sound occur in waters where murrelet densities are the highest in Washington (i.e., the Straits of Juan de Fuca and San Juan Islands) and the nets primarily occur within murrelet foraging depth. Therefore, it is reasonable to assume that murrelets are also victims of derelict nets in Puget Sound (USFWS 2009).

Stressor: Energy development
Exposure: Energy development projects.
Response: Loss of habitat, habitat fragmentation, changes in prey base, shading, entanglement, and night-lighting.
Consequence: Mortality and reduced fitness.
Narrative: Marbled murrelets may be highly vulnerable in localized areas to impacts from energy development and production. The threat(s) these projects may pose to murrelets varies greatly, depending on the proposed location and type of equipment. In some cases, such as tidal energy projects that will use underwater turbines, the threat may be mortality. In other cases, the projects may degrade marine habitat through shading, collision/entanglement obstacles, night-lighting, changes in prey abundance, and/or increased human presence. In some cases, the project may have little or no impact to murrelets (USFWS 2009).

Stressor: Marine and terrestrial disturbance
Exposure: Presence of humans, boat traffic, underwater detonations, and pile driving.
Response: Behavior changes.
Consequence: Mortality, injury, reduced fitness, and reduced fecundity.
Narrative: Disturbances from boat traffic elicits behavioral responses in murrelets. Boat disturbance can decrease the amount of time available for murrelets to forage, or murrelets may be unable to forage effectively due to increased vigilance and time spent escaping. Boat disturbance may cause an energetic impact on murrelets, due to the cost of flight compounded with being flushed off preferred feeding grounds. Juveniles may be at greater risk of negative impacts from boat traffic because of their propensity to flush in response to boat traffic. Murrelets may or may not habituate to boat traffic (USFWS 2009).The potential for mortality, injury, and disturbance due to exposure to elevated underwater sounds has been identified as a threat. High underwater sound pressure levels (SPLs) are known to have negative physiological and neurological effects on a wide variety of vertebrate species, including fishes, mammals, and birds. The injuries associated with exposure to high SPLs are referred to as barotraumas, and include hemorrhage and rupture of internal organs, hemorrhaged eyes, temporary stunning, and ruptured eardrums. The scope of this threat appears to be localized to Washington, and the severity is currently being ameliorated through Section 7 consultations. Noise disturbance may affect murrelet fitness and reproductive success, but further research is needed. New information does not tie observed effects directly to human disturbance, but further corroborates the tie of human presence to increased predation. Most of the recent disturbance information is specific to the coastal redwood zone in California. Further research throughout the range is necessary to determine the severity of disturbance on marbled murrelets (USFWS 2009).

Stressor: Toxins
Exposure:
Response: Decline in prey
Consequence: Reduced fitness and fecundity, and mortality.
Narrative: Several studies looked at contaminant levels in their prey, in particular Pacific herring (Clupea pallasii) and Pacific sand lance (Ammodytes personatus). Pacific sand lance collected from nine locations throughout Puget Sound were sampled for toxic contaminants (such as polycyclic aromatic hydrocarbons (PAHs), polybrominated diphenyl ether (PBDE), and polychlorinated biphenyl (PCBs)). PCBs, PBDEs, PAHs, and some organochlorine pesticides were broadly detected, including banned chemicals such as PBDE flame retardants and DDT. Higher concentrations were found in fish collected from urbanized embayments; however, the

widespread occurrence of toxic contaminants in Pacific sand lance tissues suggests persistent exposure (Puget Sound Ecosystem Monitoring Program [PSEMP] Toxics Work Group 2017, p. 16). Contaminant levels in Pacific herring in Puget Sound have been monitored since 1994. While PCBs have declined in areas with low development, they continue to be problematic in developed areas, such as south and central Puget Sound (PSEMP Toxics Work Group 2017, p. 29). PCBs appear to persist in the environment, despite prohibitions on production and use; however, PBDEs declined or remained static, suggesting that source controls and mitigation efforts have been somewhat successful (PSEMP Toxics Work Group 2017, p. 29). (USFWS, 2019) Good et al. (2014, entire) measured contaminant levels in forage fish, comparing sites within Puget Sound to sites on the outer Washington coast. Good et al. (2014, pp. 5-7) found PCBs were higher (1.8 to 4.9 times) for Pacific sand lance, Pacific herring, surf smelt (Hypomesus pretiosus), and chinook salmon (Oncorhynchus tshawytscha) collected at Protection Island in Puget Sound than for fish collected at Tatoosh and Destruction Islands on the outer coast and PBDEs were higher (1.5 to 3.5 times) for Pacific sandlance, Pacific herring, surf smelt, and chinook salmon at Protection Island than at Tatoosh or Destruction Islands. Forage fish collected in Puget Sound were much more likely to be contaminated than those collected on the outer coast, which results in potentially higher contaminant burdens in the birds that are consuming these fish (Good et al. 2014, p. 8). Based on diet composition, Good et al. (2014, p. 10) estimated the dietary PCB exposure for rhinoceros auklet (Cerorhinca monocerata) chicks in Puget Sound to be 4.5 times greater than on the outer coast, and PBDE exposure to be 4.5 to 7.5 times greater than on the outer coast. In addition to chemical toxicants, microplastics are being found in forage fish species. In a study in Haro Strait, British Columbia, 85 percent of Pacific sand lance collected contained colored plastic filaments (PSEMP Toxics Work Group 2017, p. 22). (USFWS, 2019)

Recovery

Reclassification Criteria:
The recovery plan for the species does not identify reclassification criteria. The species is listed as threatened, and downlisting criteria have not been identified.

Delisting Criteria:
The recovery plan indicates that delisting can be considered after research and monitoring provides the necessary information on present populations and life history requirements for the development of recovery criteria. These criteria should be reasonable, attainable, and adequate to maintain the species over the period of reduced habitat availability during the next 50 years, and to ensure viable populations over the long term (greater than 200 years) (USFWS 2009). Interim delisting criteria include:

Trends in estimated population size, densities, and productivity have been stable or increasing in four of the six Conservation Zones over a 10-year period. This period of time will encompass at least one to two El Niño events, based on recent frequency of occurrences (USFWS 1997; USFWS 2009).

Management commitments, including protection and monitoring in marine and terrestrial habitats, have been implemented to provide adequate protection of marbled murrelets in the six Conservation Zones for at least the near future (50 years) (USFWS 2009). These commitments include delineating and protecting areas of terrestrial and marine habitat essential for recovery in each Conservation Zone, and developing and implementing landscape management strategies for each of the six Conservation Zones. Monitoring commitments include accurate and repeatable inventory, monitoring of marbled murrelet populations and trends at sea, and monitoring the amount and condition of terrestrial habitat (USFWS 1997; USFWS 2009)

Providing more specific delisting criteria will be possible after:

Marbled murrelet population size, population trends, and demographic goals have been better determined for each of the six Conservation Zones. The parameters must be adequate to ensure sustainable populations throughout its range (e.g., 100 to 200 years) (USFWS 1997).

The quantity, quality, and distribution of nesting habitat in each zone that is necessary to sustain appropriate demographic and population size goals for marbled murrelets have been better determined, and these requirements are projected to be met in the near future (50 years). To determine the amount of habitat required to stabilize the population, information on the amount and quality of forest habitat required to support a specific number of marbled murrelets in each Conservation Zone is needed, along with the current trend of population size, density, and productivity;

The quantity, quality, and distribution of marine habitats and prey populations that are necessary to sustain demographic and population size goals of marbled murrelets in each Conservation Zone have been better determined, and these requirements are projected to be met in the near future (next 50 years) at a minimum (USFWS 1997).

Detailed studies of the survivorship and productivity of marbled murrelets are completed (USFWS 1997).

Recovery Actions:

- Implement management plans for each Marbled Murrelet Conservation Zone (USFWS 1997).
- Delineate and protect areas of habitat in each Zone (USFWS 1997).
- Incorporate management recommendations for protected habitat areas (USFWS 1997).
- Initiate research necessary to guide recovery efforts (USFWS 1997).
- Establish a Regional West Coast Data Center for the marbled murrelet (USFWS 1997).
- More information for the next review is needed concerning: • Genetic differences across the range; • Regulatory effectiveness and conservation status of the murrelet in Canada; • Natal and adult movement and dispersal, effects on the rates of immigration/emigration; • Habitat quality, quantity, and trends; • Further information on the effects of predation across the range; • Population trends; and • Linking site-specific information to landscape characteristics (USFWS 2004).
- Because the recovery plan is greater than 10 years old and information regarding threats and population has changed, a revision of the recovery plan is warranted (USFWS 2009).
- Information regarding marine threats and general life history, including reproduction, is lacking; therefore, research on these topics is needed (USFWS 2009).
- Further examine marbled murrelet population trends in the coastal redwood zone, given the magnitude and imminence of threats (USFWS 2009).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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SPECIES ACCOUNT: *Branta (=Nesochen) sandvicensis* (Hawaiian goose (nene))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

A medium-sized, heavily barred, gray-brown goose.A medium-sized goose, averaging about 64 cm long; face, cap, and hindneck black, side of neck buff with dark furrows; body and folded wings are gray-brown and barred; bill and feet black; relatively little webbing between the toes; sexes are similar in appearance (Pratt et al. 1987).Medium-sized goose: 63-69 cm long; female 1315-2560 g; male 1675-3050 g. Face and crown black, cheek cream-colored; neck pale grayish, streaked with black (NatureServe, 2015).

Taxonomy

The n‘n‘ or Hawaiian goose (Branta sandvicensis) is in the family Anseridae, subfamily Anserinae, tribe Anserini, with other true geese. This is the only one of five or so endemic Hawaiian goose species to survive into historic times (Olson and James 1984; Olson and James 1991). Using genetic information, Quinn et al. (1991) speculated that n‘n‘ and Canada geese (B. canadensis) diverged from a common North American ancestor less than 3 million years ago (USFWS, 2004).

Historical Range

Fossil records suggest that this species originally occurred on all the main islands. Historically, this species occurred on the Big Island (Hawaii) from sea level to 2,400 meters in elevation. It probably also occurred on Maui in the subalpine zone (NatureServe, 2015).

Current Range

Currently, the species ranges from just above sea level to approximately 2,700 meters on the islands of Kauai, Maui, and Hawaii. Highest densities on the Big Island occur on the upper slopes of Hualalai, in upper Kau, and in the saddle area between Mauna Kea and Mauna Loa. Highest densities on Maui occur in Haleakala National Park (Scott et al. 1986, Hawaii Audubon Society 1993) (NatureServe, 2015). It also occurs on Molokai (USFWS, 2011). As of 2016, wild populations of nene now occur on four of the main Hawaiian Islands. (USFWS, 2018).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are granivores, herbivores, and frugivores. Eats greens, fruits, seeds. Green vegetation and berries of native plants, such as Vaccinium spp., Coprosma ernodeodes, Styphelia tameiameiae, and Osteomeles anthyllidifolia (Matthews and Moseley

1990). During nonbreeding season feeds in pastures dominated by introduced grasses. This species exhibits a diurnal phenology (NatureServe, 2015). N‘n‘ are browsing grazers, eating over 50 species of native and introduced plants (Baldwin 1947; Black et al. 1994; Banko et al. 1999) (USFWS, 2004).

Reproduction Narrative

Adult: Nests on lava often in site well concealed by vegetation; also nests in vegetation near edges of kipukas. Nesting season is about October - March in native habitat. Clutch size usually is 3 - 5. Incubation lasts 29 - 31 days. Young able to run as soon as dry, first fly at 10 - 12 weeks; vulnerable to predators before flight attained. Sexually mature typically in 2 years. Usually does not renest in same season if first attempt fails. Nonbreeders form loose flocks during breeding season (NatureServe, 2015). N‘n‘ usually pair for life and the birds typically remain in close proximity to each other during the year (Banko et al. 1999; U. Zillich and J. Black, unpubl. data). Banko (1988) found that at least 9 percent of females in the wild renested after predators destroyed their first nest or the first brood died (USFWS, 2004). New in 2019: Nene nest on the ground, in a shallow scrape in the dense shade of a shrub or other vegetation. During molt, adults are flightless for a period of 4 to 6 weeks and generally attain their flight feathers at about the same time as their offspring. Nene reach sexual maturity at 1 year of age, but usually do not form pair bonds until the second year. Females are highly philopatric (loyal to their place of birth) and nest near their natal area, while males more often disperse (Banko et al. 1999, p. 13). (USFWS, 2018).

Geographic or Habitat Restraints or Barriers

Adult: 0 - 8,000 ft. elevation (USFWS, 2004)

Spatial Arrangements of the Population

Adult: Flocks, family groups (USFWS, 2004)

Environmental Specificity

Adult: Broad (inferred from USFWS, 2004)

Site Fidelity

Adult: High (NatureServe, 2015)

Habitat Narrative

Adult: Mainly on sparsely vegetated lava flows (regarded as marginal habitat). Formerly occupied lowland habitats now destroyed or inhabited by predators. Does not require open water. Commonly returns to same area to nest in successive years. Terrestrial habitat is characterized as bare rock/talus/scree (NatureServe, 2015). It is currently found at elevations ranging from sea level to almost 2,500 meters (8,000 feet) in a variety of habitats including nonnative grasslands (such as golf courses, pastures, and rural areas); sparsely vegetated, high elevation lava flows; cinder deserts; native alpine grasslands and shrublands; open native and nonnative alpine shrubland-woodland community interfaces, mid-elevation (approximately 700 to 1,200 meters [2,300 to 3,900 feet]) native and nonnative shrubland; and early successional cinderfall. From June to September, family groups join others in postbreeding aggregations (flocks), often far from nesting areas. Family break-up occurs just prior to a new nesting season, when the goslings are 10 to 11 months old. Family groups also may reunite after nesting and siblings may continue to associate with each other in the nonbreeding season over their lifetimes (10+ years) (D. Hu, pers. comm. 1999) (USFWS, 2004).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory. Detailed information on home range lacking, but generally range within 200 square kilometers (Banko et al. 1999) (NatureServe, 2015).

Additional Life History Information

Adult: The Hawaiian goose is adapted to a terrestrial and largely nonmigratory lifestyle in the Hawaiian Islands with limited freshwater habitat (Banko et al. 1999, p. 1). Adaptations to a terrestrial lifestyle include increased hindlimb size, decreased forelimb size, more upright posture, and reduced webbing between the toes compared to other species of Branta (Banko et al. 1999, p. 1; Olson and James 1991, p. 42). Compared to the related Canada goose (Branta canadensis), nene wings are about 16 percent smaller in size and their flight is not as strong (Banko et al. 1999, p. 9). Nene are capable of interisland and high altitude flight, but they do not migrate out of the Hawaiian archipelago (Banko et al. 1999, p. 9). (USFWS, 2018).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Most islands: stable; Kauai: increasing (USFWS, 2011)

Resiliency:

Low (inferred from NatureServe, 2015 and USFWS, 2011; see current range/distribution)

Representation:

Very low (USFWS, 2011)

Redundancy:

Moderate (inferred from NatureServe, 2015)

Number of Populations:

25 (NatureServe, 2015)

Population Size:

1,888 - 1,978 (USFWS, 2011). As of 2016, the Statewide population of wild Hawaiian geese was estimated to have reached 2,855 individuals; the wild populations on the islands of Hawaii, Maui, Molokai, Kauai, and Oahu were estimated to have 1,095, 616, 35, 1,107, and 2 individuals, respectively (Nene Recovery Action Group [NRAG] 2017, unpublished). (USFWS, 2018).

Adaptability:

Low (inferred from NatureServe, 2015)

Population Narrative:

Formerly abundant; extirpated first from lowlands; became extinct on Maui before 1890; nearly extinct in wild by 1951. Range and numbers subsequently increased through captive breeding and release, but most populations are not self-sustaining (Banko et al. 1999). This species has experienced a long-term decline of > 90%. There are about 25 separate sites (from map in Banko et al. 1999). Many of these, however, are not self-sustaining. (NatureServe, 2015). The population in 2010 was estimated at 1,888 - 1,978 individuals. Veillet et al. (2008) looked at polymorphic satellites in nene and their data corroborates previous studies showing high levels of inbreeding in wild nene populations that may impact breeding success and juvenile survival (Paxinos et al. 2002, Rave 1994). Studies have shown that nene went through a prehistoric population bottleneck and have very low genetic diversity (Paxinos et al. 2002, Rave 1994, Rave et al. 1999, Veillet et al. 2008). Nene populations are currently stable on most islands and increasing on Kauai (USFWS, 2011).

Threats and Stressors

Stressor: Predation (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Predation is believed to be the main threat to this species at this time (USFWS 2004). Mongooses are believed to be the most serious egg predator (Banko 1988, 1992, Black and Banko 1994, Stone et al. 1983). Rats and pigs also take eggs and cats have been observed moving eggs in nests, so they may also predate eggs (Baker and Baker 1995; Zaun in litt. 2008). Goslings are taken by mongooses, rats, pigs, and cats (Banko 1992, Hoshide et al. 1990; K. Misjon, NPS, pers. comm. 2011). Dogs and mongooses have been cited as being responsible for most known cases of predation on adult birds, but cats and probably pigs are known to be significant predators of adults as well (Banko and Elder 1990, Kear and Berger 1980; K. Misjon, NPS, pers. comm. 2011) (USFWS, 2011).

Stressor: Disease (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: The spread of avian influenza and West Nile virus (WNV) on the mainland has serious implications if either arrives in Hawaii. WNV causes mortality in domestic geese, with goslings more susceptible than adults. Of the three known cases of nene infected with WNV on the U.S. mainland, all were adults and one died (Jarvi et al. 2008) (USFWS, 2011). Toxoplasma gondii is a protozoan parasite transmitted by domestic cats (Felis catus) that has historically caused mortality in native Hawaiian birds, and is the most commonly encountered infectious disease in nene, primarily affecting adult birds (Work et al. 2015, p. 691). As herbivores, nene are likely

exposed by eating transport hosts such as insects or ingesting oocysts (reproductive phase of the parasite) in contaminated water, soil, or vegetation (Work et al. 2016, p. 255). For mortalities attributed to T. gondii, the cause of death is typically diagnosed as inflammation or lesions on multiple organs. The detection of T. gondii in over 30 percent of feral cats sampled (n=67) at 2 locations on Mauna Kea, Hawaii Island (Danner et al. 2007, p. 316) suggests that exposure to and infection by T. gondii is likely to continue and to play a role in mortality of nene. This parasite may also have non-lethal effects on nene, making them more susceptible to trauma caused by vehicle collisions, as a high prevalence of T. gondii was observed in road kills of other species (Work et al. 2016, p. 256). Widespread exposure to T. gondii was detected in wild birds from Kauai, Maui, and Molokai (21 to 48 percent of birds examined) (Work et al. 2016, p. 255). However, the parasite is implicated as the cause of death in a relatively low proportion (4 percent) in the number of nene mortalities submitted to the U.S. Geological Survey National Wildlife Health Center (USGS– NWHC) between 1992 and 2013 (Work et al. 2015, pp. 690–694). This suggests that although exposure to T. gondii is widespread and ongoing, the threat of disease caused by T. gondii is expected to be low in magnitude and is not likely to have significant population-level impacts on nene. Omphalitis, a bacterial infection of the umbilical stump, has been found to cause mortality in both wild and captive nene goslings (USFWS 2004, p. 34). Work et al. (2015, supplemental material) recently diagnosed omphalitis at low levels (2 percent, 7 of 300) in a number of nene mortalities submitted to the USGS–NWHC. Avian pox is caused by a virus that causes inflammation of the skin, and in severe cases may result in large scabs that block circulation and lead to the loss of digits or entire limbs or lead to blindness, the inability to eat, or death (USGS–NWHC 2017a, in litt.). Pox-like lesions have been reported in adult birds in captivity (Kear and Brown 1976, pp. 133–134; Kear and Berger 1980, pp. 42, 86, 138), and pox scars on many birds in the wild on Hawaii and Maui indicate that avian pox is common, but generally not fatal to nene (Banko et al. 1999, pp. 20–21). Avian pox was recently found in an emaciated bird, but was judged to be a secondary finding (Work et al. 2015, p. 693). (USFWS, 2018).

Stressor: Urbanization (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Habituation to humans results in direct harm to birds such as road kills and being struck by golf balls. A common cause of known mortality in adults at Hawaii Volcanoes National Park during 1989-1999 was road kill (Rave et al. 2005). It is important to conduct outreach to prevent people from feeding nene and to keep them wild. Vehicle-related mortality also occurs where roads pass though nene habitat, such as location where roads bisect nesting and rearing habitat, roosting and day-use sites, or a historic flocking area. This forces birds, including families with unfledged goslings, to cross dangerous roads. Wind farms are a new threat to nene. To date, at least six nene have been killed at the West Maui wind farm site (USFWS, 2011).

Stressor: Low reproductive success (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Low genetic variation may limit reproductive success and survival (USFWS 2004). Studies have shown that nene went through a prehistoric population bottleneck and have very low genetic diversity (Paxinos et al. 2002, Rave 1994, Rave et al. 1999, Veillet et al. 2008). Some

studies indicate that inadequate nutrition is a factor limiting nene reproduction and gosling survival, especially on Hawaii and Maui, and especially in harsh conditions (Baker and Baker 1995, Hu 1998, Rave et al. 2005, Tamayose 2006, USFWS 2004) (USFWS, 2011).

Stressor: Lack of lowland habitat (USFWS, 2018)
Exposure:
Response:
Consequence:
Narrative: Nene continue to be affected by historic and ongoing habitat destruction and modification caused by urbanization, agricultural activities, drought, feral ungulates, and nonnative plants. These factors limit suitable breeding and flocking habitat, constraining the recovery of nene populations. (USFWS, 2018). The threat of destruction and modification of habitat, particularly in lowland areas, by urbanization and land use conversion, including agriculture, is ongoing and expected to continue to limit the amount of nene foraging and nesting habitat. Past land use practices have resulted in great reduction or loss of native vegetation below 2,000 feet ft) (600 meters (m)) throughout the Hawaiian Islands (TNC 2006). Hawaii's agricultural industries (e.g., sugar cane, pineapple) have been declining in importance, and large tracts of former agricultural lands are being converted into residential areas or left fallow (TNC 2007). In addition, Hawaii's population has increased almost 10 percent in the past 10 years, further increasing demands on limited land and water resources in the islands (Hawaii Department of Business, Economic Development and Tourism 013, in litt.). While breeding habitat has some level of protection in the national parks, national wildlife refuges, and some State lands, there is little to no protection for habitat that nene use outside the breeding season. Nene are vulnerable at this time as well as during the breeding season as they are moving around to different areas, exposing them to additional predation in unprotected habitat, poor availability of suitable foraging habitat, and interactions with humans and human structures (wind towers, vehicles, etc). Human activities associated with the development and urbanization of lowland habitat will continue to impact nene. For example, nene collide with trees, fences, and particularly motor vehicles (Banko and Elder 1990; Banko et al. 1999). Nene are attracted to feeding opportunities provided by mowed grass, weeds, and human handouts. Feeding, in particular, makes nene vulnerable to collisions along roadsides as they frequently become tame and unafraid of human activity (Banko et al. 1999). Mortality is high in human-modified habitats due to increased predation, collisions, and human-caused accidents (Banko et al. 1999).(USFWS, 2018). Feral ungulates and nonnative plants led to further degradation of nene habitat by negatively impacting forage quality, shelter, and potential nest sites. Grazing and browsing by introduced cattle, goats, and sheep converted significant portions of native montane forest and shrubland between 1,640 and 6,562 ft (500 and 2,000 m) to wild grassland and managed pastureland dominated by nonnative species (Cuddihy and Stone 1990, pp. 59–63, 63–67). Effects of nonnative ungulates have been somewhat less severe above 6,562 ft (2,000 m) because nonnative weeds are less prevalent (Banko et al. 1999, p. 6). Nonnative plants adversely affect native habitat in Hawaii by: (1) Modifying the availability of light, (2) altering soil-water regimes, (3) modifying nutrient cycling, and (4) altering fire regimes of native plant communities (i.e., the ''grass/fire cycle'' that converts native-dominated plant communities to nonnative plant communities) (Smith 1985, pp. 180–181; Cuddihy and Stone 1990, p. 74; D'Antonio and Vitousek 1992, p. 73; Vitousek et al. 1997, p. 6). (USFWS, 2018).

Stressor: Inadequate nutritional quality (USFWS, 2018)
Exposure:

Response:
Consequence:
Narrative: Emaciation was the most common cause of death diagnosed in 71 out of 300 adult and gosling mortalities submitted to the National Wildlife Health Research Center between 1992 and 2013 for which a cause of death was identified (Work et al. 2015, p. 692). Habitat also continues to be reduced due to the spread of unpalatable alien grasses (e.g., guinea grass (Megathyrsus maximus), sword grass (Miscanthus floridulus)) and other weeds (e.g., koa haole (Leucaena leucocephala), lantana (Lantana camara)), as this spread diminishes foraging opportunities (Banko et al. 1999, p. 23). Therefore, inadequate nutritional quality due to the lack of suitable foraging opportunities in and around current breeding areas, particularly at higher elevations on Maui and Hawaii Island, coupled with the loss of lowland breeding areas across its range, is expected to continue as a threat to the nene. (USFWS, 2018).

Stressor: Drought (USFWS, 2018)
Exposure:
Response:
Consequence:
Narrative: Nene exhibited higher rates of mortality in drought years during the prolonged island-wide drought between 1976 and 1983 on Hawaii Island (Black et al. 1997, pp. 1,165–1,169). Drought was also thought to have contributed to the population decline (10 percent) at Hawaii Volcanoes National Park in the late 1990s (Rave et al. 2005, p. 12). Numerous and recurrent droughts have been historically documented throughout the Hawaiian Islands (Giambelluca et al. 1991, pp. 3–4; Hawaii Civil Defense 2011, ch. 14, pp. 1–12), with the most severe events often associated with the El Nin˜o phenomenon (Hawaii Civil Defense 2011, p. 14–3). Based on the frequency of drought and its population-level impacts to nene, we conclude that the threat of drought is ongoing and likely to continue periodically into the foreseeable future. (USFWS, 2018).

Stressor: Wind Energy Production facilities (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: A significant number of nene mortalities have been reported at wind energy facilities. Nene collide with the towers or collide with or are struck by blades of wind turbine generators (WTGs). The diameter of rotor blades (approximately 330 ft (100 m)) and combined height of WTGs (up to 428 ft (131 m)) create large obstacles for nene during flight. On Maui, 3 facilities with a total of 40 WTGs are in operation, Kaheawa Wind Power I (20 WTGs) and Kaheawa Wind Power II (12 WTGs) in western Maui, and Auwahi Wind (8 WTGs) in southeastern Maui. From 2006 to 2016, a total of 26 nene fatalities and an adjusted take of 50 nene have been reported at the three Maui wind energy facilities (DOFAW 2016, in litt.). Take is adjusted by adding estimates of take undetected by search efforts, indirect take (e.g., eggs or goslings taken by parental deaths in the current year), and lost productivity in future years. All three Maui facilities have approved habitat conservation plans (HCPs) and have received Federal incidental take permits and State incidental take licenses authorizing the total combined take of 95 nene during the 20-year period of operation for each project. The HCPs include the following conservation measures to offset the amount of authorized take: (1) Establish an additional population of 75 nene at an off-site location (Haleakala Ranch), (2) conduct predator control and habitat enhancement at the additional population site, (3) conduct on-site habitat restoration, (4) conduct on-site monitoring of nene, and (5) fund nene conservation actions at Haleakala National Park (DOFAW 2016, in

litt.). (USFWS, 2018). On Hawaii Island, two facilities with a total of 30 WTGs are in operation in Hawi (16 WTGs) and South Point (14 WTGs); however, there are no reports of nene being killed at these facilities (D. Sether 2017, pers. comm.). Based on the proximity of these facilities to areas used by nene, there is the potential for collisions. On Oahu, a total of 42 WTGs are in operation at Kawailoa Wind Power (30 WTGs) and Kahuku Wind Power (12 WTGs), and an additional 9 to 10 WTGs are proposed at the Na Pua Makani project in the Kahuku area. Na Pua Makani has submitted a draft HCP and requested incidental take for nene due to the proximity of the proposed wind energy project to James Campbell NWR, where the nene have been frequently observed. Based on the recent occurrence of only two individuals, which failed to breed successfully in 2016, wind energy facilities on Oahu are not a current threat, but represent a potential future threat should a breeding population of nene become established. On Maui and Hawaii Island, we expect that collisions at wind energy facilities will continue to result in take of nene now and in the foreseeable future; however, conservation measures in approved and permitted HCPs are expected to offset any population-level impacts to the species. (USFWS, 2018).

Stressor: Human activities (USFWS, 2018)
Exposure:
Response:
Consequence:
Narrative: Nene are attracted to feeding opportunities provided by mowed grass and human handouts, and can become tame and unafraid of human activity, making them vulnerable to the impacts of various human activities. These activities include direct harm, such as that caused by vehicles and golf ball strikes, as well as possible disturbance by hikers, hunters, and other outdoor recreationists (Banko et al. 1999, pp. 23–24; Rave et al. 2005, p. 12; USFWS 2011a, p. 11; Hawaii Volcanoes National Park 2015, in litt.; Mello 2017, in litt.). Nene may also be impacted by human activities through the application of pesticides and other contaminants, ingestion of plastics and lead, collisions with stationary or moving structures or objects, entanglement in artificial hazards (e.g., fences, fishing nets, erosion control material), disturbance at nest and roost sites, and mortality or disruption of family groups through direct and indirect human activities (Banko et al. 1999, pp. 23–24; USFWS 2004, pp. 30–31; Work et al. 2015, pp. 692–693). (USFWS, 2018).

Stressor: Vehicle collisions (USFWS, 2018)
Exposure:
Response:
Consequence:
Narrative: Vehicle collisions have been an ongoing cause of nene mortality (Hoshide et al. 1990, p. 153; Rave et al. 2005, p. 15; Work et al. 2015, pp. 692– 693). In many areas, nene habitat is bisected by roads, with nesting and roosting on one side, foraging on the other side. This poses a serious threat, particularly during the breeding season, when adults walk goslings cross roads. The greatest number of vehicle collisions occurs between December and April, during the peak of the breeding and molting season. It is during this time of year that both adults and goslings are flightless for a period of time and are especially vulnerable. The problem is worse in some areas because birds are attracted to handouts by visitors and the young shoots of recently manicured or irrigated lawns of roadsides and golf courses. Nene are often seen foraging along the edges of highways and ditches as a result of regular mowing and runoff from the pavement creating especially desirable grass in these areas. The impact is further exacerbated when, after a nene is

killed on a road, the remaining family members are often unwilling to leave the body, resulting in multiple birds being killed over a short period of time (DLNR 2016, in litt.) and potential loss of future reproductive output from breeding pairs. In the past, a number of mortalities caused by vehicle collisions were reported in Hawaii Volcanoes National Park (41) and in Haleakala National Park (14) (USFWS 2004, pp. 30–31; Rave et al. 2005, p. 12). More recent data indicate this is an ongoing issue both inside and outside park boundaries on Maui and Hawaii Island; the average annual number of nene killed by cars at Haleakala National Park was 1.2 ± 1.2 (from 1988 to 2011), and occurred at an average annual rate of 3 ± 2.39 at Hawaii Volcanoes National Park and an adjacent State highway (from 2009 to 2016) (Bailey and Tamayose 2016, in litt.; Misajon 2017, in litt.). Mortality of nene due to vehicle collisions has also been a continual problem on Kauai (Uyehara 2016c, in litt.). Over 50 nene were struck and killed by cars across the roadways of Kauai in 2 years (Kauai DOFAW 2016, in litt.). On Kauai, typically the majority of vehicle strikes occur in Hanalei and Kilauea, where the largest proportion of the Kauai population occurs; however, the most recent strikes are occurring on the western side of the island. (USFWS, 2018).

Stressor: Natural and artificial hazards (USFWS, 2018)
Exposure:
Response:
Consequence:
Narrative: Nene can become entangled or trapped in artificial hazards (e.g., old grass-covered fence wire; fishing line, predator traps; spilled tar) and some natural hazards (lava tube openings or deep depressions in ash deposits) (Banko et al. 1999, p. 24). Goslings occasionally drown in stock ponds, water troughs, and other water sources where exit to land is difficult (Banko et al. 1999, p. 24). Predator traps outfitted with protective guards have been effective at reducing the incidence of injury to goslings (NRCS 2007, p. 6). The use of certain fencing and erosion control materials has resulted in entanglement of nene with the potential to cause impaired movement, injury, and in some cases mortality. Over 2 years, a total of 44 nene (27 adults and 17 hatch-year birds) in the Poipu/Koloa population on Kauai have been observed with woven threads from erosion control slope matting wrapped around their legs at a single construction site (Kauai DOFAW 2016, in litt.). Once the material is wrapped around their legs, nene have an increased risk of becoming entangled with other objects, experiencing skin lacerations, and having the circulation cut from their legs leading to infection and the death of the limb (Kauai DOFAW 2015, in litt.). Not all instances of entanglement result in harm to nene, as birds may free themselves from threads. Nine of the 44 entangled nene have been observed with constriction or swelling on their legs; 3 have received rehabilitation and been released; and 1 was euthanized due to injuries sustained from the material. Kauai DOFAW is working with the landowners to minimize impacts and has recommended that the use of this type of erosion control matting be discontinued. (USFWS, 2018).

Recovery

Reclassification Criteria:
1. Self-sustaining populations exist on Hawaii, Maui, Molokai, Lanai, Kahoolawe, and Kauai for a period of 15 years (USFWS, 2011).

2. Sufficient suitable habitat to sustain the target nene population levels on each island is identified, protected, and managed in perpetuity (USFWS, 2011).

Delisting Criteria:
1. All of the downlisting criteria have been met, and population levels on Hawai`i, Maui Nui, and Kaua`i have all shown a stable or increasing trend (from downlisting levels) for a minimum of 15 additional years (i.e., for a total of 30 years) (USFWS, 2004).

2. A monitoring plan shall be in place and ready for implementation for a minimum of 5 years post-delisting to ensure the continuing effectiveness of management actions and the welfare of the species (USFWS, 2004).

Recovery Actions:
- Identify and protect Nene habitat which focuses on the identification and protection of sufficient habitat to sustain target population levels (USFWS, 2004).
- Manage habitat and existing populations for sustainable productivity and survival complemented by monitoring changes in distribution and abundance (USFWS, 2004).
- Control alien predators which addresses control of introduced mammals to enhance Nene populations (USFWS, 2004).
- Continue captive propagation program which describes techniques and priorities for the captive propagation and release of Nene into the wild (USFWS, 2004).
- Establish additional Nene populations which focuses on partnerships with private landowners (USFWS, 2004).
- Address conflicts between Nene and human activities which addresses potential management and relocation of Nene in unsuitable areas (USFWS, 2004).
- Identify new research needs and continue research which describes general categories of research needed to better evaluate threats to Nene and develop and evaluate management strategies to address these threats (USFWS, 2004).
- Provide a public education and information program which describes important outreach and education activities (USFWS, 2004).
- Validate recovery actions which calls for formalizing the Nene Recovery Action Group and evaluating management and research projects to determine if recovery objectives have been met (USFWS, 2004).

Conservation Measures and Best Management Practices:
- Identify and protect nene habitat, particularly summer flocking areas and potential lowland breeding sites (USFWS, 2011).
- Control alien predators (USFWS, 2011).
- Manage habitat and existing populations for sustainable productivity and survival (USFWS, 2011).
- Conduct research on improving nutritional quality and availability of food (USFWS, 2011).
- Conduct research on habitat restoration (USFWS, 2011).
- Establish additional populations (USFWS, 2011).
- Determine minimum viable population estimates by island and state-wide (USFWS, 2011).
- Utilize results of genetic studies to enhance flock management (USFWS, 2011).
- Identify new research needs and continue research (USFWS, 2011).
- Provide public outreach programs (USFWS, 2011).

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SPECIES ACCOUNT: *Buteo platypterus brunnescens* (Puerto Rican broad-winged hawk)

Species Taxonomic and Listing Information

Listing Status: Endangered; September 9, 1994; Southeast Region (R4)

Physical Description

The Puerto Rican broad-winged hawk is a small hawk that measures approximately 39 centimeters (cm) (15.5 inches), with dark chocolate brown upperparts, heavily streaked rufous breast, and a broadly banded black and white tail. It is smaller than the North American subspecies, Buteo platypterus platypterus, but larger than the Lesser Antillean subspecies. This is the darkest subspecies of the broad-winged hawk. Adult male and female are similar in appearance, but the female is slightly larger. Immature birds have dark bars on the breast and lack the distinctive tail bands of the adult. Broad-wings flap more than the similar, but larger, red-tailed hawk (Raffaele 1989).

Taxonomy

The broad-winged hawk (Buteo platypterus) is a polytypic species with six subspecies distributed in North America and the West Indies. Buteo platypterus platypterus (Vieillot) breeds in continental North America, wintering south to South America. There are five resident subspecies in the West Indies: B. p. cubanensis Burns of Cuba; B. p. brunnescens Danforth and Smith of Puerto Rico; B. p. insulicola Riley of Antigua; B. p. rivierel Verrill of Dominica, Martinique, and Saint Lucia; and B. p. antillarum Clark of Saint Vincent, the Grenadines, Grenada, and Tobago (Friedmann 1950).

Historical Range

The broad-winged hawk was first reported in Puerto Rico by Gundlach (1878). He reported this species as “common” in the “interior” of the island. Stahl (1883) reported the species as “transient.” In the first half of the 20th century, the species was not reported by other naturalists that visited the island (Bowdish 1902, Wetmore 1914, and Danforth 1931). Wetmore (1927) believed the species extinct. Danforth and Smyth (1935) collected a specimen in Luquillo (Caribbean National Forest) and described it as a distinct resident subspecies, the Puerto Rican broad-winged hawk (Buteo platypterus brunnescens). Danforth (1936) reported sightings of Puerto Rican broad-winged hawks from Utuado. Leopold (1963) reported the species from Luquillo, Utuado, and Maricao forests.

Current Range

At the present time, the Puerto Rican broad-winged hawk is an uncommon and extremely local resident. Extant populations are restricted to montane habitats of three forests: Rio Abajo Commonwealth Forest, Carite Commonwealth Forest, and Caribbean National Forest.

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: At Río Abajo Forest, Puerto Rican broad-winged hawks feed primarily on rats, lizards, and small birds (Hengstenberg and Vilella 2005, p. 411). Snyder et al. (1987) found that the prey types taken included centipedes, frogs, lizards, mice, rats, and birds (as large as 200 grams).

Reproduction Narrative

Egg: The incubation period may vary from 28 to 31 days

Juvenile: Nestlings become able fliers during their sixth week after hatching (Johnsgard 1990).

Adult: New information on the abundance and demographic features of the population of Puerto Rican broad-winged hawks at the Río Abajo Commonwealth Forest indicates high pair fidelity; a nest survival rate of 0.67 across breeding seasons; and an average annual productivity of 1.1 young per nest (Hengstenberg and Vilella 2004, p.34-35, 52, and 107). Puerto Rican broad-winged hawks prefer tall, large diameter trees with large crown dimensions. Hengstenberg and Vilella (2004, p.41) described the nest sites of Puerto Rican broad-winged hawks at Río Abajo Forest as occurring in mature closed-canopy overstory stands sheltering a midstory, with dense understory, in close proximity to a limestone rock wall, and on southwest facing slopes (sheltered from the easterly trade winds). Delannoy (1995b) reported that Puerto Rican broad-winged hawks were more active in territorial and epigamic displays from December through March. Clutch sizes are fairly consistent in this species, with 2 to 4 eggs being typical. There is a clear division of labor during incubation, with the female incubating and the male hunting. The male only covers the eggs during times that the female is eating food brought by the male. The young are brooded fairly intensively and through the night, for the first few weeks after hatching until they are about 21 to 24 days old. They are fed by the female until they are about 29 to 30 days old, and at that time begin venturing out of the nest.

Geographic or Habitat Restraints or Barriers

Adult: Forest boundaries

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Moderate

Site Fidelity

Adult: High (see dispersal/migration narrative)

Habitat Narrative

Adult: This species occurs in elfin woodland, sierra palm, caimitillo-granadillo, and tabonuco forest types of the Río Abajo Commonwealth Forest, Carite Commonwealth Forest, and El Yunque National Forest as well as within hardwood plantations, shade coffee plantations, and mature secondary forests. The Puerto Rican broad-winged hawk is found in mature forests within the subtropical moist, subtropical wet, and rain forest life zones (Ewel and Whitmore

1973, p. 10). It shows a clumped spatial pattern within the forests, associated with certain types of habitats such as tabonuco-palo colorado forest types, tabonuco and caimitillo-granadillo forest types at El Yunque and Carite forests (Delannoy 1997, p. 25). At Río Abajo, they inhabit the limestone hillsides, sinkholes, and valleys between haystack hills or “mogotes” (Delannoy 1997, p. 25). Hengstenberg and Vilella (2004, p.74) found that, within this forest, Puerto Rican broad-winged hawk nests are located in timber producing plantations and secondary forests, primarily Callophylum calaba (palo de María). Hengstenberg and Vilella (2005, p. 406) cited abandoned shade-grown coffee plantations as part of the secondary forest used by the Puerto Rican broad-winged hawk. Closed canopy forests may be the major structural characteristic describing the suitability of Puerto Rican broad-winged hawk habitat (Hengstenberg and Vilella 2004, p.73). Other habitat associations (e.g., pasture, regenerating forests) may lack a closed canopy, but may advantageously offer areas to locate prey for Puerto Rican broad-winged hawks (Hengstenberg and Vilella 2004, p.73). Hengstenberg and Vilella (2004, p.71) found that the vast majority (97%) of Puerto Rican broad-winged hawk movements and home ranges at Río Abajo Forest were confined to the boundaries of the forest.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: Low

Dispersal/Migration Narrative

Adult: Hengstenberg and Vilella (2004, p.69) reported an average annual home range of 106 hectares (ha) and a breeding home range size of 82.5 ha for the Puerto Rican broad-winged hawk at Río Abajo Forest. The high degree of territory reoccupancy observed in Río Abajo Forest suggests little migration into adjacent habitats (Delannoy and Tossas 2000, p.115).

Population Information and Trends

Population Trends:

Unknown

Species Trends:

Stable

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Growth Rate:
Slow (see reproduction narrative)

Number of Populations:
3 (see current range/distribution)

Population Size:
125 New in 2019: Vilella and Gallardo (2018) found broad-winged hawks in 31 of 63 survey stations and a total of 117 individuals were observed. 77 were found in the municipality of Arecibo, 36 in Utuado, and 10 inside RACF (Rio Abajo Commonwealth Forest). (USFWS, 2019).

Population Narrative:
The Río Abajo Commonwealth Forest supports close to 50% of the currently known population. The most recent study of the population within the Río Abajo Commonwealth Forest (Hengstenberg and Vilella 2004, p.101) indicates that this population continues to be stable since publication of the species' recovery plan in 1997. The Puerto Rican broad-winged hawk population is estimated at about 125 individuals island-wide. The USFWS does not have any information on the species abundance, population trends, demographic features or demographic trends for El Yunque and Carite forests. This species is susceptible to habitat disturbances due to limited distribution and low population numbers.

Threats and Stressors

Stressor: Habitat destruction and modification
Exposure:
Response:
Consequence:
Narrative: Timber harvest, road construction and/or repair in the forests, construction of recreational facilities, construction of power and communication structures, and other management practices that result in a reduction in numbers or diminished habitat quality for the species could be detrimental, since the species is limited in abundance and distribution (Delannoy 1997, p.29; US Fish and Wildlife Service 1997, p.12). Although surrounding private lands may provide corridors or nesting habitat for dispersing individuals, land use practices surrounding private lands may also hinder movement into these areas (Hengstenberg and Vilella 2004, p.101). Permits to build new communication facilities or expand currently existing ones within or near Commonwealth forests are prevalent. There have been proposals to the DNER for the construction of cell towers within Commonwealth forests in the last five years (Toro Negro Commonwealth Forest, Gerardo Hernández, DNER, pers. comm., 2007).

Stressor: Limited distribution and low population numbers
Exposure:
Response:
Consequence:
Narrative: The final rule and recovery plan state that the most important factors affecting the Puerto Rican broad-winged hawk are their limited distribution and low population numbers. The species is susceptible to natural habitat disturbances, such as strong storms and hurricanes,

because of their limited distribution and specific habitat requirement of mature montane forests that may not be available in storm-damaged forests (Delannoy 1997, p.27, US Fish and Wildlife Service 1997, p.13). This hawk species has experienced drastic population declines (Delannoy 1997, p.27) attributed to possible direct and indirect effects of hurricane Hugo in 1989 and possibly due to the effect of Hurricane Georges in 1998 (Tossas 2010, pers. comm.).

Recovery

Reclassification Criteria:
1. Maintain a Puerto Rican broad-winged hawk breeding population of 60 pairs (20 breeding pairs in El Yunque National Forest, Carite Commonwealth Forest, and Río Abajo Commonwealth Forest, respectively).

2. Reach an island-wide Puerto Rican broad-winged hawk population of 200 individuals (60 individuals in Río Abajo and Carite Commonwealth forests, and 80 individuals in El Yunque National Forest).

3. Gather additional documentation on population trends (i.e., conduct surveys, search for new populations, obtain population biology information, identify mortality factors and threats) and adequate support habitat for both hawk species (i.e., characterize currently used habitat, identify additional habitat, determine spatial and temporal use of habitat).

Delisting Criteria:
1. Species occurs in at least 75% of suitable habitat. (USFWS, 2019).

2. Within the island-wide distribution there will be at least 3 populations within existing protected areas that show stable or increasing population trends, evidenced by natural recruitment and multiple age classes. (USFWS, 2019).

3. Habitat corridors exist between at least 3 protected areas that support populations. (USFWS, 2019).

Recovery Actions:
- 1. Conduct surveys and identify habitat.
- 2. Protect and manage hawk populations and habitat.
- 3. Monitor Puerto Rican broad-winged hawk and Puerto Rican sharp-shinned hawk populations.
- 4. Develop an education program.
- 5. Refine recovery goals.
- 6. Implement a captive breeding program to stabilize population to at least pre-hurricane Maria levels. (USFWS, 2019).
- 7. Increase monitoring efforts and in particular coordinate with ongoing island-wide acoustic monitoring, especially in areas known to support species. (USFWS, 2019).
- 8. Plan and implement forest recovery and enhancement efforts in public and surrounding private lands to develop mature closed canopy forest with preferred tree species. (USFWS, 2019).

Conservation Measures and Best Management Practices:

- Conduct no management activities within 150 meters of nest trees or roosts.
- Conduct only compatible management activities (e.g., nonmanipulative research, placement of parrot nests, bee traps, or thrasher boxes, etc.) within 500 meters from nest trees or roosts
- Plan other activities (e.g., recreational development, timber demonstration, etc.) at least 500 meters from nest sites, following biological assessment and consultation with the Fish and Wildlife Service.
- Timber demonstration or other silvicultural activities planned near nesting areas should be designed to result in stand conditions favorable to raptor recovery.
- Plan any activity with potential to disturb raptors 350 meters away from nest or roost sites; or time it to avoid the nest selection and breeding time (i.e., activities may occur from August through November).
- Conduct raptor inventories during nest selection/breeding seasons, prior to planning forest management activities.

References

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USFWS. 2019. Puerto Rican broad-winged hawk and Puerto-Rican sharp-shinned hawk (Buteo platypterus brunnescens and Accipiter striatus venator) Recovery Plan, Amendment 1. USFWS, Atlanta, Georgia. 23 pp.

SPECIES ACCOUNT: *Buteo solitarius* (Hawaiian (='lo) Hawk)

Species Taxonomic and Listing Information

Listing Status: Endangered/proposed for delisting; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

Small, broad-winged raptor with dark or light plumage. Dark phase adult is uniformly dark brown; immature has tawny mottling on head and breast. Light phase adult is pale below, more or less streaked on the breast; immature is clear golden buff on the head and breast, with a dark streak through the eye. Cere and feet are yellow in adults, blue-green in immatures. (Pratt et al. 1987). From Clarkson and Laniawe (2000): Small, broad-winged hawk; average body mas 606 g for females, 441 g for males. Average total length 46 cm for females, 41 cm for males. Exhibits distinct light and dark color morphs. In adult light morph, crown dark brown; chin and throat white, with variable brown flecks and increasing brown flecks alongside of breast. Dark morph adult plumage mostly brown, with whitish and tawny tinge on belly, particularly along flanks. Sexes not distinguished by plumage or bare parts. Plumage coloration remains the same throughout year. (NatureServe, 2015)

Taxonomy

Also known by its Hawaiian name, 'Io. (NatureServe, 2015)

Current Range

Located on the island of Hawaii (sea level to about 2600 m); accidental on Maui, Molokai, Oahu, and Kauai (Banko 1980, Scott et al. 1988). (NatureServe, 2015)

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Feeds opportunistically on birds, rodents, and insects. Io generally hunt from a perch, less frequently stooping from flight (Clarkson and Laniawe 2000). (NatureServe, 2015)

Adult: Feeds opportunistically on birds, rodents, and insects. Io generally hunt from a perch, less frequently stooping from flight (Clarkson and Laniawe 2000). (NatureServe, 2015)

Reproduction Narrative

Adult: Io remain in and defend their territories year-round. Eggs in nest peak late April to mid-May and nesting occurs from March through September; young may be still in nest in early September (Clarkson and Laniawe 2000). Clutch size historically reported as 1-3, but in recent studies (Griffin 1985, USFWS 1998) clutch size was invariably 1. Incubation, mainly by female, lasts about 38 days (Clarkson and Laniawe 2000). Hatching success is about 87 percent. After nesting the male vists nests only to provide food. Young fledge at about 8-9 weeks, remain dependent for several months (Clarkson and Laniawe 2000, Shallenberger 1977). Fleding success is about 70% of total eggs laid (C. R. Griffin, unpubl. data). Juveniles disperse to territories of their own in late fall or early winter (Matthews and Moseley 1990). The length of post-fledging juvenile dependency for the 'io is exceedingly long compared to that of other buteos. It is not known at what age sexual maturity is reached, but birds probably do not breed until at least 3 to 4 years of age. Does not usually breed every year (Clarkson and Laniawe 2000). Home ranges in different habitat types varied from 48 to 608 hectares (n = 16; Clarkson and Laniawe 2000). No information on dispersal from breeding site. Solitary or in pairs. Mated pair tends to use same nest in successive years (Matthews and Moseley 1990). (USFWS, 1984; NatureServe, 2015)

Geographic or Habitat Restraints or Barriers

Adult: Nests at elevations of 30 m to 1700 m above sea level most often in native ohia trees; more abundant in windward than in leeward forests; avoids dry scrub areas and prefers either open savanna or denser rain forest; 'io are found near sea level to approximately 2,600 m (8,500 feet) (USFWS, 1984; NatureServe, 2015)

Environmental Specificity

Adult: Low (USFWS, 1984)

Site Fidelity

Adult: High (USFWS, 1984)

Habitat Narrative

Adult: Io are very sedentary and remain in and defend their territories year-round. Most native and exotic forests (including papaya, guava, and macadamia orchards), grasslands, and cane fields; more abundant in windward than in leeward forests; avoids dry scrub areas and prefers either open savanna or denser rain forest (Clarkson and Laniawe 2000, Mathews and Moseley 1990). 'Io are found from near sea level to approximately 2,600 meters (8,500 feet). Nests in trees of various kinds, but in recent survey, native ohia trees (Metrosideros spp.) were selected 80% of the time (USFWS 1998). Mated pair tends to use same nest in successive years (Matthews and Moseley 1990). Nests at elevations of 30 m to 1700 m above sea level (Clarkson and Laniawe 2000). 'Io nest in a wide variety of habitats, ranging from lowland agricultural areas and exotic forests to upper elevation pasturelands and native rain forests. Nests have been recorded in both short (10 m) and tall (24 m) trees and constructing nests from 3.5 to 18 m from the ground. (USFWS, 1984; NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: Low (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Io are very sedentary. (USFWS, 1984)

Population Information and Trends

Population Trends:

Unknown (NatureServe, 2015)

Resiliency:

Low (inferred from NatureServe, 2015)

Representation:

Medium (inferred from NatureServe, 2015)

Redundancy:

Low (inferred from NatureServe, 2015)

Number of Populations:

Few (NatureServe, 2015)

Population Size:

1000 - 2500 (NatureServe, 2015)

Population Narrative:

Population trends are unknown. In 1985, the population was estimated to be 1,400-2,500 individuals (Griffin 1985). A 1993 rangewide survey estimated 1,600 birds (including 1,120 adults, 560 pairs) (Hall et al. 1997); a 1998 survey estimated 1,233 birds (USFWS 1998). Occurrences not defined, but undoubtedly few exist. (NatureServe, 2015)

Threats and Stressors

Stressor: Harassment and shooting (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: Harassment of nesting birds and shooting may be the most significant factors directly affecting the 'io today. Harassment of breeding 'io can result in nest abandonment, especially when the disturbance occurs prior to egg laying or during incubation (C. R. Griffin unpubl. data). Disturbance of nests can also cause young to leave the nest prior to normal fledging. This can result in abandonment of the young by adults and/or taking of young by predators. The current extent of these losses is unknown. It has been suggested that the taking of forest birds for feathers and food by the early Hawaiians and the collection of birds for museum specimens by early naturalists may have played a major role in the extinction or local extirpation of some forest birds (Berger 1981). (USFWS, 1984)

Stressor: Habitat destruction (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: Hawaii's forests have been drastically reduced as the result of cutting for firewood, timber, croplands, and pasture (Nelson 1967, Berger 1981). Most lowland forests were already modified before European contact (Kirch 1982). Today, most lowland forests have been

converted to agricultural or urban uses, and introduced plants (primarily sugarcane, pastureland, and diversified crops) now dominate much of the island below 800 m elevation. Upper elevation koa forests have also been drastically reduced as a result of logging and subsequent conversion to pasture. Recent (1983) volcanic activity and lava flows have destroyed some forested areas containing 'io nests (C. R. Griffin, unpubl. data). Future urban development also threatens additional areas, particularly in forested regions around Hilo. (USFWS, 1984)

Stressor: Predation (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: Several potential predators of the 'io or their eggs have been introduced to Hawaii. These include the domestic cat (Felis catus), Polynesian rat (Rattus exulans), black rat or roof rat (R. ratus), Norwegian rat (R. norvegicus), and mongoose (Herpestes auropunctatus). While several of these predators are known to prey on small native forests birds or seabirds in Hawaii (Kepler 1967, Berger 1981), there is no evidence that they are significant affecting the 'io. However, all of these predators overlap the range of the 'io, and in the instances when a relatively young chick falls from the nest, it is likely the chick would be eaten by any one of these predators. (USFWS, 1984)

Stressor: Avian disease (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: The endemic passerines of Hawaii appear to be very vulnerable to the two introduced diseases of avian pox and avian malaria (Warner 1968, van Riper et al. 1982). Both diseases are known to be transmitted by the introduced mosquito (Culex quinquefasciatus). Avian pox is also transmitted directly by contact among birds and by mites. Viable populations of Culex decline above 1,500 m (4,900 ft.) elevation, and there is a lower incidence of both pox and malaria in bird populations above this elevation (C. van Riper, pers. comm.). (USFWS, 1984)

Stressor: Environmental contaminants (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: Organochlorine compounds have produced more devastating effects on raptor populations worldwide than have any natural factors or any other poisons (Newton 1979). However, relatively few of the compounds are used in Hawaii (L. F. Frank, pers. Comm.), and only trace amounts have been found in 'io eggs and carcasses which have been analyzed (Berger 1981; C. R. Griffin, unpubl. data.). The potential for secondary poisoning of 'io due to the use of rodenticides in Hawaii is believed to be low. While rodenticides have been commonly used in Hawaiian macadamia nut orchards and sugarcane fields, there is no direct evidence of secondary poisoning of 'io. (USFWS, 1984)

Recovery

Reclassification Criteria:

1. To ensure a self-sustaining 'io population in the range of 1,500 to 2,500 adult birds in the wild, as distributed in 1983, and maintained in stable, secure habitat. For purposes of tracking the progress of recovery, 2,000 will be used as a target to reclassify to threatened status. (USFWS, 1984)

Delisting Criteria:
Not available.

Recovery Actions:
- 1. Determine present distribution and abundance of the 'io on Hawaii. (USFWS, 1984)
- 2. Determine 'io habitat requirements. (USFWS, 1984)
- 3. Identify factors limiting the 'io population. (USFWS, 1984)
- 4. Minimize or eliminate identified detrimental factors. (USFWS, 1984)
- 5. Monitor 'io population status. (USFWS, 1984)
- 6. Develop and implement a public information program to inform public agencies and private citizens about the 'io. (USFWS, 1984)
- 7. Determine appropriate status of this species and downlist or delist. (USFWS, 1984).

Conservation Measures and Best Management Practices:
- Not available.

References

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USFWS. 2016. Environmental Conservation Online System (ECOS) – Species Profile. http://ecos.fws.gov/ecp0/. Accessed September 2016

NatureServe. 2015. NatureServe Explorer: an encyclopedia of life [web application]. Accessed September 2016

USFWS. 1984. Hawaiian Hawk Recovery Plan. Fish and Wildlife Service, Portland, OR

SPECIES ACCOUNT: *Calidris canutus rufa* (Red Knot)

Species Taxonomic and Listing Information

Listing Status: Threatened; 01/12/2015; Northeast Region (Region 5) (USFWS, 2015)

Physical Description

Length: 25-28 cm. Adults in spring: Above finely mottled with grays, black and light ochre, running into stripes on crown; throat, breast and sides of head cinnamon-brown; dark gray line through eye; abdomen and undertail coverts white; uppertail coverts white, barred with black. Adults in winter: Pale ashy gray above, from crown to rump, with feathers on back narrowly edged with white; underparts white, the breast lightly streaked and speckled, and the flanks narrowly barred with gray. Adults in autumn: Underparts of some individuals show traces of the "red" of spring. (USFWS, 2015)

Current Range

Nesting range in North America is in northwestern and northern Alaska, and Canadian arctic islands east to Ellesmere and south to southern Victoria and Southhampton islands, probably also on Adelaide Peninsula and Mansel Island; nesting also occurs in the northern Palearctic. During the boreal winter, the range in the New World extends mainly from coastal regions of southern California, Gulf Coast and Massachusetts south to Tierra del Fuego; generally rare north of southern South America; major South American nonbreeding areas are Tierra del Fuego and Patagonian coast of Argentina, especially Bahia Lomas (Morrison and Ross 1989). New World red knots principally occupy two areas: about 100,000 birds along Atlantic coast of southern Argentina, about 10,000 along Florida Gulf Coast, with no evidence of interchange between the 2 groups (Harrington et al. 1988). In the Old World, most red knots are in southern Europe, southern Asia, Africa, and the Australasian region during the boreal winter. Nonbreeders occasionally summer in the winter range. Delaware Bay is the most important spring migration stopover in the eastern United States (Clark et al. 1993, Botton et al. 1994). (NatureServe, 2015)

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: The Red Knot is an invertivore that consumes mollusks, eggs of crab (primarily horseshoe crab), seeds, small fishes. Horseshoe crab eggs are an important source of food for north-bound migrants at Delaware Bay (Botton et al. 1994). This species can be found scouring sand or mud, making pecks and snatches at sand. (NatureServe, 2015)

Reproduction Narrative

Adult: Arrival in breeding areas occurs in late May or early June; most have departed breeding areas by mid-August. Red Knot lays a clutch of usually 4 eggs in June to July. Egg incubation periods last 20 to 25 days. Eggs are trended mostly by males. Females leave the nest soon after hatching and before fledging. Young can fly in about 18 days. (NatureServe, 2015)

Geographic or Habitat Restraints or Barriers

Adult: Nests on ground in barren or stony tundra and in well-vegetated moist tundra (NatureServe, 2015)

Environmental Specificity

Adult: Moderate. Generalist or community with some key requirements scarce. (NatureServe, 2015)

Habitat Narrative

Adult: The Red Knot is found primarily near seacoasts on tidal flats and beaches, less frequently in marshes and flooded fields (AOU 1983), sandy or pebbly beaches, and river mouths. This species feeds on mudflats and loafs and sleeps on salinas and salt-pond dikes (Costa Rica, Stiles and Skutch 1989). They are found nesting on the ground in barren or stony tundra and in well-vegetated moist tundra. During the winter season they use relatively undisturbed sandy beaches and tidal flats. (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory/in spring (NatureServe, 2015)

Dispersal

Adult: High (NatureServe, 2015)

Immigration/Emigration

Adult: Emigrates (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Red knots migrate long distances between nesting areas in mid- and high arctic latitudes and southern nonbreeding habitats as far north as the coastal United States (low numbers) and southward to southern South America, and to southern Asia, Africa, and Australasian region. Subspecies rufa migrates from nesting areas in the central Canadian Arctic to wintering grounds at the southern tip of South America. Red knots migrate in large flocks northward through the contiguous United States mainly April-June, southward July-October (Bent 1927). Arrival in breeding areas occurs in late May or early June; most have departed breeding areas by mid-August. The species is more abundant in migration along the U.S. Atlantic coast than on the Pacific coast. Knots that visit Delaware Bay in spring come mostly from South America, and these have strong fidelity to migration stopover sites; those that winter in Florida are underrepresented during migration in New Jersey and Massachusetts. Migration through Costa Rica occurs late August-October and mainly mid-March to late April (Stiles and Skutch 1989). This species typically makes long flights between stops (Hayman et al. 1986). (NatureServe, 2015)

Population Information and Trends

Population Trends:

Long-term trends suggest a decline of >90% to an increase of <25%, while short-term trends indicate a 75% decline over three generations (20-25 years) (NatureServe, 2015). Between 2012 and 2019, the population seems to have stabilized (USFWS, 2019).

Species Trends:

Declining (NatureServe, 2015)

Resiliency:

Medium (NatureServe, 2015)

Representation:

Medium (NatureServe, 2015)

Redundancy:

Medium (NatureServe, 2015)

Population Growth Rate:

Rapid decline (NatureServe, 2015)

Population Size:

10,000 to 100,000 (NatureServe, 2015)

Additional Population-level Information:

As of 2017, the peak count at Delaware Bay was 17,969 individuals. The modeled estimate of total stopover population for the Delaware Bay was 49,405 (46,368-53,109, 95% CI). (USFWS, 2019).

Population Narrative:

Population trend estimates at Delaware Bay and eastern Canadian migration stopover sites for subspecies rufa have been consistently negative over the past several decades, though some of the decline data were not statistically significant (Howe et al. 1989, Clark et al. 1993, Morrison et al. 1994, Morrison, Aubry et al. 2001). Recent population surveys showed a dramatic decline of the population that winters primarily in South America (main wintering areas on the coasts of Patagonia and Tierra del Fuego, Argentina and Chile, corresponding with subspecies rufa, which comprises a portion of the North American nesting population) (González et al. 2004, Morrison et al. 2004). Totals in 2003 were about 30,000 compared to 67,500 in the mid-1980s. Numbers at the principal wintering site, Bahia Lomas, fell by approximately 50%, from 45,300 in 2000 to 22,000-25,000 in 2002-2003. Numbers at peripheral sites on the coast of Patagonia declined dramatically, decreasing 98% compared to numbers in the mid-1980s. The declines at core sites did not result from a shift of birds within the known wintering (or other) areas, but reflected a general population decline, with most birds now restricted to key sites in Tierra del Fuego (Morrison et al. 2004). Population estimates are between 10,000 to 100,000 but short-term trends indicate a rapid decline (75%) over the past three generations. (NatureServe, 2015)

Threats and Stressors

Stressor: Disease (USFWS, 2014)

Exposure:
Response:
Consequence:
Narrative: While it has been concluded that disease and parasites are not threats to the red knot, the Services acknowledge an unlikely but potentially high-impact, synergistic effect among avian influenza, environmental contaminants, and climate change could produce a population-level impact in Delaware Bay (USFWS, 2014).

Stressor: Habitat destruction and modification (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Threats to the red knot from habitat destruction and modification are occurring throughout the entire range of the subspecies. These threats include climate change, sea level rise, shoreline stabilization, and coastal development, exacerbated regionally or locally by lesser habitat-related threats such as beach cleaning, invasive vegetation, agriculture, and aquaculture. The subspecies-level impacts from these activities are expected to continue into the future (USFWS, 2014).

Stressor: Other natural and manmade factors (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The red knot faces subspecies-level impacts from other natural and manmade factors that are already occurring and are anticipated to continue and possibly increase into the future. Reduced food availability at the Delaware Bay stopover site due to commercial harvest of the horseshoe crab is considered a primary causal factor in the decline of rufa red knot. Under the current management framework (the ARM), the present horseshoe crab harvest is not considered a threat to the red knot. However, continued implementation of the ARM is imperiled by lack of funding to support the requisite monitoring programs. It is not yet known if the horseshoe crab egg resource will continue to adequately support red knot population growth over the next decade. The red knot's life-history strategy makes this species inherently vulnerable to mismatches in timing between its annual cycle and those periods of optimal food and weather conditions upon which it depends. The red knot also faces a range of ongoing and emerging threats to its food resources throughout its range, including small prey sizes from unknown causes, warming water and air temperatures, ocean acidification, physical habitat changes, possibly increased prevalence of disease and parasites, marine invasive species, and burial and crushing of invertebrate prey from sand placement and recreational activities (USFWS, 2014). Additional moderate threats include wind energy development, harmful algal blooms and oil spills. (USFWS, 2019).

Stressor: Overutilization (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Threats to the red knot from overutilization for commercial, recreational, scientific, or educational purposes exist in parts of the Caribbean and South America. Specifically, legal and illegal hunting do occur. Mortality of individual knots from hunting is expected to continue into

the future, but at stable or decreasing levels due to the recent international attention to shorebird hunting, and due to new voluntary and regulatory hunting restrictions in some areas (USFWS, 2014).

Stressor: Timing asynchronies (USFWS, 2019)
Exposure:
Response:
Consequence:
Narrative: The red knot's sensitivity to timing asynchronies has been demonstrated through a population-level response, as the late arrivals of birds in Delaware Bay is generally accepted as a key causative factor (along with reduced supplies of horseshoe crab eggs) behind population declines in the 2000s (Baker et al. 2004, p. 878). The factors that caused delays in the spring migrations of red knots from Argentina and Chile are still unknown (Niles et al. 2008, p. 2), and we have no information to indicate if this delay will reverse, persist, or intensify in the future. Superimposed on the existing threat of late arrivals in Delaware Bay are new threats emerging due to climate change (Summary for Policymakers in IPCC 2014, p. 30; Root et al. 2013, pp. 85-88; Hurlbert and Liang 2012, p. 4), such as changes in the timing of reproduction for both horseshoe crabs and mollusks (Burrows et al. 2011 , p. 652; Poloczanska et al. 2013, pp. 3-4; Smith et al. 2010b, p. 563; van Oils et al. 2005a, p. 2615; van Oils et al. 2005b, pp. 126-127; Philippart et al. 2003, p. 2171). Climate change may also cause shifts in the period of optimal arctic insect and snow conditions relative to the time period when red knots currently breed (Grabowski et al. 2013, p. 1097; McGowan et al. 2011 a, p. 13; Smith et al. 20 I 0a, p. 292; Tulp and Schekkerrnan 2008, p. 48; Meltofte et al. 2007, pp. 7, 25; Piersma et al. 2005, p. 270; Schekkerman et al. 2003, p. 340). (USFWS, 2019).

Recovery

Reclassification Criteria:
Reclassification criteria are not available.

Delisting Criteria:
As of 2019, preliminary conditions for achieving full recovery of the red knot include the following: (1) populations within all four wintering regions (Argentina/Chile,5 northern South American coast, northwestern Gulf of Mexico, and southeastern United States/Caribbean) are sufficiently large and stable, based on adequate surveys and monitoring, and on scientific modeling such as a full-life-cycle population viability analysis (PY A) [resiliency, representation}. (USFWS, 2019).

2019 preliminary recovery item (2) rates, trends, and trajectories of adult survival, juvenile survival, and reproduction are adequately understood (including consideration of Arctic ecosystem change), and are sufficient to support the resilient wintering populations described in (1), above [resiliency}. (USFWS, 2019).

2019 preliminary recovery item (3) the rufa subspecies breeding and nonbreeding distributions are well understood and delineated relative to other subspecies, and the rufa population structure is clarified (e.g., genetic relationships among subspecies, and among the rufa wintering regions) [resiliency, representation}. (USFWS, 2019).

2019 preliminary recovery item (4) a network of key wintering habitats and major spring and fall migration staging areas across North America and South America provides sufficient suitable food resources at the appropriate times in the annual cycle and is adequately managed and protected [resiliency, representation] (USFWS, 2019).

2019 preliminary recovery item (5) migration stopover habitats across the range (in addition to the key staging areas) are sufficient to allow red knots to adapt to short-term (e.g., annual weather, food, predation, disturbance conditions) and long-term (e.g., climate change, sea level rise, habitat modification) changes in their migratory landscape and timing, and are adequately managed and protected [redundancy, representation]. (USFWS, 2019).

Recovery Actions:

- 2019 Preliminary action plan item 1: Support, encourage, and, if possible, fund the research priorities listed in U.S. Fish and Wildlife Service Rufa Red Knot Research Priorities, 2019 to 2022. (USFWS, 2019).
- 2019 Preliminary action plan item 2: *In Delaware Bay, continue the Service's active role in horseshoe crab management, in the management of intertidal aquaculture, and in supporting State-led efforts to monitor and protect red knots, with a goal of steadily increasing the percent of red knots that depart the bay at adequate weights even as numbers of knots using the bay also increases. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 3: *Avoid and minimize loss and degradation of nonbreeding habitat from coastal engineering and development. a. Work through the Atlantic Flyway Shorebird Initiative's (AFSI) Coastal Engineering Committee (Habitat Work Group) to develop best practices. b. Work with the U.S. Army Corps of Engineers (Corps) and the States to adopt the best practices at the landscape- and project-level scales (e.g., through sections 7(a)(l) and 7(a)(2) of the ESA). c. Focus on documented red knot staging areas, as well as regularly used stopover and wintering habitats. When possible, pursue multispecies conservation opportunities that also benefit other State or federally listed species. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 4: *Work with partners to preserve, enhance, and restore nonbreeding habitat, both proactively and incidental to engineering and development projects. For example, carefully planned beach nourishment can increase or improve red knot habitat in some areas, such as parts of Delaware Bay. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 5: *Develop Service recommendations for managing recreation and other sources of human disturbance in red knot nonbreeding habitats. In developing the recommendations, build on related work being done by the National Wildlife Refuge System, through the AFSI's Human Activities Committee (Habitat Working Group), and in the piping plover wintering range. Work with land managers and project proponents to implement the Service recommendations. Also work with recreation user groups (e.g., fishermen) to enlist support for minimizing disturbance of red knots. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 6: *Work with partners to monitor and manage invasive vegetation in red knot nonbreeding habitats. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).

- 2019 Preliminary action plan item 7: *Work with land managers to evaluate gull and raptor management in the vicinity of red knot nonbreeding habitats on a case-by-case basis. [n some instances, management adjustments may be warranted, such as relocating peregrine falcon (Falco peregrinus) nesting structures. Build on the AFSI's forthcoming shorebird predation best management practices. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 8: *Work with the U.S. Coast Guard and other partners to identify key red knot habitats in oil spill response planning, and prioritize these areas for protection in the event of a spill. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 9: *Work with wind energy developers and regulators to explore alternatives to siting new turbines in red knot concentration areas or along major migration pathways. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 10: *Work with all States, Service Regions, and the U.S. Geological Survey's Bird Banding Lab to ensure best practices are followed by all individuals and entities engaged in red knot trapping, marking, and other research. * = This item focuses on coastal (intertidal) habitats from Maine to Texas. (USFWS, 2019).
- 2019 Preliminary action plan item 11: Establish a Red Knot Information Partnership of interested species experts, researchers, and conservation practitioners from across the species' range. Facilitate the exchange of information by establishing an email listserve and perhaps other electronic tools/platforms. Hold an annual conference call or webinar to discuss collaborative research, new advances in red knot science, new information about threats, and new developments in conservation. Hold ad hoc conference calls or webinars to address urgent issues as they arise. (USFWS, 2019).
- 2019 Preliminary action plan item 12: Enhance and facilitate international cooperation on red knot research and conservation. (USFWS, 2019).

Conservation Measures and Best Management Practices:

- Recovery and maintenance of Delaware Bay horseshoe crab egg densities to levels sufficient to sustain stopover populations of all shorebirds including 100,000 red knots. (NatureServe, 2015). As of 2019, the Delaware Bay horseshoe crab harvest, which is considered a primary causal factor in the decline of the red knot population in the 1990s and 2000s, is now considered adequately managed with harvest levels tied to red knot populations via scientific modeling. (USFWS, 2019)
- Control impact of disturbance at all stopovers and wintering areas, particularly in high-importance, high-disturbance areas like Delaware Bay and the west coast of Florida. (NatureServe, 2015)
- By 2008, develop a system for the yearly determination of population demographic status based on counts, capture data, and resightings of banded individuals. (NatureServe, 2015)
- By 2008, determine the genetic and breeding status of the three main wintering populations (Tierra del Fuego, Maranhão, and Florida). (NatureServe, 2015)
- By 2008, identify all important breeding locations in Canada and recommend protection needs and designations for the most important sites. (NatureServe, 2015)
- By 2009, complete site assessments and management plans for all important wintering areas and stopovers in the Flyway. (NatureServe, 2015)
- By 2009, delineate and propose protection measures for key habitats within the main wintering areas of Maranhão, Tierra del Fuego, and Florida, and develop management plans to guide protection. (NatureServe, 2015)

- By 2009, determine key southbound and northbound stopovers that account for at least 80% of stopover areas supporting at least 100 red knots, and develop coast-wide surveillance of birds as they migrate. (NatureServe, 2015)
- By 2011, create a hemisphere-wide system of protected areas for each significant wintering, stopover, and breeding area. Also crucial to recovery is adequate funding to support the conservation actions and research needed. (NatureServe, 2015)
- Regulations and conservation programs: Atlantic Flyway Shorebird Initiative, Migratory Bird Treaty Act, Atlantic States Marine Fisheries Commission's Fishery Management Plan for horseshoe crabs (key food source), Western Hemisphere Shorebird Reserve Network, Delaware Bay Shorebird Project, US Shorebird Conservation Plan, Red Knot Conservation Plan for the Western Hemisphere, New Jersey Audubon Society, Manomet and the Conserve Wildlife Foundation of New Jersey's Red Knot Working Group. (USFWS, 2019).

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SPECIES ACCOUNT: *Campephilus principalis* (Ivory-billed woodpecker)

Species Taxonomic and Listing Information

Listing Status: Proposed delisting

Physical Description

The Ivory-billed Woodpecker is noted for its striking black-and white plumage; robust white, chisel-tipped bill; lemon-yellow eye; and pointed crest. Males are red from the nape to the top of their crest with black outlining the front of the crest. Females have a solid black crest which is somewhat more pointed and slightly recurved to point forward. The bases of the male's red crest feathers are white and may allow a spot of white to be displayed on the side of the crest when the feathers are fully erect. Available information from such sources suggests the Ivory-billed Woodpecker has an overall length of approximately 48-51 centimeters (cm), an estimated wingspan of 76-80 cm, and a weight of 454-567 grams (g).

Taxonomy

The Ivory-billed Woodpecker (Campephilus principalis) belongs to a genus composed of 11 species of woodpeckers inhabiting the Western Hemisphere— primarily Central and South America. Two forms of Ivory-billed Woodpecker have been recognized (American Ornithologists' Union 1983): the North American form with a historical range covering most of the southeastern and a small portion of south-central United States and the Cuban form with a historical range throughout Cuba. The Cuban form has been recognized by some authors to be a distinct species, C. bairdii (American Ornithologists' Union 1983; Fleischer et al. 2006) while others define the 2 forms as subspecies -- C. p. principalis and C. p. bairdii (e.g., Integrated Taxonomic Information System 2008).

Historical Range

This species was once an inhabitant of forested habitats throughout the Southeastern United States and Cuba. It once roamed forests of the southeastern United States from the coastal plain of Texas and eastern Oklahoma into North Carolina, southward to include all of Florida, and the Mississippi Alluvial Valley northward to the confluence with the Ohio River and then eastward on the Ohio River bordering Kentucky and Illinois (Hasbrouck 1891).

Current Range

In 2005, multiple sightings and recorded audio and video interpreted to be an Ivory-billed Woodpecker were reported within a section of Bayou DeView, located in the Cache River National Wildlife Refuge (NWR) in east-central Arkansas.

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Juvenile: For nestling feeding, see adult feeding narrative.

Adult: Diet is poorly understood and based on anecdotal observations and the examination of the stomach contents from eight collected birds (Jackson 2002). Large beetle larvae appear to be an important component of the diet throughout the year, but especially during breeding when feeding young. These beetle larvae are obtained according to Tanner (1942) primarily by stripping large pieces of bark from recently dead or dying tree trunks and branches as well as by the more typical woodpecker approach of excavating rotted wood. Most notable in both the stomachs of collected birds as well as remains in nests were the members of the beetle family Cerambycidae (long-horned and round-headed borers), but many other species of wood-boring larvae also have been documented in the diet. In addition to animal matter, the contents of three stomachs examined in detail from birds collected outside the breeding season (1 during August, 2 during November; described in Tanner 1942, Jackson 2002), illustrated a high percentage and broad range of vegetable matter was also eaten when available. Included in these stomachs, with anecdotal observations from others, were various nuts, such as pecans and acorn, and fruits and seeds, such as from hackberry, persimmon, wild grape, poison ivy, magnolia, black gum, and tupelo.

Reproduction Narrative

Juvenile: Young fledge after about 35 days.

Adult: Breeding phenology (annual cycle) is poorly known. Generally, it is thought that breeding occurs between January and April (Tanner 1942). Cavities are excavated in a dead or dying portion of a live tree, although in some cases a dead tree may be used. Nest cavities have ranged from 4.6 m to over 21 m up the nest tree with nests rarely being excavated below 9 m from the tree's base. Reported clutch size ranges from 1-5 eggs, but most reports are of clutches of 2 to 4 eggs. Both sexes of the Ivory-bill incubate the eggs, and Tanner documented that both parents feed the young until they have fledged. The young may be fed by the parents for an additional two months and forage with and roost near the parents into the next breeding season.The only quantified data regarding reproductive success for the Ivory-billed Woodpecker is from Tanner (1942). While he identified up to seven potential family groups during this six year period, only three of the seven produced young in at least one year. Ultimately during the period of 1934-1939, 9 of the 16 young observed came from one area (again John's Bayou), and 6 from another area (Mack's Bayou combined with Titepaper), with the other five areas mostly failing to produce any young (the only exception being Bayou Despair in 1937). Life span has been estimated to be in excess of 10 years, although this is also not known for certain. Current knowledge of the species suggests that the relatively low reproductive capacity of the species may require many years for significant population growth.

Geographic or Habitat Restraints or Barriers

Adult: Forest boundaries

Environmental Specificity

Adult: Narrow

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: Moderate

Habitat Narrative

Adult: The Ivory-billed Woodpecker was historically described as a resident of large, contiguous forests with numerous large trees. Bottomland hardwood forests are frequently noted as important (Jackson 2002, Tanner 1942). In Florida, bald cypress was noted as an important component of the forest used by Ivory-billed Woodpeckers, especially in conjunction with an adjacent pine forest (Jackson 2002). The Ivory-bill requires large tracts of forest for foraging and trees large enough for nesting and roosting. Additionally, the species may have sought older forests subjected to recent catastrophic events such as drought, fire, hurricanes, tornadoes, ice storms, and flooding, leading to the death of large patches of trees. In more modern times, Tanner documented that Ivory-billed Woodpeckers used forests that had undergone some partial logging, as long as many damaged, dying, and stressed trees were left standing and there were nearby remaining large areas of unlogged, older forests. Essential features of Ivory-billed Woodpecker habitat include: extensive, continuous forest areas, very large trees, and agents of tree mortality resulting in a continuous supply of recently dead trees or large dead branches in mature trees (Jackson 2002). Ivory-billed Woodpeckers are thought to be dependent on extensive forested areas with old-growth characteristics and naturally high volumes of dead and dying wood needed to sustain the species in between disturbance events (Tanner 1042). Ivory-billed Woodpeckers excavate and/or use roost cavities. Roost cavities are similar in appearance to nest cavities. Individuals can be faithful to the same roost cavity for at least a year and a half (Tanner 1942). The ecology of the species likely includes substantial spatial and temporal flexibility, due to their use of disturbed sites containing increased volumes of stressed and dead trees.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: Moderate

Dispersal/Migration Narrative

Adult: The Ivory-billed Woodpecker was known to fly distances of at least several kilometers each day between favored roost sites and feeding areas. Such movements are associated with maintaining large home ranges (Tanner 1942)

Population Information and Trends

Population Trends:

Unknown

Species Trends:

Unknown

Resiliency:
Low

Representation:
Low

Redundancy:
Low

Population Growth Rate:
Low (see reproduction narrative)

Number of Populations:
Unknown

Population Size:
Unknown

Adaptability:
Moderate (see habitat narrative)

Population Narrative:
Information on the status of the population is limited, and current population size and distribution is not known. Ivory-billed Woodpecker populations appear to have been in a state of continuous fragmentation and decline since the early 1800s (Jackson 2002, Tanner 1942). The exact number and genetic health of any remaining birds are unknown. Little hope was held for its continued existence until compelling evidence of the species was obtained in 2004 and announced in 2005 (Fitzpatrick et al. 2005).

Threats and Stressors

Stressor: Habitat loss and degradation
Exposure:
Response:
Consequence:
Narrative: The historical decrease in Ivorybilled Woodpecker numbers throughout the range appears to be mainly due to large-scale reduction and conversion of forest habitats, though this is not universally accepted. According to Tanner, “In many cases [Ivory-billed Woodpeckers’] disappearance almost coincided with logging operations. In addition, before large scale logging had commenced, Tanner also commented that the reduced occurrence of recently dead and dying wood was probably responsible for declines of woodpeckers in the Singer Tract. Forest loss continued with another period of accelerated clearing and conversion to agriculture of bottomland hardwood forests of the Lower Mississippi Valley (LMV) during the 1960s and 1970s.

Stressor: Stochastic events
Exposure:
Response:

Consequence:
Narrative: Threats exist from continued fragmentation and normal environmental changes. For example, sporadic natural events such as tornadoes or ice storms could destroy the only remaining nest or roost trees, or severe weather conditions could result in nesting or fledging failures. There is no information on the number and genetic health of any remaining birds. Small populations are normally at risk from genetic and demographic stochastic events (such as normal variations in survival and mortality, genetic drift, inbreeding, etc.).

Stressor: Difficulty in confirming species presence
Exposure:
Response:
Consequence:
Narrative: Difficulty in confirming and delineating populations and the limited basic biological and ecological information on the species is an important factor that currently threatens the ability to recover the species.

Recovery

Reclassification Criteria:
1. Potential habitats for any occurrences of the species are surveyed.

2. Current habitat use and needs of any existing populations are determined.

3. Habitat on public land where Ivory-bills are located is conserved and enhanced. If needed, additional acreage is acquired from willing sellers and listed in the public habitat inventory.

4. Habitat on private lands is conserved and enhanced through the use of voluntary agreements (e.g., conservation easements, habitat conservation plans) and public outreach.

5. Viability of any existing populations (numbers, breeding success, population genetics, and ecology) is analyzed.

6. The number and geographic distribution of subpopulations needed to create conditions favorable to a self-sustaining metapopulation and to evaluate habitat suitable for species reintroduction is determined.

Delisting Criteria:
Not developed

Recovery Actions:
- 1. Population surveys and monitoring in the historical range where habitat and sighting information indicate potential for the presence of the species
- 2. Habitat inventory and monitoring in the historical range of the species
- 3. Population and habitat modeling to facilitate survey efforts and to inform potential management actions
- 4. Research directed at testing biological assumptions otherwise implicit in modeling and management actions

- 5. Landscape characterization and assessment of the Mississippi Alluvial Valley and other areas of the historical range
- 6. Conservation design aimed at defining the spatially explicit landscape conditions needed to support the species
- 7. Education and outreach on the conservation of the species
- 8. Management of public use in areas where the species is known to occur to avoid possible adverse impacts from intense public use, and
- 9. Management of rediscovered populations and forested habitats to aid recovery

Conservation Measures and Best Management Practices:

- Current conservation efforts in Arkansas have focused on learning more about the status and distribution of the species in the Cache River and White River drainages; managing public access to potentially sensitive sites and directing visitors to appropriate areas; protection of land through acquisition of easements or fee interest; forest management, reforestation; and public education.
- Various quantitative models were developed to identify the amount and quality of habitat needed to support recovery. Additionally, NWR forest management activity was carefully reviewed for potential impacts on the Ivory-billed Woodpecker.
- About 326,000 acres of the Cache River-White River basin is in public ownership as national wildlife refuges, state natural areas, or state WMA. In addition, private conservation interests, primarily TNC and Ducks Unlimited, hold nearly 20,000 acres. These fee title ownerships are supplemented by approximately 52,882 acres of Wetland Reserve Program easements administered by the Natural Resources Conservation Service. Together these lands total almost 400,000 acres of current and future habitat that is being managed and conserved.
- Active forest management (thinning and other tree cutting) on Cache River and White River National Wildlife Refuges was temporarily suspended (2005-7) while the existing forest management plans were reviewed to ensure that they created habitat that best meets the requirements of the Ivory-billed Woodpecker. Managers of the adjacent state lands at Dagmar and Rex Hancock/Black Swamp WMAs also established a temporary moratorium on harvesting or thinning stands for forest management. Current forest management prescriptions allow the manager to apply appropriate silvicultural practices for individual stands to meet habitat needs for a wide variety of target species. The publication Restoration, Management and Monitoring of Forest Resources in the Mississippi Alluvial Valley: Recommendations for Enhancing Wildlife Habitat provides these recommended objectives and guidelines (LMVJV Forest Resource Conservation Working Group 2007).
- In 2005 limited morticulture (stressing/killing live trees) management was implemented as an experiment along Bayou DeView on the Benson Creek Natural Area, which is jointly owned by TNC and the Arkansas Natural Heritage Commission. Four 4-acre blocks were treated with varying amounts of tree girdling to create potential Ivory-billed Woodpecker feeding habitat and to attract the birds for observation. The results are being monitored and may serve as a pilot for larger studies in the future. Additional modified harvesting practices and morticulture plots have been developed and established by the LDWF on WMAs and Tensas NWR in Louisiana. These activities are part of ongoing research the better to understand dynamics associated with insect colonization of stressed trees in bottomland hardwood forests; potentially informing the development of Ivory-billed Woodpecker foraging habitat.
- Land acquisitions at Cache River NWR, in cooperation with TNC, also provide long-term habitat benefits for a multitude of species. This refuge is a regional priority for additional acreage, primarily driven by North American Waterfowl Management Plan objectives for the mid-continent mallard population.

- The Natural Resources Conservation Service has been a leader in restoring bottomland hardwood habitat in the lower White River basin. Since the 2005 announcement of rediscovery of the Ivory-billed Woodpecker their Wetland Reserve Program (WRP) has enrolled 3,601 acres, and the Wildlife Habitat Incentives Program has established easements to reforest or enhance existing forests on 5,958 acres of privately owned land. The Wetland Reserve Enhancement Program is committed to supplemental tree planting on 1,000 additional acres of WRP lands.
- The Fish and Wildlife Service's Partners for Fish and Wildlife Program committed $1 million in support of habitat improvement activities on private lands in Arkansas and Louisiana. In 2005, 996 acres were enrolled in and reforested by this program in and around the Big Woods. In 2006, an additional 1,362 acres were planted in the same area.
- A central database has been established where all Ivory-billed Woodpecker sightings can be reported (http://www.birds. cornell.edu/ivory/identifying/). In May 2005 three "Town Hall" meetings were held in the communities of Brinkley, Stuttgart, and Augusta to provide information on the announcement of rediscovery and the first steps which are expected to be taken towards recovery.

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SPECIES ACCOUNT: *Caprimulgus noctitherus* (Puerto Rican nightjar)

Species Taxonomic and Listing Information

Listing Status: Endangered; June 4, 1973; Southeast region (R4)

Physical Description

The Puerto Rican nightjar is a small cryptically plumaged caprimulgid endemic to Puerto Rico. It is robin-sized with long bristles about the bill. The fluffy plumage is mottled with dark brown, black, and gray. There is a white band across the throat and white spots at the end of the tail feather (Kepler and Kepler 1973).

Taxonomy

The phylogeny of Neotropical caprimulgids is generally not well understood. However, the Greater Antillean nightjar (Caprimulgus cubanensis), the Hispaniola nightjar (Caprimulgus ekmani), and the Puerto Rican nightjar may be more closely related to the whip-poor-will (Caprimulgus vociferus) than to other species of Neotropical Caprimulgus. Han et al. (2010) reconstructed a molecular phylogeny of the Caprimulgidae using mitochondrial and nuclear DNA. Results indicated neither of the traditional subfamilies of nighthawks (Chordeilinae) and nightjars (Caprimulginae) is monophyletic, and suggested the nightjar morphology construction ("body plan") is an old and conservative one. Han et al. (2010) propose a taxonomic revision of the family based on the combined tree. However, such revision should not affect the species as it was described.

Historical Range

All of the original records for the nightjar were from the northern moist karst forest regions of the island. This included an individual (type specimen) collected in Bayamón in 1888, a collection of sub-fossil bones from cave deposits in Morovis, and a record of a bird seen in Río Piedras in 1911 (Wetmore 1919, 1920).

Current Range

The species was rediscovered by Reynard (1962) in 1961 at the Guánica Commonwealth Forest, located 62 km to the southwest of the last recorded sighting 50 years earlier. A study was conducted during 1985-1992 found in three main areas located in coastal dry and lower cordillera forests of southwestern Puerto Rico. These included; Guánica-Ensenada, Susúa-Maricao, and Guayanilla-Peñuelas. This study also reported the first nightjar records in the La Parguera Hills and Sierra Bermeja, located on the southwestern tip of Puerto Rico.

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: This species is a strict insectivore. This species does not appear to travel to open agricultural lands for foraging. Instead, nightjars forage under the canopy by sallying from favored perches (Vilella 1989). At the Guánica Commonwealth Forest, nightjars also feed on insects attracted to artificial light sources (Vilella 1989). Kepler and Kepler (1973) indicate that this species captures insects in flight. This species is nocturnal.

Reproduction Narrative

Egg: Kepler and Kepler reported that hatching occurs in 19 days asynchronously.

Juvenile: Young usually wander from the nest by the third day and are able to fly by the 14th day.

Adult: Based on data from three nests, Kepler and Kepler (1973) suggested that the breeding season probably lasts from May throughout July. This species may produce two broods per year, based on other caprimulgids. The Keplers observed that C. noctitherus does not build a nest, but lays its eggs (usually two) on leaf litter under a bush. Eggs were not laid in open areas. Nightjar nesting success at the Guánica Commonwealth Forest was estimated at 87% (Vilella 1995). Nightjars sit tightly on the eggs during the day and hold their body pressed to the ground, enhancing their inconspicuousness (Vilella 2010). Being a ground nester, the nightjar is not dependent on arboreal structures (e.g., cavities, tree crowns, branches) for reproduction. Adults do not return to the nest site after chicks have fledged (Kepler and Kepler 1973).

Geographic or Habitat Restraints or Barriers

Adult: Agricultural lands (see feeding narrative), wet forests at higher elevations

Site Fidelity

Adult: Low (see reproduction narrative)

Habitat Narrative

Adult: Most (65 %) of the predicted nightjar habitat was found within the region encompassed by the municipalities of Guánica, Sabana Grande, Yauco, Guayanilla, Peñuelas and Ponce (González 2010). This region has been known for some time as encompassing the best habitats for nightjars within the geographic range of the species (Vilella 1989). The region is characterized by large areas of continuous dry, mature, closed-canopy, semi-deciduous and evergreen forests. Outside this region of southwestern Puerto Rico, predicted nightjar habitat is characterized by small fragments of forest distributed across the southern coast of the island (González 2010). Wet forests at higher elevations reduces the probability that the whip-poor-will could inhabit these areas as there would not be enough food to sustain a population (Kepler and Kepler 1973).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal/Migration Narrative

Adult: This species exhibits sedentary behavior.

Population Information and Trends

Population Trends:

Stable

Representation:

Unknown

Population Size:

2,800 - 4,000

Population Narrative:

While no information exists to estimate population trends for the nightjar, information collected in Guánica and Susúa Commonwealth Forests over the years (Kepler and Kepler 1973, Wiley 1985, Vilella and Zwank 1993a, Gonzalez 2010) suggests the number of nightjars detected along survey routes has remained fairly constant. Vilella and Zwank (1993a) reported approximately 1,400–2,000 male nightjars were distributed across some 10,000 hectares in southwest Puerto Rico. Thus, assuming each singing nightjar may represent a potential breeding pair; nightjar estimates by Vilella and Zwank (1993a) represent 2,800 to 4,000 individuals across southwestern Puerto Rico. No information exists on genetic structure of the nightjar.

Threats and Stressors

Stressor: Habitat destruction and modification
Exposure:
Response:
Consequence:
Narrative: Extensive clearing of forests in Puerto Rico began early in the nineteenth century, and by 1828 about one-third of the island had been cleared for agriculture (Wadsworth 1950). Deforestation peaked in the early 1930s when forest cover reached a low of approximately 81,000 ha, representing about 9% of the Island (Birdsey and Weaver 1987). By late 1940s, forest cover reached a low of about 6%. However, forest recovery following cessation of intensive land-use has progressed in time and space (Lugo et al. 1996). By the 1980s, forest cover, including coffee shade, occupied about 280,000 hectares or about 31.5% of the island's land area (Birdsey and Weaver 1987), and about 32 to 42% of the island’s area by 1990 (Gould et al. 2007). The economic shift away from agriculture resulted in agricultural lands reverting to forests, but urban expansion and land development have led to the loss of agricultural and forest land and their associated wildlife (Birdsey and Weaver 1987). The recent rapid development (urbanization and industrialization) of most municipalities of southwestern Puerto Rico during the last decades is the most serious threat to the species' survival, because it promotes fragmentation of remaining nightjar habitat and may result in declines and local extinctions of isolated nightjar populations (Thomas 1990).

Stressor: Predation
Exposure:

Response:
Consequence:
Narrative: Predation of breeding nightjars and their nests by exotic mammals has been documented (Vilella 1995). The mongoose was introduced into the West Indies during the 1870's with the intention of controlling rat populations (Rattus spp.) on sugar-cane plantations. Avian predators have been reported to take eggs from Puerto Rican nightjar nests (Vilella 1995). Ants can also overwhelm nightjar chicks while hatching. Two species of exotic primates established in southwestern Puerto Rico, the patas monkeys (Erythrocebus patas) and rhesus macaques (Macaca mulatta), may also represent a threat to the nightjar. These monkeys are considered omnivorous with diets consisting primarily of vegetative matter, but will feed on small mammals and birds opportunistically (USDA 2008).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. A population of 600 breeding pairs in Guánica forest, 400 breeding pairs in the Guayanilla-Tallaboa area, and 200 breeding pairs in Susúa forest.

2. Assurance of long-term protection of the essential habitat needed to sustain these populations.

Recovery Actions:
- 1. Determine the status of the population
- 2. Determine habitat requirements
- 3. Protect the population
- 4. Conduct natural history studies
- 5. Monitor recovery of the population

Conservation Measures and Best Management Practices:
- 1. Update the Recovery Plan for the Puerto Rican Nightjar to incorporate new information and new science, as well as to update the recovery actions for the species.
- 2. The lack of life history parameter estimates for the Puerto Rican nightjar is one of the primary information gaps for the species. Information on nest, juvenile and adult survival is needed if demographic models are to be developed for the nightjar.
- 3. Additional information on productivity is needed. Virtually all the nesting information for the species has been obtained from the Guánica Commonwealth Forest. No information on productivity exists for nightjar populations from the Susúa Commonwealth Forest or the Guayanilla-Peñuelas Hills.
- 4. Detailed information on dispersal and spatial dynamics should be obtained. Recent advances in radio transmitter design and capture techniques for caprimulgids can be applied to the Puerto Rican nightjar (Conway et al. 2007, Wilson and Watts 2008). Information on juvenile dispersal as well as movement dynamics of adult Puerto Rican nightjars at multiple scales in the landscape is needed. This is particularly relevant given the apparent isolation of some nightjar populations (e.g., Susúa-

Maricao) and the high degree of fragmentation of a large portion of privately owned lands occupied by nightjars (González 2010).

- 5. Additional research on nightjar-habitat relationships is warranted. Previous studies indicated the main limiting factor determining nest habitat use by nightjars was the presence of dense, tangled vegetation near the ground. Vilella (2008) illustrated relationships that could serve as the basis for future experimental work.
- 6. Reintroducing the Puerto Rican Nightjar into the north-central region of the island should be considered as a long-term recovery action of the species.
- 7. Results by González (2010) clearly indicate the vast majority of suitable nightjar habitat (81.4%) remains under private ownership. The most significant portion of privately owned nightjar habitat is encompassed by the region extending beyond the eastern limits of the Guánica Commonwealth Forest, to the municipality of Yauco (Barina Hills) and east to the western limits of the city of Ponce. Efforts must be concentrated in acquiring and protecting as much forest habitat in this fairly large tract of coastal dry forest as possible. Conservation programs from agencies like the USFWS and Natural Resources Conservation Service (NRCS) should also be implemented in private lands within this region.

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USFWS 2012. Puerto Rican Nightjar or guabairo (Caprimulgus noctitherus) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office, Boquerón, Puerto Rico.

SPECIES ACCOUNT: *Centrocercus minimus* (Gunnison sage-grouse)

Species Taxonomic and Listing Information

Commonly-used Acronym: GUSG

Listing Status: Threatened; 12/22/2014; Mountain-Prairie Region (R6) (USFWS, 2016)

Physical Description

A large bird (grouse). This is a large grouse, dark gray overall, with a long, pointed tail, pale breast, and black belly (Sibley 2003). Males are larger than females; adult total length averages around 22 inches (56 cm) in males, 18 inches (46 cm) in females; body mass is around 2,100 grams in males, 1,100 grams in females (Sibley 2003). (NatureServe, 2015). New in 2019: This is the second largest grouse species in North America. Male GUSG are larger than females, weighing from 1.7–2.4 kg (3.7–5.3 lbs.) and females weigh 0.9–1.3 kg (2.0–2.9 lbs.) (Young et al. 2000, p. 447). GUSG are dark brown in color with black underparts, and coarsely barred brown-white or white-yellow tail feathers. During the non-breeding seasons, males and females appear similar except females are smaller with shorter feathers and the yellow-green eye comb is larger on males (Young et al. 2000, p. 448). Adult males are most conspicuous during the breeding season when they have developed long, thin, black, specialized ornamental contour feathers (filoplumes) on the back of the neck and rounded air sacs that are greenish-yellow within a white upper breast with scale-like feathers (Young et al. 2000, p. 448) (Figure 2). During the breeding season, males use the air sacs to create a popping sound nine times and strut on leks to attract females. Strutting is slower than other species of sage-grouse (Young 1994, p. 15). Juveniles resemble adults of their sex but may be distinguished for up to 17 months by two outermost primaries that are more pointed than adult primaries (Braun and Schroeder 2015, p. 183). GUSG eggs ranges from deep olive-buff and light olive buff color to greenish drab and greenish white with lighter shades of brown or olive green, and are marked with small spots of chocolate brown and brownish olive ovate. Eggs average 54.5 mm in length and 38.0 mm in diameter (Young 1994, p. 37; Young et al. 2015, p. 12). (USFWS, 2019)

Taxonomy

Gunnison sage-grouse are significantly smaller than greater sage-grouse in size of culmen, carpel, and tarsus, and they weigh approximately 1/3 less (Hupp and Braun 1991, Young et al. 2000). The two species also exhibit genetic differences (Kahn et al. 1999, Oyler-McCance et al. 1999). Additionally, Gunnison sage-grouse males have more elaborate head plumes than do greater sage-grouse males, and they have broader white barring on the tail feathers (Young et al. 2000). The two species also differ in male display behavior; for example, the Gunnison sage-grouse display ends with a tail-shaking motion of the raised tail (absent in greater sage-grouse) (Barber 1991; Young et al. 1994, 2000). (NatureServe, 2015)

Historical Range

The historical range is thought to have included southwestern Colorado, northwestern New Mexico, northeastern Arizona, and southeastern Utah (Schroeder et al. 2004). (NatureServe, 2015)

Current Range

This species occurs locally in the Gunnison Basin and southwestern Colorado, and in adjacent southeastern (San Juan County) Utah south and east of the Colorado River (AOU 2000, Beck et al. 2003, Schroeder et al. 2004, Gunnison Sage-grouse Rangewide Steering Committee 2005, USFWS 2014). (NatureServe, 2015)

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 11/20/2014.

Legal Description

On November 20, 2014, the U.S. Fish and Wildlife Service (Service), designated critical habitat for the Gunnison sagegrouse (Centrocercus minimus) under the Endangered Species Act (79 FR 69311 - 69363). In total, approximately 1,429,551 acres (ac) (578,515 hectares (ha)) are designated as critical habitat in Delta, Dolores, Gunnison, Hinsdale, Mesa, Montrose, Ouray, Saguache, and San Miguel Counties in Colorado; and in Grand and San Juan Counties in Utah.

Critical Habitat Designation

The critical habitat designation for Centrocercus minimus includes six units totaling approximately 1,429,551 ac (578,515 ha) in Grand and San Juan Counties, Utah, and Delta, Dolores, Gunnison, Hinsdale, Mesa, Montrose, Ouray, Saguache, and San Miguel Counties, Colorado. The units are (1) MonticelloDove Creek, (2) Pinon Mesa, (3) San Miguel Basin, (4) Cerro SummitCimarron-Sims Mesa, (5) Crawford, and (6) Gunnison Basin. The Service considers approximately 55 percent of all critical habitat to be currently occupied and 45 percent to be currently unoccupied by Gunnison sage-grouse.

Unit 1: Monticello-Dove Creek. Unit 1 consists of 343,000 ac (138,807 ha) of Federal, State, and private lands in San Juan County, Utah; and Montrose, San Miguel, and Dolores Counties, Colorado. Approximately 13 percent of the land area within the unit is managed by Federal agencies, 1 percent is owned by the State of Colorado and the State of Utah, and the remaining 86 percent comprises private lands. We consider 33 percent of this unit to be currently occupied by Gunnison sage-grouse, based on mapping developed for the 2005 RCP, as updated (GSRSC 2005, p. 54; CPW 2013e, spatial data). Tables 4 and 5 provide detailed acreage estimates for all critical habitat units. The occupied portion of the Monticello-Dove Creek Unit contains the physical and biological features essential to the conservation of the Gunnison sage-grouse, but these areas are interspersed within lands in agricultural production. Within the occupied portion of this Unit, approximately 23,220 ha (57,377 ac) or 51 percent of the area is currently in agricultural production (USGS 2004, entire). However, a significant portion of the agricultural lands within the Unit are enrolled in the USDA Farm Service Agency's Conservation Reserve Program (CRP), which is a land conservation program where farmers agree to remove environmentally sensitive lands from agricultural production in exchange for a yearly rental payment. Many CRP lands are used by Gunnison sage-grouse (Lupis et al. 2006, pp. 959–960; Ward 2007, p. 15). Factors potentially affecting the physical and biological features of the Monticello-Dove Creek Unit include, but are not limited to: Habitat loss, degradation, and fragmentation resulting from conversion to agriculture; climate change, drought-related effects; oil and gas production and associated infrastructure; the proliferation of predators of Gunnison sage-grouse; the spread of invasive plant species and associated changes in sagebrush plant community structure and dynamics; and past and present grazing management that degrades or eliminates vegetation structure; all of which can result in the loss, degradation, or fragmentation of sagebrush plant communities. Special management actions that may be needed to address these threats include, but are not limited to: The rangewide prioritization and protection of crucial seasonal habitats from development and agricultural conversion; the control of invasive plant species and restoration of historic plant community structure and dynamics, including altered fire regimes and other natural disturbance factors; and the implementation of grazing regimes that result in proper vegetation structure for Gunnison sage-grouse lifehistory needs in areas used for domestic and wild ungulate grazing and browsing. Limiting the designation of critical habitat in this unit only to currently occupied areas would be inadequate to ensure the conservation of the species. Accordingly, we are designating currently unoccupied areas that we conclude are essential for the conservation of the species. Designated unoccupied habitat comprises approximately 69 percent of the unit, including lands defined in the 2005 RCP as potential habitat or vacant or unknown habitat (GSRSC 2005, p. 54) and other unoccupied areas that met our criteria for critical habitat (see Criteria and Methods Used to Identify and Map Critical Habitat). We acknowledge, however, that portions of these unoccupied lands are locally unsuitable as habitat for Gunnison sage-grouse. For instance, some areas within the critical habitat unit are dominated by pin˜onjuniper communities (Messmer 2013, p. 17). As described earlier, critical habitat was identified on a landscape scale, and includes areas with varying amounts of overall sagebrush cover, plus habitat types that may facilitate bird movements and dispersal. These areas are also located adjacent to occupied habitat or are located immediately between surrounding populations. In addition to contributing to the fulfillment of the landscape scale habitat needs of Gunnison sage-grouse, these areas provide habitat for future population growth and reestablishment of portions of presettlement range, and facilitate movement between other units and within the unit. Some unoccupied habitat areas within this unit consist of lands that recently supported sagebrush-dominant plant communities but are currently in agricultural production or are currently subject to encroachment by coniferous trees or shrubs, most commonly pin˜ onjuniper or mountain shrub plant communities. These areas require management to reestablish or enhance sagebrush communities to support the primary constituent elements of Gunnison sage-grouse nesting or broodrearing habitats. However, in their current state, these areas provide essential habitat for inter-population movements and thus may reduce population isolation and increase genetic exchange among populations.

Unit 2: Pinon Mesa. Unit 2, the Pinon Mesa Unit, consists of 207,792 ac (84,087 ha) of Federal, State, and private lands in Grand County, Utah, and Mesa County, Colorado. Approximately 73 percent of the land area within the unit is managed by Federal agencies, less than 1 percent is owned by the State of Utah, and 27 percent comprises private lands. We consider 14 percent of this unit to be currently occupied by Gunnison sagegrouse, based on mapping developed for the 2005 RCP and subsequently (GSRSC 2005, p. 54; CPW 2013e, spatial data). Tables 4 and 5 provide detailed estimates for all critical habitat units. The occupied portion of the Pin˜ on Mesa Unit contains the physical and biological features essential to the conservation of Gunnison sage-grouse. Factors potentially affecting the physical and biological features of the Pin˜ on Mesa Unit include, but are not limited to: Residential and commercial development including associated landclearing activities for the construction of access roads, utilities, and fences; increased recreational use of roads and trails; the proliferation of predators of Gunnison sage-grouse; climate change, drought-related effects; the spread of invasive plant species and associated changes in sagebrush plant community structure and dynamics; and past and present grazing management that degrades or eliminates vegetation structure; all of which can result in the loss, degradation, or fragmentation of sagebrush plant communities. Special management actions that may be needed to address these threats include, but are not limited to: The rangewide prioritization and protection of crucial seasonal habitats subject to future residential and commercial development and increasing recreational use of roads and trails; the control of invasive plant species and restoration of historical plant community structure and dynamics, including altered fire regimes and other natural disturbance factors; and the implementation of grazing regimes that result in proper vegetation structure for Gunnison sage-grouse life-history needs in areas used for domestic and wild ungulate grazing and browsing. Limiting the designation of critical habitat in this unit only to currently occupied areas would be inadequate to ensure the conservation of the species. Accordingly, we are designating currently unoccupied areas that we conclude are essential for the conservation of the species. Designated unoccupied habitat comprises approximately 86 percent of the unit, including lands defined in the 2005 RCP as potential habitat or vacant or unknown habitat (GSRSC 2005, p. 54) and other unoccupied areas that met our criteria for critical habitat (see Criteria and Methods Used to Identify and Map Critical Habitat). These areas consist of lands with varying amounts of overall sagebrush cover, or have habitat types suitable for movements and dispersal. These areas are also located adjacent to occupied habitat or are located immediately between surrounding populations. In addition to contributing to the fulfillment of the landscape specific habitat needs of Gunnison sagegrouse, these areas provide habitat for future population growth and reestablishment of portions of presettlement range, and facilitate or allow movement between other units and within the unit. Some unoccupied habitat areas within this unit consist of lands that recently supported sagebrushdominant plant communities but are currently in agricultural production or are currently subject to encroachment by coniferous trees or shrubs, most commonly pin˜on-juniper or mountain shrub plant communities. These areas require management to reestablish or enhance sagebrush communities to support the primary constituent elements of Gunnison sage-grouse nesting or brood-rearing habitat. However, in their current state, these areas provide essential habitat for interpopulation movements and thus may reduce population isolation and increase genetic exchange among populations.

Unit 3: San Miguel Basin. Unit 3, the San Miguel Basin Unit, consists of 121,929 ac (49,343 ha) of Federal, State, and private lands in Montrose, San Miguel, and Ouray counties, Colorado. Approximately 41 percent of the land area within the unit is managed by Federal agencies, 12 percent is owned by the State of Colorado, and 47 percent comprises private lands. We consider 67 percent of this unit to be currently occupied by Gunnison sage-grouse, based on mapping developed for the 2005 RCP and subsequently (GSRSC 2005, p. 54; CPW 2013e, spatial data). Tables 4 and 5 provide detailed estimates for all critical habitat units. The occupied portion of the San Miguel Basin Unit contains the physical and biological features essential to the conservation of the Gunnison sage-grouse. Factors potentially affecting the physical and biological features within the San Miguel Basin Unit include, but are not limited to: Residential and commercial development including associated land-clearing activities for the construction of access roads, utilities, and fences; increased recreational use of roads and trails; the proliferation of predators of Gunnison sage-grouse; climate change, droughtrelated effects; the spread of invasive plant species and associated changes in sagebrush plant community structure and dynamics; past and present grazing management that degrades or eliminates vegetation structure; and oil and gas development and associated infrastructure, all of which can result in the loss, degradation, or fragmentation of sagebrush plant communities. Special management actions that may be needed to address these threats include, but are not limited to: The rangewide prioritization and protection of crucial seasonal habitats subject to future residential and commercial development (including oil and gas development) and increasing recreational use of roads and trails; the control of invasive plant species and restoration of historical plant community structure and dynamics, including altered fire regimes and other natural disturbance factors; and the implementation of grazing regimes that result in proper vegetation structure for Gunnison sage-grouse life-history needs in areas used for domestic and wild ungulate grazing and browsing. Limiting the designation of critical habitat in this unit only to currently occupied areas would be inadequate to ensure the conservation of the species. Accordingly, we are designating currently unoccupied areas that we conclude are essential for the conservation of the species. Designated unoccupied habitat comprises approximately 33 percent of the unit including lands defined in the 2005 RCP as potential habitat or vacant or unknown habitat (GSRSC 2005, p. 54) and other unoccupied areas that met our criteria for critical habitat (see Criteria and Methods Used to Identify and Map Critical Habitat). These areas consist of lands with varying amounts of overall sagebrush cover, or have habitat types suitable for movements and dispersal. These areas are also located adjacent to occupied habitat or are located immediately between surrounding populations. In addition to contributing to the fulfillment of the landscape scale habitat needs of Gunnison sage-grouse, these areas provide habitat for future population growth and reestablishment of portions of presettlement range, and facilitate or allow movement between other units and within the unit. Some unoccupied habitat areas within this unit consist of lands that recently supported sagebrush-dominant plant communities but are currently in agricultural production or are currently subject to encroachment by coniferous trees or shrubs, most commonly pin˜ onjuniper or mountain shrub plant communities. These areas require management to reestablish or enhance sagebrush communities to support the primary constituent elements of Gunnison sage-grouse nesting or broodrearing habitat. However, in their current state, these areas provide essential habitat for inter-population movements and thus may reduce population isolation and increase genetic exchange among populations.

Unit 4: Cerro Summit-Cimarron-Sims Mesa. Unit 4, Cerro Summit-Cimarron-Sims Mesa Unit, consists of 52,544 ac (21,264 ha) of Federal, State, and private lands in Montrose, Ouray, and Gunnison Counties, Colorado. Approximately 19 percent of the land area within the unit is managed by Federal agencies, 8 percent is owned by the State of Colorado, and 74 percent comprises private lands. We consider 64 percent of this unit to be currently occupied by Gunnison sage-grouse, based on mapping developed for the 2005 RCP and subsequently (GSRSC 2005, p. 54; CPW 2013e, spatial data). Tables 4 and 5 provide detailed estimates for all critical habitat units. The occupied portion of the Cerro Summit-CimarronSims Mesa Unit contains the physical and biological features essential to the conservation of the Gunnison sagegrouse. Due to the amount of private land within this population, and the small size and scattered nature of the individual populations, we do not consider that having a viable population in this area to be necessary for the conservation of the species. However, we conclude that this population area currently provides a key linkage area between the Gunnison Basin and the Crawford and San Miguel populations. Data indicates that current gene flow between populations is very low (OylerMcCance et al. 2005, p. 635), but if potentially suitable habitat is restored in these population areas, then the Cerro Summit-Cimarron-Sims Mesa population area could provide connectivity for gene flow between these populations. Therefore, we are finalizing critical habitat in this unit primarily for the purpose of facilitating connectivity between Gunnison Basin and the two smaller populations. Factors potentially affecting the physical and biological features of the Cerro Summit-Cimarron-Sims Mesa Unit include, but are not limited to: Residential and commercial development including associated landclearing activities for the construction of access roads, utilities, and fences; increased recreational use of roads and trails; the proliferation of predators of Gunnison sage-grouse; the spread of invasive plant species and associated changes in sagebrush plant community structure and dynamics; climate change, drought-related effects; and past and present grazing management that degrades or eliminates vegetation structure; all of which can result in the loss, degradation, or fragmentation of sagebrush plant communities. Special management actions that may be needed to address these threats include, but are not limited to: The rangewide prioritization and protection of crucial seasonal habitats subject to future residential and commercial development and increasing recreational use of roads and trails; the control of invasive plant species and restoration of historical plant community structure and dynamics, including altered fire regimes and other natural disturbance factors; and the implementation of grazing regimes that result in proper vegetation structure for Gunnison sage-grouse life-history needs in areas used for domestic and wild ungulate grazing and browsing. Limiting the designation of critical habitat in this unit only to currently occupied areas would be inadequate to ensure the conservation of the species. Accordingly, we are designating currently unoccupied areas that we conclude are essential for the conservation of the species. Designated unoccupied habitat comprises approximately 36 percent of the unit including lands defined in the 2005 RCP as potential habitat or vacant or unknown habitat (GSRSC 2005, p. 54) and other unoccupied areas that met our criteria as critical habitat (see Criteria and Methods Used to Identify and Map Critical Habitat). These areas consist of lands with varying amounts of overall sagebrush cover, or have habitat types suitable for movements and dispersal. These areas are also located adjacent to occupied habitat or are located immediately between surrounding populations. In addition to contributing to the fulfillment of the landscape scale habitat needs of Gunnison sage-grouse, these areas provide an important linkage area between populations. Some unoccupied habitat areas within this unit consist of lands that recently supported sagebrush-dominant plant communities but are currently in agricultural production or are currently subject to encroachment by coniferous trees or shrubs, most commonly pin˜ onjuniper or mountain shrub plant communities. These areas require management to reestablish or enhance sagebrush communities to support the primary constituent elements of Gunnison sage-grouse nesting or broodrearing habitat. However, in their current state, these areas provide essential habitat for inter-population movements and thus may reduce population isolation and increase genetic exchange among populations.

Unit 5: Crawford. Unit 5, the Crawford Unit, consists of 83,671 ac (33,860 ha) of Federal and private lands in Delta, Montrose, and Gunnison Counties, Colorado. Approximately 53 percent of the land area within the unit is managed by Federal agencies, and 47 percent comprises private lands. We consider 39 percent of this unit to be currently occupied by Gunnison sage-grouse, based on mapping developed for the 2005 RCP and subsequently (GSRSC 2005, p. 54; CPW 2013e, spatial data). Tables 4 and 5 provide detailed estimates for all critical habitat units. The occupied portion of the Crawford Unit contains the physical and biological features essential to the conservation of the Gunnison sagegrouse. Factors potentially affecting the physical and biological features of the Crawford Unit include, but are not limited to: Residential and commercial development including associated land clearing activities for the construction of access roads, utilities, and fences; increased recreational use of roads and trails; the proliferation of predators of Gunnison sage-grouse; climate change, drought-related effects; the spread of invasive plant species and associated changes in sagebrush plant community structure and dynamics; and past and present grazing management that degrades or eliminates vegetation structure; all of which can result in the loss, degradation, or fragmentation of sagebrush plant communities. Special management actions that may be needed to address these threats include, but are not limited to: The rangewide prioritization and protection of crucial seasonal habitats subject to future residential and commercial development and increasing recreational use of roads and trails; the control of invasive plant species and restoration of historical plant community structure and dynamics, including altered fire regimes and other natural disturbance factors; and the implementation of grazing regimes that result in proper vegetation structure for Gunnison sage-grouse life-history needs in areas used for domestic and wild ungulate grazing and browsing. Limiting the designation of critical habitat in this unit only to currently occupied areas would be inadequate to ensure the conservation of the species. Accordingly, we are designating currently unoccupied areas that we conclude are essential for the conservation of the species. Designated unoccupied habitat comprises approximately 61 percent of the unit including lands defined in the 2005 RCP as potential habitat or vacant or unknown habitat (GSRSC 2005, p. 54) and other unoccupied areas that met our criteria for critical habitat (see Criteria and Methods Used to Identify and Map Critical Habitat). These areas consist of lands with varying amounts of overall sagebrush cover, or have habitat types suitable for movements and dispersal. These areas are also located adjacent to occupied habitat or are located immediately between surrounding populations. In addition to contributing to the fulfillment of the landscape scale habitat needs of Gunnison sage-grouse, these areas provide habitat for future population growth and reestablishment of portions of presettlement range, and facilitate or allow movement between other units and within the unit. Some unoccupied habitat areas within this unit consist of lands that recently supported sagebrush-dominant plant communities but are currently in agricultural production or are currently subject to encroachment by coniferous trees or shrubs, most commonly pin˜ onjuniper or mountain shrub plant communities. These areas require management to reestablish or enhance sagebrush communities to support the primary constituent elements of Gunnison sage-grouse nesting or broodrearing habitat. However, in their current state, these areas provide essential habitat for inter-population movements and thus may reduce population isolation and increase genetic exchange among populations.

Unit 6: Gunnison Basin. Unit 6, the Gunnison Basin Unit, consists of 620,616 ac (251,154 ha) of Federal, State, local government, and private lands in Gunnison, Hinsdale, Montrose, and Saguache Counties, Colorado. Approximately 78 percent of the land area within the unit is managed by Federal agencies, 2 percent is owned by the State of Colorado, less than 0.1 percent is owned by Gunnison County and the City of Gunnison, and 20 percent comprises private lands. We consider 81 percent of this unit to be currently occupied, based on mapping developed for the 2005 RCP and subsequently (GSRSC 2005, p. 54; CPW 2013e, spatial data). Tables 4 and 5 provide detailed estimates for all critical habitat units. The Gunnison Basin contains the largest remaining expanse of sagebrush plant communities within the occupied range of Gunnison sagegrouse. The occupied portion of the Gunnison Basin Unit contains the physical and biological features essential to the conservation of the Gunnison sage-grouse. Factors potentially affecting the physical and biological features of the Gunnison Basin Unit include, but are not limited to: Residential and commercial development including associated land-clearing activities for the construction of access roads, utilities, and fences; increased recreational use of roads and trails; climate change, drought-related effects; the proliferation of predators of Gunnison sage-grouse; the spread of invasive plant species and associated changes in sagebrush plant community structure and dynamics; and past and present grazing management that degrades or eliminates vegetation structure; all of which can result in the loss, degradation, or fragmentation of sagebrush plant communities. Special management actions that may be needed to address these threats include, but are not limited to: The rangewide prioritization and protection of crucial seasonal habitats subject to future residential and commercial development and increasing recreational use of roads and trails; the control of invasive plant species and restoration of historical plant community structure and dynamics, including altered fire regimes and other natural disturbance factors; and the implementation of grazing regimes that result in proper vegetation structure for Gunnison sage-grouse life-history needs in areas used for domestic and wild ungulate grazing and browsing. Limiting the designation of critical habitat in this unit only to currently occupied areas would be inadequate to ensure the conservation of the species. Accordingly, we are designating currently unoccupied areas that we conclude are essential for the conservation of the species. Designated unoccupied habitat comprises approximately 19 percent of the unit including lands defined in the 2005 RCP as potential habitat or vacant or unknown habitat (GSRSC 2005, p. 54; CPW 2013e, spatial data) and other unoccupied areas that met our criteria for critical habitat (see Criteria and Methods Used to Identify and Map Critical Habitat). These areas consist of lands with varying amounts of overall sagebrush cover, or have habitat types suitable for movements and dispersal. These areas are also located adjacent to occupied habitat or are located immediately between surrounding populations. Occupied habitat within the Gunnison Basin population is much larger (592,168 ac (239,600 ha)) than the RCP model's predicted minimum required area. However, extensive sagebrush landscapes capable of supporting a wide array of seasonal habitats and annual migratory patterns for Gunnison sage-grouse are rare across the species' range. The Gunnison Basin population is the largest population, and the population is extremely important for the species' survival. With the satellite populations declining, providing more stability for the Gunnison Basin population through additional expanses of sagebrush landscapes is essential for the conservation of the species. Further, these unoccupied areas of sagebrush expanses also provide potential connectivity to the Crawford and Cerro Summit-Cimarron-Sims Mesa populations to the west. The small piece of unoccupied habitat to the east of the Gunnison Basin provides a link between those birds in occupied habitat to the north and west. Some unoccupied habitat areas within this unit consist of lands that recently supported sagebrush-dominant plant communities but are currently in agricultural production or are currently subject to encroachment by coniferous trees or shrubs, most commonly pin˜ onjuniper or mountain shrub plant communities. These areas require management to reestablish or enhance sagebrush communities to support the primary constituent elements of Gunnison sage-grouse nesting or broodrearing habitat. However, in their current state, these areas provide essential habitat for inter-population movements and thus may reduce population isolation and increase genetic exchange among populations. The maintenance and enhancement of inter-population connectivity is particularly important for the Gunnison Basin because it is the largest population in the species' range and is, therefore, the most likely source of dispersal of Gunnison sage-grouse to other populations.

Primary Constituent Elements/Physical or Biological Features

Within these areas, the primary constituent elements (PCEs) of the physical and biological features essential to the conservation of Gunnison sage-grouse consist of five components:

(i) Landscape Specific Primary Constituent Element. Primary Constituent Element 1—Extensive sagebrush landscapes capable of supporting a population of Gunnison sage-grouse. In general, this includes areas with vegetation composed primarily of sagebrush plant communities (at least 25 percent of the land is dominated by sagebrush cover within a 0.9-mi (1.5-km) radius of any given location), of sufficient size and configuration to encompass all seasonal habitats for a given population of Gunnison sage-grouse, and facilitate movements within and among populations. These areas also occur wholly within the potential historical range of Gunnison sage-grouse.

(ii) Seasonally Specific Primary Constituent Elements. (A) Primary Constituent Element 2—Breeding habitat composed of sagebrush plant communities that, in general, have the structural characteristics within the ranges described in the following table. Habitat structure values are average values over a project area. Breeding habitat includes lek, nesting, and early brood-rearing habitats used typically March 15 through July 15. Early broodrearing habitat may include agricultural fields. B) Primary Constituent Element 3— Summer-late fall habitat composed of sagebrush plant communities that, in general, have the structural characteristics within the ranges described in the following table. Habitat structure values are average values over a project area. Summer-fall habitat includes sagebrush communities having the referenced habitat structure values, as well as agricultural fields and wet meadow or riparian habitat types. Wet meadows and riparian habitats are also included qualitatively under PCE 5 at paragraph (2)(ii)(D) of this entry. (C) Primary Constituent Element 4— Winter habitat composed of sagebrush plant communities that, in general, have sagebrush canopy cover between 30 to 40 percent and sagebrush height of 15.8 to 21.7 in (40 to 55 cm). These habitat structure values are average values over a project area. Winter habitat includes sagebrush areas within currently occupied habitat that are available (i.e., not covered by snow) to Gunnison sagegrouse during average winters. (D) Primary Constituent Element 5— Alternative, mesic habitats used primarily in the summer-late fall season, such as riparian communities, springs, seeps, and mesic meadows.

Special Management Considerations or Protections

Critical habitat for the Gunnison sage-grouse does not include manmade structures (such as buildings, airport runways, roads, and other paved areas) and the land on which they are located existing within the boundaries of designated critical habitat on December 22, 2014.

Special management considerations or protection may be required to address these threats in designated critical habitat. Continued or future management activities that could ameliorate these threats include, but are not limited to: Comprehensive land-use planning and implementation that prevents a net decrease in the extent and quality of Gunnison sage-grouse habitat through the prioritization and protection of habitats and monitoring; protection of lands by fee title acquisition or the establishment of permanent CEs; management of recreational use to minimize direct disturbance and habitat loss; activities to control invasive weed and invasive native plant species; management of domestic and wild ungulate use so that overall habitat meets or exceeds Gunnison sage-grouse structural habitat guidelines; monitoring of predator communities and management as appropriate; coordinated and monitored habitat restoration or improvement projects; and wildfire suppression, particularly in Wyoming big sagebrush communities. In some cases, continuing current land management practices may be appropriate and beneficial for Gunnison sage-grouse.

Life History

Feeding Narrative

Juvenile: Sage-grouse are herbivores and insectivores whose diet consists of almost exclusively sagebrush in winter; during the remainder of the years Gunnison sage-grouse eat sagebrush, forbs, and insects (Wallestad et al. 1975, Schroeder et al. 1999, Young et al. 2000). Insects are important in the diet of chicks during their first three weeks of life; subsequently, forbs and sagebrush increase in importance (see Gunnison Sage-grouse Rangewide Steering Committee 2005). (NatureServe, 2015)

Adult: Sage-grouse are herbivores and insectivores whose diet consists of almost exclusively sagebrush in winter; during the remainder of the years Gunnison sage-grouse eat sagebrush, forbs, and insects (Wallestad et al. 1975, Schroeder et al. 1999, Young et al. 2000). Activity occurs throughout the year, primarily during daylight hours. Mating activity peaks shortly after sunrise but occasionally occurs near sunset or during nights with bright moonlight (Schroeder et al. 1999). During the mating season, sage-grouse forage in morning after breeding activity and in afternoon before roosting or breeding activity (Schroeder et al. 1999). During nesting season, females remain on nests throughout most of the day and night, but they take brief foraging breaks during morning and late afternoon or evening (Girard 1937). In summer, sage-grouse forage in early morning, loaf during midday, and forage again in the afternoon (Nelson 1955). (NatureServe, 2015)

Reproduction Narrative

Adult: The life cycle involves several significant stages, minimally including wintering, lek attendance, nesting, and brood rearing. In Colorado and likely Utah, males display on leks from mid-March through late May, depending on elevation and conditions (Rogers 1964). Females visit leks, mate with one or more males, then depart to begin nesting. Clutch size averages around 6 to 7 eggs (Young 1994, USFWS 2010). Incubation, by the female alone, lasts about 4 weeks. Hatching begins around mid-May and may extend into July; the peak usually is in mid-June (Gunnison Sage-grouse Rangewide Steering Committee 2005). Chicks leave the nest with the female shortly after hatching. Females infrequently renest if they lose their first nest. In greater sage-grouse (Centrocerus urophasianus), yearling males are capable of breeding, but most breeding is done by older males; yearling females often breed but somewhat less frequently than do older females (see Schroeder et al. 1999). Most Gunnison sage-grouse live less than 2 years in the wild. Sage-grouse are strong fliers but tend to travel slowly on foot unless threatened, in which case the grouse tend to hide or fly (less likely to run long distances) (Patterson 1952, Schroeder et al. 1999). (NatureServe, 2015). Males begin to appear and strut on leks beginning in March with peak breeding occurring in April, with exact onsets and peak lek attendance varying 1 to 3 weeks depending on winter severity. Females initiate nests in April, May, and sometimes June if their first nest is lost to depredation early enough in the incubation period, although this appears uncommon in the Gunnison Basin population (Young 1994, pp. 37-44). Nest initiation depends on snow depth and the age of the female. (USFWS, 2019).

Geographic or Habitat Restraints or Barriers

Adult: Unsuitable habitat includes open water as well as other habitats through or over which birds may travel but in which they do not nest or forage much if at all. (NatureServe, 2015)

Environmental Specificity

Adult: Moderate (NatureServe, 2015)

Site Fidelity

Adult: Both male and female sage-grouse exhibit breeding and nesting site fidelity (Connelly et al. 2004, p. 60). Adult males generally return to the same lek to mate throughout their lives (Dunn and Braun 1985, p. 625). Females typically nest in the same area each year (Young 1994, p. 42). If females do not have a successful nest, they may move nest location further (each year) compared to successful females (Connelly et al. 2011, p. 60). Yearling males visit more than one lek in their first breeding season, suggesting an age-related period of establishment (Connelly et al. 2011, p. 60). Of 11 yearling GRSG males in northern Colorado, all visited more than one lek, compared to 3 of 11 adult males visited more than 1 lek (Emmons and Braun 1984, p. 1026). (USFWS, 2019).

Habitat Narrative

Juvenile: During the early summer/brood-rearing season, mesic (wet) areas within or near sagebrush habitats provide important habitats for females and chicks. Juveniles and all other life stages use mesic habitat that provide abundant forbs and invertebrates, especially once those resources are no longer available in the nesting area. Mesic habitats and drainages also provide cover from predators (Young et al. 2015, p. 5). (USFWS, 2019).

Adult: Sage-grouse use a variety of habitats throughout the year, but the primary component necessary is sagebrush (Artemisia spp.), especially big sagebrush (A. tridentata) (Braun 1995). Sagebrush is used for hiding and thermal cover as well as for food in the winter (Hupp and Braun 1989). Leks, used for male displays from mid-March to early June, consist of open areas with good visibility (for predator detection) and acoustics (for transmission of male display sounds). Female nesting sites typically are in relatively tall and dense stands of sagebrush, about 0.2-8.0 kilometers from the leks. Nest sites also have grass and forbs that provide additional hiding cover. Females with young remain in sagebrush uplands if hiding cover is adequate and if food (succulent forbs and insects) is available. As chicks mature and vegetation in the uplands desiccates, females move their broods to wet meadow areas that retain succulent forbs and insects through the summer (Klebenow 1969, Wallestad 1971). Preferred wet meadow areas also contain tall grasses for hiding and sagebrush stands at least 150 meters wide (Dunn and Braun 1986) along the periphery for hiding and foraging.From mid-September into November all individuals use upland areas with 20 percent or greater sagebrush cover and some green forbs. As winter progresses and snow cover is extensive (> 80 percent) and deep (> than 30 centimeters), individuals forage in tall sagebrush (> 41 centimeters) in valleys and lower flat areas (Hupp and Braun 1989) and roost in shorter sagebrush along ridge tops. Roosting and foraging is typically restricted to south- or west- facing slopes where snow is typically shallower and less extensive (Hupp and Braun 1989). Small foraging areas that have 30-40 percent big sagebrush canopy cover also are important. (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory but limited seasonal movements (NatureServe, 2015)

Dispersal

Adult: Moderate (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is basically nonmigratory in some areas, but in other areas it makes limited seasonal movements among different habitats. For example, in San Juan County, Utah, females nested within 3.3 km of lek sites, broods remained within 3.0 km of nest sites, and males stayed within 4.0 km of the nearest lek site (Lupis 2005). Females without broods traveled the farthest, moving up to 7.4 km from the lek on which they were captured (Lupis 2005). In the Gunnison basin, 20 of 25 nests were within 6.4 km of the lek on which the female was captured (Young 1994, Apa 2004, Gunnison Sage-grouse Rangewide Steering Committe 2005). Overall, the vast majority of nests are within 6.4 km of the lek of capture (Gunnison Sage-grouse Rangewide Steering Committee 2005). Longer movements sometimes occur. Movements of up to 24 km have been observed in individual Gunnison sage-grouse in the Gunnison Basin population (Phillips 2010, pers. comm., cited by USFWS 2010). Sage-grouse sometimes move 30 km or more between winter range and nesting areas (see Gunnison Sage-grouse Rangewide Steering Committee 2005). (NatureServe, 2015)

Population Information and Trends

Population Trends:

Long-term trends indicate declines of >80%, whereas short-term trends indicate a relatively stable population (NatureServe, 2015)

Resiliency:

Low (inferred from NatureServe, 2015). New in 2019: Currently, Dove Creek is the only population in a critical condition (Table 6, Figure 12). Three populations are in low condition (Crawford, Poncha Pass, and Monticello), two populations are in moderate condition (CSCSM and San Miguel), and two populations are in high condition (Gunnison Basin and Piñon Mesa). Five of the populations have habitat in moderate quality, two populations have low habitat quality, and the Gunnison Basin and Piñon Mesa populations have habitat in high condition. Populations in higher resiliency categories are at less risk from potential stochastic events, such as extreme weather events, than populations in lower resiliency At the species level, the eight populations are distributed north to south in southwestern Colorado and east to west in southeastern Utah and southwestern Colorado (redundancy). In general, the eight populations occur in similar habitats, although in six ecoregions with differences between them, such as elevation differences (representation). The eight populations reduce risk associated with potential catastrophic events, such as drought. However, only two of the eight populations are in the high resiliency category. Furthermore, the relatively narrow distribution of the eight populations across the southwestern corner of Colorado and southeastern Utah increases risk from a catastrophe. (USFWS, 2019). Gunnison Basin population is in high condition that has not received additional GUSG individuals through translocations. The high health condition is driven largely by its consistently large population size and sufficient quantity of sagebrush habitat. Piñon Mesa also came out as having high health due to the quality of habitat, and moderate health of the HMC demographic factors. The next two largest populations, San Miguel (moderate condition) and Crawford (low condition), have all fluctuated in HMCs during the same period but have generally increased since 2011 to 2012. These populations also received translocated birds from the Gunnison Basin. Poncha Pass (low condition) had a HMC of zero in 2013, and received 27 translocated birds from Gunnison Basin in 2013 and 2014. CSCSM is in low condition, with consistently low population numbers, yet persists without translocations or other significant population management actions. All the other smaller populations are at higher risk because of their low numbers and poor habitat conditions. (USFWS, 2019). Analysis of microsatellite and mtDNA sequence data has found some evidence of movements among populations, yet substantial genetic structure exists among populations, indicating that gene flow is low and movements among populations are rare (Oyler-McCance et al. 2005, p. 635). For populations of GUSG with low connectivity to other populations, we will continue to see the high levels of genetic differentiation between populations, which, in small populations, ultimately reduces their genetic fitness. The Cerro Summit-Cimarron-Sims Mesa population may provide an important “stepping-stone” that links the larger populations of Gunnison and San Miguel (GSRSC 2005, p. 51). (USFWS, 2019). Therefore, the overall viability of the species is essentially reliant on the resiliency of the Gunnison Basin population. As the only population in a high resiliency condition that has self-sustaining recruitment, the Gunnison Basin population is the best able to withstand stochastic events, so it is critical to the viability of the species. Piñon Mesa is in a high condition as well, although it is at the lower level and reliant on conservation efforts. The remaining populations are currently in moderate, low, or critical condition, so they are at greater risk from stochastic events. Additionally, due to the limited quantity of habitat and low connectivity between populations, this species is reliant on relocation efforts to maintain resiliency. Translocation efforts have been important to ensure that some of the eight populations are resilient currently, and these efforts will likely need to continue in the future to maintain genetic diversity (Zimmerman et al. 2019, p. 8). (USFWS, 2019).

Representation:

Low (inferred from NatureServe, 2015). New in 2019: The eight populations of GUSG occupy a diversity of environmental conditions, ranging from cold and dry (Gunnison Basin) to warmer and wetter (Piñon Mesa) as well as hot and dry (Dry Creek Basin in San Miguel) and six different ecoregions. The conditions in other populations fall on a gradient between these conditions. Populations also differ in the composition of sagebrush species, topography, and soils Although this seems to indicate the GUSG has some adaptability to ecological variation, the majority (about 85 percent) of the species occurs in Gunnison Basin where temperatures are cooler, there is more precipitation, more sagebrush, and better forb and grass cover. These environmental differences between the populations help spread risk associated with potential catastrophes, such as widespread drought, and help reduce risk associated with novel, environmental change, such as long-term climatic changes. (USFWS, 2019). There is low genetic diversity in GUSG compared to GRSG (Oyler-McCance et al. 2005, p. 630) which is likely influenced by the lack of connectivity between populations. A genetic study of the allelic differences between populations revealed lower levels of genetic diversity in six smaller populations (not including CSCSM) compared to the Gunnison Basin prior to any translocations (Oyler-McCance et al. 2005, p. 635). Collectively, the smaller populations (San Miguel, Monticello-Dove Creek, Piñon Mesa, and Crawford) contain 24 percent of the genetic diversity of the species while representing only about 14 percent of the entire population size. Cerro Summit-Cimarron-Sims Mesa population was not analyzed in this study and Poncha Pass has no unique genomes, following local extirpation and reestablishment of the current population through translocations from Gunnison Basin. (USFWS, 2019). Within the entire range, genetic heterogeneity is highest in the Gunnison Basin population and lowest in Piñon Mesa, which is the most geographically isolated from Gunnison Basin. Low genetic diversity puts an entire population at greater risk from new environmental and demographic stresses (GSRSC 2005, p. 113), such as potential mortality from disease and low hatching success resulting from inbreeding (Stiver et al. 2008, p. 479). Even the largest of the satellite populations, San Miguel, is likely experiencing an inbreeding depression. The population as a whole has moderate HMC growth and HMCs are less than, but near, the target HMC. However, the subpopulations are spread out across the San Miguel Basin and individually, may not be moderately healthy. (USFWS, 2019). In addition to the low resiliency of the satellite populations, connectivity between all populations is limited. Distances between populations ranges from less than 11 km (7 mi) to over 100 km (60 mi). Some telemetered birds made seasonal migrations of 14 km (9 mi), while the majority of birds return to the same breeding and nesting areas each year and stay within a 5 km (3 mi) area (Commons 1997, p. iii). Oyler-McCance et al. (2005, p. 636) identified three possible dispersers (birds moving between populations) based on genetics. Two probable dispersers were individuals moving from San Miguel into Dove Creek/Monticello and Crawford, distances range 30-100 km (18-60 mi) and 60-100 km (37-60 mi) respectively. The other disperser involved movement into Crawford from Curecanti (western edge of Gunnison population) approximately 50 km (31 mi) (Oyler-McCance et al. 2005, p. 636). The long distance between populations reduces the likelihood of GUSG to migrate between them, resulting in decreased genetic diversity and a lower fitness. We have very little evidence of how birds currently move between populations, and it is very unlikely that birds would repopulate an extirpated area on their own due to low population numbers. However, the successful translocations that occurred in 2006-2014, the increase in HMCs following translocations, and successful breeding with the local population indicates translocating is an effective way to supplement populations. With a focused effort on the populations that are most likely to continue to support the demographic and habitat needs of GUSG, translocations are a recovery action that could increase the redundancy of GUSG. We investigate the potential effects of ongoing, additional, and reduced translocations to population resiliency under the Future Conditions chapter. (USFWS, 2019). Recent genetics work found that birds translocated from the Gunnison Basin to the other populations successfully bred with resident birds (Zimmerman et al. 2019), indicating that translocated birds survived and increased the diversity of the host populations. However, it is unclear if the remaining genetic differences between populations confer some type of adaptive advantage, such as those tailored to population's specific habitat type. It is possible that some of the genetic differences between GUSG satellite populations could represent adaptation to the different environmental conditions found across the current distribution. This would include variation in the dominant sagebrush species and micro-climates. Possible genetic adaptations to local environmental conditions, such as the digestibility of local sagebrush species, needs further investigation (Kohl et al. 2015, p. 432). Many of the genomic differences have also been altered from translocations from Gunnison Basin. Although this means the unique genes of the satellite populations could be lost, it also makes the satellite populations more genetically diverse and more likely to avoid inbreeding depression. (USFWS, 2019).

Redundancy:

Low (inferred from NatureServe, 2015). New in 2019: GUSG currently has seven populations in southwestern Colorado and one population in Utah (Figure 12, below). The eight populations provide redundancy that reduces risk from catastrophic events. However, the eight populations are distributed relatively narrowly in southwestern Colorado and a small corner of Utah, which put the species at greater risk to catastrophic events than if it were more broadly distributed. Additionally, the Gunnison Basin and Piñon Mesa populations are the only populations in the high resiliency category and Gunnison Basin provides the majority of the adaptive capacity of the species because Piñon Mesa's high health has been reliant on translocated GUSG individuals into the population. (USFWS, 2019).

Population Growth Rate:

Declining (NatureServe, 2015)

Number of Populations:

7 (NatureServe, 2015). As of 2019, 8 populations have been identified. (USFWS, 2019).

Population Size:

4,705 (NatureServe, 2015)

Population Narrative:

The current range is thought to be only about 8.5-10 percent of the historical potential habitat area (Schroeder et al. 2004, USFWS 2014). Population size has clearly declined, but degree of decline in population size is not well established (Gunnison Sage-grouse Rangewide Steering Committee 2005). Long-term population trends indicate declines of >80%, whereas short-term trends suggest a relatively stable population. As of 2014, the total population was estimated to be about 4,705 individuals, with about 3,978 of these in the Gunnison Basin, Colorado; the other populations ranged from 10-206 individuals, averaging approximately 100 (USFWS 2014). Gunnison Sage-grouse Rangewide Steering Committee (2005) identified eight extant populations (these are metapopulations, each of which includes gaps in occupied habitat). USFWS (2014) stated that the species currently occurs in seven distinct populations. (NatureServe, 2015). As of 2019, USFWS acknowledges 8 populations within 8 counties in southwestern Colorado and one county in southeastern Utah: Gunnison Basin, Poncha Pass, Crawford, Cerro Summit-Cimarron-Sims Mesa, Pinon Mesa, San Miguel Basin, Dove Creek, Monticello. The Gunnison Basin population is largest population and has the largest quantity of occupied habitat, covering an estimated 239,641 ha (592,168 ac) (50 FR, p. 69195). Poncha Pass, to the east of the city of Gunnison, is the smallest population and has the least amount occupied habitat, covering 11,234 ha (43.4 mi^2). Gunnison Basin supports approximately 85 percent of the breeding birds for the species and 65 percent of the occupied habitat. The remaining 15 percent of the individuals are distributed among the remaining populations, which comprise 35 percent of the overall occupied habitat. Of the eight populations, the San Miguel Basin contains six subpopulations that occupy discreet habitat areas. (USFWS, 2019).

Threats and Stressors

Stressor: Climate change (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Climate change has the potential to alter important seasonal habitats and food resources of Gunnison sage-grouse, the distribution and extent of sagebrush, and the occurrence of invasive weeds and associated fire frequencies. Climate change effects, including increased drought, are predicted in all populations (USFWS, 2014).

Stressor: Drought (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Drought has contributed to substantial declines in all Gunnison sage-grouse populations. Drought likely intensifies other stressors such as predation, invasive plants, and fire. Drought is a substantial threat to Gunnison sage- grouse rangewide, both now and into the future (USFWS, 2014).

Stressor: Habitat destruction or modification (USFWS, 2014)
Exposure:

Response:
Consequence:
Narrative: Habitat loss due to residential and infrastructural development (including roads and powerlines) is a current and future threat to Gunnison sage-grouse range-wide. The collective disturbance from human activities around residences and infrastructure results in habitat decline that negatively impacts Gunnison sage-grouse survival. Other habitat-related threats that are impacting Gunnison sage-grouse include grazing practices inconsistent with local ecological conditions, fences, invasive plants, fire, mineral development, pinion-juniper encroachment, and large-scale water development and irrigation. The cumulative presence of all these features and activities constitutes a threat to Gunnison sage-grouse as they collectively contribute to habitat decline. In particular, the satellite populations are less resilient and more vulnerable to extirpation and environmental pressures including habitat loss and fragmentation. Several issues, such as fire, invasive species, and pinion- juniper encroachment, may not currently have a substantial impact on Gunnison sage-grouse; however, the documented synergy among these three issues results in a high likelihood that they will pose a threat to the species in the future. Invasive plants negatively impact Gunnison sage-grouse primarily by reducing or eliminating native vegetation that sage-grouse require for food and cover, resulting in habitat decline. Climate change will likely alter the range of invasive plants, intensifying the proliferation of invasive plants to the point that they become a threat to the species (USFWS, 2014).

Stressor: Predation and disease (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Due to the known presence of West Nile virus across the majority of Gunnison sage-grouse range, the high risk of mortality and population-level impacts based on the biology of the species, and the immediacy of those potential impacts, West Nile virus is a future threat to Gunnison sage-grouse rangewide. Predation is a current and future threat to the species, particularly in the satellite populations. Major predators of adult sage-grouse include many species, including golden eagles, red foxes, and bobcats. Juvenile sage-grouse also are killed by many raptors as well as common ravens (Corvus corax), badgers (Taxidea taxus), red foxes, coyotes (Canis latrans), and weasels (Mustela spp.). Nest predators include badgers, weasels, coyotes, common ravens, American crows (Corvus brachyrhyncos), magpies (Pica spp.), and elk (Cervus canadensis). Egg predators are weasels, coyotes, and corvids. Adult male Gunnison and greater sage-grouse are very susceptible to predation while on the lek; predation of adult sage-grouse is low outside the lekking, nesting, and brood- rearing season. Both predation and disease are threats that are likely to increase in the future (USFWS, 2014).

Stressor: Small population size and structure (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Small population size and structure is a threat to the six satellite populations of Gunnison sage-grouse, both now and into the future. Resiliency, redundancy, and representation in Gunnison sage-grouse are inadequate, or will be inadequate in the future, to ensure the species' long-term viability. Although genetic consequences of low Gunnison sage-grouse population numbers have not been definitively detected to date, the results from Stiver et al. (2008, p. 479) suggest that six of the seven populations may have effective sizes low enough to

induce genetic deterioration, and that all seven could be losing adaptive potential (USFWS, 2014).

Stressor:
Exposure:
Response:
Consequence:
Narrative:

Stressor:
Exposure:
Response:
Consequence:
Narrative:

Stressor:
Exposure:
Response:
Consequence:
Narrative:

Recovery

Reclassification Criteria:
Reclassification criteria are not available.

Delisting Criteria:
Delisting criteria are not available.

Recovery Actions:
- Recovery actions are not available.

Conservation Measures and Best Management Practices:
- Conservation measures are not available.

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SPECIES ACCOUNT: *Charadrius alexandrinus nivosus* (Western snowy plover)

Species Taxonomic and Listing Information

Commonly-used Acronym: WSP

Listing Status: Threatened; March 5, 1993 (58 FR 12864).

Physical Description

The western snowy plover (Charadrius nivosus nivosus) is a small shorebird in the family Charadriidae. It weighs from 34 to 58 grams (1.2 to 2 ounces) and ranges in length from 15 to 17 centimeters (cm) (5.9 to 6.6 inches [in.]). It is pale gray-brown on its wings and head, and white below on its stomach, with a white hind neck collar and dark lateral breast patches, forehead bar, and eye patches. The bill and legs are blackish. In breeding plumage, males usually have black markings on the head and breast; in females, usually one or more of these markings are dark brown. Early in the breeding season, a rufous crown may be evident on breeding males, but it is not typically seen on females. In nonbreeding plumage, sexes cannot be distinguished because the breeding markings disappear. Fledged juveniles have buffy edges on their upper parts and can be distinguished from adults until approximately July through October, depending on when in the nesting season they hatched. After this period, molt and feather wear makes fledged juveniles indistinguishable from adults (USFWS 2007).

Taxonomy

The snowy plover was first described in 1758 by Linnaeus. Two subspecies of the snowy plover have been recognized in North America: the western snowy plover (Charadrius nivosus nivosus, formally Charadrius alexandrinus nivosus) and the Cuban snowy plover (C. a. tenuirostris). The Pacific coast population of the western snowy plover breeds from southern Washington to southern Baja California, Mexico (USFWS 2007). Based on genetic, morphological, and behavioral differences, the American Ornithologist Union split the Kentish plover (C. alexandrinus) from the snowy plover and changed the scientific name of the snowy plover in Central and North America to Charadrius nivosus, with three subspecies: western snowy plover (C. nivosus nivosus) (range to include all of the continental United States and portions of Mexico), Cuban snowy plover (C. nivosus tenuirostris) (range to include Cuba, Puerto Rico, the Caribbean, and the Yucatan Peninsula), and Peruvian/Humboldt snowy plover (C. nivosus occidentalis) (range to include South America) (77 FR 2243). The U.S. Fish and Wildlife Service (USFWS) amended the List of Endangered and Threatened Wildlife at 50 Code of Federal Regulations 17.11(h) to identify the listed entity as the western snowy plover (Pacific Coast population Distinct Population Segment [DPS]) (Charadrius nivosus nivosus) (77 FR 36728). The western snowy plover differs from the Cuban snowy plover in being much darker dorsally (light hair brown to nearly drab) (NatureServe 2015).

Historical Range

Historical records indicate that western snowy plovers were once more widely distributed and abundant in coastal Washington, Oregon, and California. Surveys, status reviews, and literature searches have identified 159 current or historical western snowy plover breeding or wintering locations on the Pacific coast of the United States. These localities include six in Washington, 19 in Oregon, and 134 in California (USFWS 2007).

Current Range

The current Pacific coast breeding range of the western snowy plover extends from Damon Point, Washington, to Bahia Magdelena, Baja California, Mexico. Three of the five Washington nesting sites have had active nesting in recent years. A new site in Washington was also discovered in 2006. In Oregon, seven core nesting sites are consistently used, with a few additional areas occupied during some years. In California, by the late 1970s, nesting western snowy plovers were absent from 33 of 53 locations with breeding records prior to 1970. The western snowy plover no longer breeds along the beach at Mission Bay or at Buena Vista Lagoon in San Diego County. In Orange County, the only remaining breeding location was the Bolsa Chica wetlands. In Ventura County, the western snowy plover has ceased breeding on Ventura Beach (San Buenaventura Beach), and in Santa Barbara County on Carpentaria, Santa Barbara (East Beach), and Goleta beaches. Nesting no longer occurs along the northernmost portion of Monterey Bay in Santa Cruz County or on Doran Beach at Bodega Harbor in Sonoma County (USFWS 2007).

Distinct Population Segments Defined

Yes; April 21, 2006 (71 FR 20607). Pacific Coast DPS. The Pacific Coast population is defined as those individuals that nest within 50 miles (mi.) of the Pacific Ocean on the mainland coast, peninsulas, offshore islands, bays, estuaries, or rivers of the United States and Baja California, Mexico (USFWS 2007).

Critical Habitat Designated

Yes; 12/7/1994.

Legal Description

On June 19, 2012, the U.S. Fish and Wildlife Service (Service) designated revised critical habitat for the Pacific Coast distinct population segment (DPS) (Pacific Coast WSP) of the western snowy plover (Charadrius nivosus nivosus, formerly C. alexandrinus nivosus) under the Endangered Species Act of 1973, as amended (Act). In total, approximately 24,527 acres (9,926 hectares) of critical habitat for the Pacific Coast WSP in Washington, Oregon, and California, fall within the boundaries of the critical habitat designation. This revised final designation constitutes an increase of approximately 12,377 ac (5,009 ha) from the 2005 designation of critical habitat for the Pacific Coast WSP. The currently recognized name for the subspecies, Charadrius nivosus nivosus, to which the listed entity (Pacific Coast WSP) belongs for references to the Pacific Coast WSP.

Critical Habitat Designation

Approximately 6,077 ac (2,460 ha) are designated in 4 units within Washington, approximately 2,112 ac (855 ha) in 9 units within Oregon, and 16,337 ac (6,612 ha) in 47 units within California. The area identified as critical habitat Units CA32, Vandenberg Air Force Base North and CA33, Vandenberg Air Force Base South (combined total of approximately 1,134 ac (459 ha)), has been exempted from the revised final designation in their entirety under section 4(a)(3)(B) of the Act.

WA 1, Copalis Spit, 407 ac (165 ha). Copalis Spit is located along the central Washington coast, approximately 20 mi (32 km) northwest of the Community of Hoquiam in Grays Harbor County.

Copalis Spit is a 2-mi (3- km) long sand spit bounded by the Copalis River on the northern and landward sides. The Copalis Beach access road off State Route 109 and State Park property line demark the southern boundary. The unit is entirely within Griffiths-Priday Ocean State Park (Washington State Parks and Recreation Commission). This unit is the northernmost unit in the range of the species and historically supported 6 to 12 nesting pairs of Pacific Coast WSPs, but no nesting has been documented since 1984 (Service 2007, p. 21). This unit was not occupied at the time of listing and is not currently occupied. The unit consists of a long sandy beach with sparsely vegetated dunes that extend to the river, providing nesting and foraging opportunities, as well as protection from the weather. The northward shift of Connor Creek washed out the beach access road at the southern end, effectively closing the area to motorized vehicles. Because of its relatively remote location, the area receives little human use and is therefore relatively undisturbed. Although currently unoccupied, the unit is considered essential for the conservation of the species as it allows for population expansion into the northern extent of the Pacific Coast WSP's historical range from adjacent occupied areas and has high-quality habitat, including a long sandy beach with limited disturbance with sparsely vegetated dunes that extend to the river, providing nesting and foraging opportunities for the species.

WA 2, Damon Point, 673 ac (272 ha). This unit is located at the southern end of the City of Ocean Shores in Grays Harbor County and is a sandy spit that extends into Grays Harbor. The unit boundary begins at the Damon Point parking area off Marine View Drive. The western boundary generally follows the property line for the Oyhut Wildlife Area. This unit was occupied at the time of listing, and we consider this unit to be currently occupied. Research in the mid-1980s indicated that up to 20 Pacific Coast WSPs have used Damon Point for nesting. However, use has declined significantly at this site, with only six adult birds documented using the area during the breeding season in 2005. A historic shipwreck (S.S. Catala) was exposed during winter storms in 2006, and the vessel was removed from the spit due to oil spill and other hazardous materials concerns over a period of 17 months (State of Washington, Department of Ecology 2007). The opportunity to view the shipwreck and removal operation drew media attention, and hundreds of visitors visited the site on weekends. Visitation of the area has dropped off since the clean-up. Even though no plover nesting has been documented at Damon Point since 2006, we still consider this unit occupied by the species based on previous use of the area, on the fluctuating use of areas in general by the species as a response to habitat and resource availability, and because breeding surveys are not extensive presence-absence surveys and only provide information during the breeding season. We have determined that the unit contains the physical and biological features essential to the conservation of the species which may require special management considerations or protection. The unit includes sandy beaches that are relatively undisturbed by human or tidal activity (nesting habitat), large expanses of sparsely vegetated barren terrain, and mudflats and sheltered bays that provide ample foraging areas. The majority (648 ac (262 ha)) of the unit is administered by the State of Washington (Department of Fish and Wildlife and Department of Natural Resources). There are over 7 mi (11 km) of sandy beaches and shoreline at Damon Point, and the shape of the spit changes constantly with winter storms and nearshore sand drift. In recent years, some of the lower elevation areas have been overwashed, and coastal erosion may result in separation of the spit from the mainland in the near future. The western edge of the unit lies adjacent to a municipal wastewater treatment facility that is managed by the City of Ocean Shores, with a few undevelopable private parcels in the tidelands near the parking area. Similar to Copalis Spit, the access road has washed out, and the area is currently inaccessible to motorized vehicles. The primary threats to Pacific Coast WSPs that may require special management at this time are recreational use, including pedestrians and unleashed pets;

habitat loss from European beach grass; and potential reopening of the vehicle access road. Special management in the form of developing and enforcing regulations to address the recreation issues may be needed. Management to remove and control beach grass will prevent further spread of nonnative vegetation, thereby maintaining and expanding the elements of essential physical or biological features identified above.

WA 3A, Midway Beach, 697 ac (282 ha). Located adjacent to the Community of Grayland, this subunit extends from the northern boundary of Grayland Beach State Park, through South Beach State Park to Cape Shoalwater at the southern end in Pacific County. Midway Beach is an expansive beach and is nearly 0.5 mi (0.8 km) wide at the widest point. This subunit was occupied at the time of listing and is currently occupied. This subunit includes the following physical and biological features essential to the conservation of the species: large areas of sand dune habitat that is relatively undisturbed, areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and close proximity to tidally influenced estuarine mud flats that provide cover or shelter from predators, and are important for foraging. Beach accretion since 1998 has greatly improved habitat conditions, resulting in this beach becoming a primary nesting area in the State. From 1998 to 2005, an average of 18 plovers nested annually at Midway Beach, and from 2003 to 2006, between 23 and 28 Pacific Coast WSPs nested at Midway Beach. Primary threats at this subunit that may require special management include motorized vehicle use on the beaches and human activity. The recent closure of the Midway Beach Access Road due to safety concerns, e.g., vehicles getting stuck in deep sand, has reduced impacts in the nesting area, but may not be permanent. Therefore, the physical or biological features essential to the conservation of the species in this subunit may require special management considerations or protection to address threats associated with human-related recreation and other activities. Developing and enforcing regulations to address the recreation issues may be needed. Management to remove and control beach grass will prevent further spread of nonnative vegetation, thereby maintaining and expanding the elements of essential physical and biological features identified above. WA 3B, Shoalwater/Graveyard Spit, 696 ac (282 ha) The subunit is located in Pacific County at Shoalwater Bay (also known as Graveyard Spit). This beach is an extension of Midway Beach, and extends south into the entrance of Willapa Bay. The western portion of this subunit starts at a narrow strip of beach adjacent to State Route 105 and extends to the western edge of the Shoalwater Bay Indian reservation. This portion of the subunit is approximately 148 ac (60 ha) in size. The eastern portion of the subunit starts at the eastern edge of the Shoalwater Bay Indian reservation boundary and continues in a southwesterly direction to the Community of Tokeland. This portion of the subunit is approximately 548 ac (222 ha) in size. The landward extent of the unit is the edge of the bay, and the seaward extent of the unit is the Pacific Ocean's water's edge. In the March 2011 revised proposal, the Service proposed 1,121 ac (454 ha) for this subunit; approximately 425 ac (172 ha) of the proposed subunit that is part of the Shoalwater Bay Tribal lands have been excluded from designation under section 4(b)(2) of the Act (refer to the Exclusions section below). This subunit was occupied at the time of listing and is currently occupied. The State Recovery Plan for the western snowy plover (WDFW 1995) defines the geographic area from Grayland Beach State Park south to Toke Point as ''South Beach.'' Based on documented sightings and records of western snowy plover use for the south beach geographic area (WDFW 1995, Appendix C), Shoalwater/Graveyard Spit was occupied at the time of listing and is a known or presumed historical nesting area (WDFW 1995, Figure 2, p. 3). Pacific Coast WSPs nested on the Shoalwater Bay Indian reservation in 2006, 2007 and 2008, but no nesting has been documented on the spit since 2008. Although fledging success is relatively high at this location, plover use of the

Shoalwater/Graveyard Spit area is sporadic. The subunit includes the following features essential to the conservation of the species: large areas of sand dune habitat that are relatively undisturbed; areas of sandy beach above and below the high-tide line with occasional surfcast wrack supporting small invertebrates; and close proximity to tidally influenced estuarine mud flats. Special management that may be required includes management of human-related activities to reduce disturbance to breeding Pacific Coast WSPs, and maintenance of the physical or biological features within the subunit. Based on interpretation of aerial imagery, the Cape Shoalwater area has experienced extensive erosion over the past 15 years. A nearly 0.3 mi-wide (0.5 km-wide) by 1.5 mi-long (2.4 km-long) section of the coastline, including roads and residences, has been reclaimed by the ocean, resulting in the accretion of Midway Beach. The accretion of beach improves elements of essential physical or biological features. Because the county ownership layer for this subunit is ambiguous and all private property parcels are under water, the layer could not be used for precise acreage calculations. However, the vast majority of the unit is managed by the State of Washington.

WA 4A, Leadbetter Spit, 2,700 ac (1,093 ha). The Leadbetter Spit subunit is located in Pacific County at the northern tip of the Long Beach Peninsula, and consists of a 26 mi-long (42 km-long) spit that defines the west side of Willapa Bay and extends down to the mouth of the Columbia River. The subunit is located just north of the community of Ocean Park and includes Leadbetter Point State Park (SP) and the Willapa NWR at the northern end of the spit. The main portion of this subunit is on the ocean side, and includes the coastal beaches from the tip of the peninsula, and the habitat restoration area down to Oysterville Road, approximately 1.8 mi (3 km) south of Leadbetter Point SP. The boundaries for this subunit have changed from that proposed in our March 2011 rule as a result of information provided to us by Willapa NWR staff and an acreage miscalculation in the March 2011 proposed rule (76 FR 16046) (refer to the Summary of Changes from the Revised Proposed section above). This subunit contains some areas that are currently not suitable habitat (water and vegetated areas) but may become suitable with management actions, sealevel rise, and ongoing natural changes and beach accretion on the spit. Although the refuge manages areas above the high tide line on the northern portion of the spit, the ownership data do not reflect where the State and Federal jurisdictions lie. Thus, all ownership acreages are approximate for this unit. The subunit includes approximately 8 mi (13 km) of coastal beaches and sheltered bays. Approximately 987 ac (399 ha) are on lands that are managed by the Willapa NWR, and the remaining 1,713 ac (693 ha) are managed by the Washington State Park and Recreation Department and Department of Natural Resources. Leadbetter Spit was occupied at the time of listing, is currently occupied, and is the largest subunit in Washington. Approximately 25 to 30 Pacific Coast WSPs nest and overwinter on the spit annually, with most of the nesting occurring in the snowy plover habitat restoration area within the Willapa NWR. Between 10 and more than 40 breeding adults were recorded between 2005 and 2009 (WDFW 2009, p. 12). A few pairs nest along the ocean beaches and on State Park lands just south of the Willapa NWR. The 2007 Recovery Plan lists a management goal of 30 breeding adults for this subunit (Service 2007, Appendix B). The subunit includes the following features essential to the conservation of the species: Relatively undisturbed, sandy beaches above and below the high-tide line and sparsely vegetated dunes for nesting; miles of coastal wrack line supporting small invertebrates; and close proximity to tidally influenced estuarine mud flats and sheltered bays for foraging. The combined dynamics of weather and surf cause large quantities of wood and shell material to accumulate on the spit, providing prime nesting habitat, hiding areas from predators, foraging opportunities, and shelter from inclement weather. European beach grass threatens the habitat quality of the subunit. Special management that may be needed includes restoration and maintenance of degraded habitat to ensure the reinfestation of nonnative vegetation does not occur. Doing so will ensure that elements of essential physical or biological features within this subunit remain intact. Primary threats that may require special management include the State's management of the spring razor clam season, which opens beaches to motorized vehicle and provides access into Pacific Coast WSP nesting areas that normally receive limited human use. The State Parks and Recreation Commission has posted areas where plovers nest, increased enforcement of the wet sand driving regulations, and conducted habitat restoration on State Park lands. WA 4B, Gunpowder Sands Island, 904 ac (366 ha) The subunit includes Gunpowder Sands Island just off the northern tip of the Long Beach Peninsula. The island shifts location annually and only a portion of the mapped area may be dry sand at any given time. The island is managed by the State of Washington. Because the island is only accessible by boat, breeding surveys for Pacific Coast WSP at this location are sporadic. It is unknown if this Gunpowder Sands Island was occupied at the time the Pacific Coast WSP was listed in 1993, but two successful nests and one failed nest were documented on the island in 1995 (WDFW heritage data). Although nesting has not been recently confirmed for this area, the Service considers this unit essential for the conservation of the species because it provides a safe nesting, resting, and foraging area free of human disturbance and connectivity between two currently occupied areas. The Service considers that it is important for the species' use, based on the proximity of the site to the occupied nesting area on Leadbetter Spit, and on fluctuating habitat and resource availability. Gunpowder Sands Island also has physical or biological features essential to the conservation of the species: Relatively undisturbed, sandy beaches above and below the high-tide line; sparsely vegetated dunes for nesting; and coastal wrackline supporting small invertebrates. The island is periodically overwashed during winter storms, resulting in dry sand and beach habitat with little or no vegetation.

OR 2, Necanicum River Spit, 11 ac (4 ha). The Service proposed 211 (85 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 200 ac (81 ha) has been excluded from critical habitat designation under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the western coast of Clatsop County, adjacent to the City of Gearhart, and less than 1 mi (2 km) north of the City of Seaside. It is bounded by the Necanicum River estuary on the south, City of Gearhart to the north and east, and Oregon Parks and Recreation Department's HCPcovered lands to the west. The mouth of the river changes periodically. The northern inland portion of the unit is overgrown with European beach grass; sea-level rise and overwashing of this area during the winter months is anticipated to result in vegetation removal and the creation of additional Pacific Coast WSP breeding habitat. Eleven ac (4 ha) of privately owned land landward of HCP-covered lands are included in this revised designated critical habitat because they are essential to the conservation of the Pacific Coast WSP to address habitat needs arising from anticipated sea-level rise. Necanicum River Spit was not considered occupied at the time the Pacific Coast WSP was listed in 1993. Two breeding Pacific Coast WSPs were documented in 2002 (Service unpublished data). We consider the unit is essential for the conservation of the species as it is needed for use in response to fluctuating habitat and resource availability. It has the capability of providing future connectivity between occupied areas, dispersal habitat between units, and habitat for resting and foraging. This unit may provide habitat to support breeding plovers and facilitate interchange between otherwise widely separated units within Recovery Unit 1 (identified in the Recovery Plan, Service 2007) in Oregon and Washington. Necanicum River Spit is a characteristic dune-backed beach with wide sand spits in close proximity to tidally influenced estuarine mud flats. The unit contains sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; and close proximity to tidally influenced estuarine mud flats, which are considered essential for the conservation of the Pacific Coast WSP.

OR 4, Bayocean Spit, 201 ac (82 ha). The Service proposed 367 ac (149 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 80 ac (32 ha) were removed from proposed critical habitat at the shoreline due to inundation, and 86 ac (35 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the western coast of Tillamook County, and about 9 mi (15 km) northwest of the City of Tillamook. It is bounded by Tillamook Bay on the east, the Tillamook Bay South Jetty to the north, the northern boundary of Bayocean Peninsula County Park 2.0 mi (3.2 km) to the south, and HCP-covered lands to the west. The unit is located behind a relatively low foredune. Sealevel rise and overwashing of this area during the winter months is anticipated to result in vegetation removal and creation of additional Pacific Coast WSP breeding habitat. Two ac (1 ha) of privately owned land and 199 ac (81 ha) of federally owned land landward of the HCP-covered lands are designated due to anticipated sea-level rise. Bayocean Spit was occupied at the time of listing. Two Pacific Coast WSPs were documented in 1993, and six plovers in 1995, in this unit during the breeding season (ODFW in litt. 1994, Appendix, Table 2; ODFW unpublished data). Prior to 2001, winter use of the area by plovers was documented consistently. Recent records indicate use by wintering plovers in 2007 and 2008 (Service unpublished data). We consider the unit to be needed by the species for future use in response to fluctuating habitat and resource availability. It has the capability of providing future connectivity between occupied areas, dispersal habitat between units, and habitat for resting and foraging. This unit may provide habitat to support breeding plovers and facilitate interchange between otherwise widely separated units within Recovery Unit 1 (identified in the Recovery Plan, Service 2007) in Oregon and Washington. Bayocean Spit is a characteristic dune-backed beach in close proximity to tidally influenced estuarine mud flats. The unit contains the following features essential to the conservation of the species: Sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; sandy beach above the mean high water line that supports small invertebrates; and close proximity to tidally influenced estuarine mud flats. Primary threats to essential physical and biological features that may require special management in this unit are degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans and pets in important foraging and nesting areas; and predators.

OR 6, Sand Lake South, 5 ac (2 ha). The Service proposed 200 ac (81 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 195 ac (79 ha) has been excluded from critical habitat designation under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the southwestern coast of Tillamook County, about 4.5 mi (7 km) north of Pacific City. It is bounded by Sand Lake estuary to the north and east, the northern limit of development in the town of Tierra Del Mar to the south, and HCP-covered lands to the west. The mouth of the lake changes periodically. The unit is a small upland portion of the spit. Sea-level rise and overwashing of this area during the winter months is anticipated to result in vegetation removal and the creation of additional Pacific Coast WSP breeding habitat. Five ac (2 ha) of privately owned land landward of HCP-covered lands are included in this revised designated critical habitat because they are essential to the conservation of the Pacific Coast WSP to address habitat needs arising from anticipated sea-level rise. Sand Lake South was not considered occupied at the time the Pacific Coast WSP was listed in 1993. However, four snowy plovers were observed during the breeding season at Sand Lake in 1986 (ODFW, in litt. 1994, Appendix, Table 2). Although nesting has not been recently confirmed for this area, Sand Lake South is an historical breeding site within the species' range. The unit has the capability of providing connectivity between occupied areas, dispersal habitat between units, and habitat for resting and foraging. This unit is needed to provide habitat to support breeding plovers and facilitate interchange between otherwise widely separated units within Recovery Unit 1 (identified in the Recovery Plan, Service 2007) in Oregon and Washington. Sand Lake South is a characteristic dune-backed beach with wide sand spits in close proximity to tidally influenced estuarine mud flats. The unit contains sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; and close proximity to tidally influenced estuarine mud flats, which are considered essential for the conservation of the Pacific Coast WSP.

OR 7, Sutton/Baker Beaches, 276 ac (112 ha). The Service proposed 372 (151 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 96 ac (39 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the western coast of Lane County, about 5 mi (8 km) north of the City of Florence. It is located 2.25 mi south of Heceta Head and bounded by Sutton Creek to the south, lands administered by the Siuslaw National Forest to the east, and HCP-covered lands to the west The unit consists of 276 ac (112 ha) of Federal lands, managed by the U.S. Forest Service's (USFS) Siuslaw National Forest. This unit was occupied at the time of listing and is currently occupied. The most recently documented Pacific Coast WSPs for this unit includes four breeding plovers in 2007 (Lauten et al. 2007, p. 5). The unit contains the physical and biological features essential to the conservation of the species which may require special management considerations or protection. This unit provides habitat to support breeding plovers and facilitates interchange between otherwise widely separated units under intensive management. It extends behind a relatively low foredune in several places into areas overgrown with beach grass. Sea-level rise and overwashing of these areas during the winter months is anticipated to result in vegetation removal and the creation of additional plover breeding habitat. The unit is characteristic of a dunebacked beach and wide sand spits with overwash areas and contains an interdune flat created through habitat restoration. It includes the following features essential to the conservation of the species: Sparsely vegetated, lowlying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; and sandy beach above the mean high water line that supports small invertebrates. Primary threats to essential physical and biological features that may require special management in this unit are degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans, pets, and horses in important foraging and nesting areas; and predators.

OR 8A, Siltcoos Breach, 15 ac (6 ha). This subunit is on the southwestern coast of Lane County, about 7 mi (11 km) southwest of the City of Florence. It is an important wintering area that includes a large opening in the foredune 1.2 mi (2 km) north of the Siltcoos River. The southern boundary is located 0.6 mi (1 km) north of the Siltcoos River, with the Oregon Dunes National Recreation Area (NRA) to the east and the Pacific Ocean to the west. The subunit consists of 7 federally owned ac (3 ha) managed by the USFS as the Oregon Dunes NRA in the Siuslaw National Forest and 8 ac (3 ha) on the ''Ocean Shore,'' managed by OPRD. This subunit was occupied at the time of listing and is currently occupied with recently documented wintering Pacific Coast WSPs in 2005, 2006, 2007, and 2010 (Service unpublished data). As many as 59 Pacific Coast WSP were documented during the winter of 2005 (C. Burns, pers. comm. 2006), and 26, 36, and 24 Pacific Coast WSP in 2006, 2007 and 2010, respectively (Service unpublished data). The subunit is characteristic of a dune-backed beach. It includes the following features essential to the conservation of the species: Sparsely vegetated, low-lying areas of sandy dune and sandy beach above the mean high water line that supports small invertebrates. Primary threats to essential physical and biological features that may require special management in this subunit are degradation of the sand dune system due to encroachment of European beach grass on the available wintering habitat and disturbance from humans, pets, and vehicles in important roosting and foraging areas. OR 8B, Siltcoos River Spit, 116 ac (47 ha) The Service proposed 241 (97 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 125 ac (51 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This subunit is located in Lane and Douglas Counties, about 7 mi (11 km) southwest of the City of Florence. It includes the sand spits to the north and south of the Siltcoos River and is bounded by the Waxmyrtle Trail and campground to the east, and HCPcovered lands to the west. It consists of 116 federally owned ac (47 ha) managed by the USFS as the Oregon Dunes NRA in the Siuslaw National Forest. Siltcoos River Spit was occupied at the time of listing and is currently occupied. Most recently documented Pacific Coast WSPs for this subunit include 26 breeding adults in 2011 (Lauten et al. 2011, p. 25). The subunit is characteristic of a dune-backed beach and sand spit in close proximity to a tidally influenced river mouth. The subunit contains the following features essential to the conservation of the species: sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; sandy beach above the mean high water line that supports small invertebrates; and close proximity to tidally influenced freshwater areas. Primary threats to essential physical and biological features that may require special management in this subunit are degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans and pets in important foraging and nesting areas; vehicle trespass into closed areas; and predators. OR 8C, Dunes Overlook/Tahkenitch Creek Spit, 383 ac (155 ha) The Service proposed 716 (290 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 333 ac (135 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This subunit is in Douglas County, about 9 mi (15 km) southwest of the City of Florence. The southern boundary of the unit is about 5.3 mi (9 km) northwest of the City of Reedsport. It is bounded by the subunit 8B to the north, a street legal vehicle area to the south, Oregon Dunes NRA to the east, and HCP-covered lands to the west. It consists of 383 federally owned ac (155 ha) managed by the USFS as the Oregon Dunes NRA in the Siuslaw National Forest. Dunes Overlook/Tahkenitch Creek Spit was occupied at the time of listing and is currently occupied. Documented Pacific Coast WSPs for this subunit include 71 breeding plovers in 2011 (Lauten et al. 2011, p. 25). The subunit is characteristic of a dune-backed beach and sand spit in close proximity to a tidally influenced river mouth and contains interdune flats created through habitat restoration. The subunit contains the following features essential to the conservation of the species: Wide sand spits or overwashes and sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; sandy beach above the mean high water line that supports small invertebrates; and close proximity to tidally influenced freshwater areas. Primary threats to essential physical and biological features that may require special management in this subunit are degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans in important foraging and nesting areas; and predators. OR 8D, North Umpqua River Spit, 59 ac (24 ha) The Service proposed 236 (95 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 177 ac (71 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This subunit is on the western coast of Douglas County, about 4 mi (5 km) west of the City of Reedsport. It is bounded by the Umpqua River North Jetty to the south, Oregon Dunes

NRA land to the north and east, and HCPcovered lands to the west. Subunit 8D consists of 59 ac (24 ha) of Federal land managed by the USFS for the Oregon Dunes NRA in the Siuslaw National Forest. This subunit was not occupied at the time of listing. Nesting Pacific Coast WSPs were last documented at North Umpqua River Spit in the 1980s (ODFW unpublished data). The subunit is located between currently occupied areas and provides habitat for adult dispersal between units. Although nesting and wintering has not been recently confirmed for this area, we consider the unit is needed by the species for use in response to fluctuating habitat and resource availability. The subunit is characteristic of a dune-backed beach in close proximity to tidally influenced freshwater areas. The subunit includes sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; sandy beach above the mean high water line that supports small invertebrates; and close proximity to tidally influenced freshwater areas, which are considered essential for the conservation of the Pacific Coast WSP.

OR 9, Tenmile Creek Spit, 223 ac (90 ha). The Service proposed 244 ac (99 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 21 ac (8 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the northwestern coast of Coos County, about 11 mi (18 km) southwest of the City of Reedsport. It includes the sand spits and beaches to the north and south of the Tenmile River. This unit is on the northwestern coast of Coos County, about 11 mi (18 km) southwest of the City of Reedsport, with Winchester Bay 6.5 mi (10.5 km) to the north, Coos Bay North Jetty 15.5 mi (25 km) to the south, the City of Lakeside 2.5 mi (4 km) to the east, and HCP-covered lands to the west. Tenmile Creek Spit was occupied at the time of listing and is currently occupied. Documented Pacific Coast WSPs for this unit include 25 breeding adults in 2011 (Lauten et al. 2011, p. 25). Unit OR 9 consists of 223 ac (90 ha) of Federal land managed as the Oregon Dunes NRA by the USFS. The unit is characteristic of a dunebacked beach and sand spit in close proximity to a tidally influenced river mouth. It includes the following features essential to the conservation of the species: Sparsely vegetated, low lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; sandy beach above the mean high water line that supports small invertebrates; and close proximity to tidally influenced freshwater areas. Primary threats to essential physical and biological features that may require special management in this unit degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans in important foraging and nesting areas; vehicle trespass into closed areas; and predators.

OR 10, Coos Bay North Spit, 273 ac (111 ha). The Service proposed 308 (125 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 35 ac (14 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the western coast of Coos County, about 3 mi (5 km) west of the City of Coos Bay. It is bounded Oregon Dunes NRA 3 mi (4.8 km) to the north, Coos Bay North Jetty to the south, Coos Bay to the east, and HCP-covered lands to the west. Coos Bay North Spit was occupied at the time of listing and is currently occupied. Documented Pacific Coast WSPs for this unit include 59 breeding plovers in 2011 (Lauten et al. 2011, p. 25). The unit consists of 273 ac (111 ha) of Federal land under the jurisdiction of the USACE, but primarily managed by the U.S. Bureau of Land Management (BLM). The unit is characteristic of a dunebacked beach in close proximity to tidally influenced estuarine mud flats and containing interior interdune flats created through dredge material disposal or through habitat restoration. It includes the following features essential to the conservation of the species: Expansive, sparsely vegetated interdune flats; open, sandy areas that are relatively undisturbed by humans; areas of sandy beach above the mean high water line with occasional surf-cast wrack supporting small invertebrates; and close proximity to tidally influenced estuarine mud flats. Primary threats to essential physical and biological features that may require special management in this unit are degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans, pets, and horses in important foraging and nesting areas; vehicle trespass into closed areas; and predators.

OR 11, Bandon to New River, 541 ac (219 ha). The Service proposed 1,016 ac (411 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, Bandon State Natural Area (227 ac, 92 ha), which is owned and managed by OPRD, and 249 ac (101 ha) of private land have been excluded from critical habitat designation for this unit under section 4(b)(2) of the Act (see Exclusions section below). The remaining lands of this unit are on the southwestern coast of Coos County, about 3 mi (5 km) south of the City of Bandon. The unit consists of multiple land ownerships bounded by the southern boundary of Bandon State Natural Area to the north, the New River to the east, north of the Floras Creek outlet to the south, and HCP-covered lands to the west. The unit encompasses all of New River Spit and extends behind a relatively low foredune north of Floras Creek. Sea-level rise and overwashing of these areas during the winter months is anticipated to result in vegetation removal and the creation of additional Pacific Coast WSP breeding habitat. New River was occupied at the time of listing and is currently occupied. Documented Pacific Coast WSPs for this unit include 20 breeding plovers in 2011 (Lauten et al. 2011, p. 25; Lauten 2012 pers. comm.). The BLM is the unit's primary land manager. Unit OR 11 consists of 459 ac (186 ha) of Federal land with 82 ac (33 ha) of private land. The unit is characteristic of a dunebacked beach and barrier spit, and contains interdune flats created through habitat restoration. It includes the following features essential to the conservation of the species: Wide sand spits or overwashes and sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; areas of sandy beach above the mean high water line with occasional surf-cast wrack supporting small invertebrates; and close proximity to tidally influenced freshwater areas. Primary threats that may require special management in this unit are degradation of the sand dune system due to encroachment of European beach grass; disturbance from humans and pets in important foraging and nesting areas; vehicle trespass into closed areas; and predators.

OR 13, Euchre Creek Spit, 9 ac (4 ha). The Service proposed 116 (47 ha) for designation in this unit in the revised proposed designation of critical habitat. In this final revision, 107 ac (43 ha) of proposed critical habitat has been excluded under section 4(b)(2) of the Act (see Exclusions section below). This unit is on the western coast of Curry County, approximately 10 mi (6 km) north of the City of Gold Beach. It located to the north and south of the Euchre Creek and is bounded by HCPcovered lands to the west. The unit consists of 9 ac (4 ha) of private land. The unit extends into low-elevation areas on the north and south side of Euchre Creek. Sea-level rise and overwashing of these areas during the winter months is anticipated to result in vegetation removal and the creation of additional Pacific Coast WSP breeding habitat. Although Euchre Creek Spit was not considered occupied at the time the Pacific Coast WSP was listed in 1993, this beach is a historical nesting site. The most recently documented Pacific Coast WSP in the area was one wintering plover in 1989 (ODFW in litt. 1994, Appendix, Table 3). Although nesting and wintering have not been recently confirmed for this area, we consider the unit is needed by the species for use in response to fluctuating habitat and resource availability. We consider the unit to be essential for the conservation of the Pacific Coast WSP as it has the capability of providing connectivity between occupied areas, dispersal habitat between units, and habitat for resting and foraging. This unit may provide habitat to support breeding Pacific Coast WSP and would facilitate interchange between otherwise widely separated units within Recovery Unit 1 (identified in the Recovery Plan, Service 2007) in Oregon and Washington. Euchre Creek Spit is characteristic of a dune-backed beach and sand spit in close proximity to a tidally influenced river mouth. The unit includes sparsely vegetated, low-lying areas of sandy dune; open, sandy areas that are relatively undisturbed by humans; and close proximity to tidally influenced freshwater areas, which are essential for the conservation of the Pacific Coast WSP.

CA 1, Lake Earl, 74 ac (30 ha). This unit is located directly west of the Lake Earl/Lake Tolowa lagoon system in Del Norte County about 4 mi (7 km) north of Crescent City. The Lake Earl Lagoon spit is approximately 3 mi (5 km) in length, encompasses approximately 74 ac (30 ha), and lies approximately 2 mi (3 km) north of Point Saint George and the McNamara Airfield. This unit was occupied at the time of listing and is currently occupied. This unit is a historical breeding site (Yocom and Harris 1975, p. 30), and has harbored a small population of wintering Pacific Coast WSP in recent years (Service unpublished data). This unit is capable of supporting 10 breeding adults with adaptive management (Service 2007, Appendix B). All 74 ac (24 ha) are managed by the State under the jurisdiction of the California Department of Fish and Game (CDFG), and California Department of Parks and Recreation (CDPR). Essential physical or biological features of the unit for Pacific Coast WSP conservation include sandy beaches above and below the mean high-tide line, wind-blown sand in dune systems immediately inland of the active beach face, and the wash over area at the lagoon mouth. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from: Degradation of the sand dune system due to encroachment of European beach grass; destruction of habitat and loss of wintering and nesting Pacific Coast WSPs from OHV use; and destruction of habitat from annual mechanical breaching (as authorized by the USACE) of the spit between the Lake Earl/Lake Tolowa Lagoon and the Pacific Ocean.

CA 2, Gold Bluffs Beach, 233 ac (94 ha). This unit is located in Humboldt County about 5 mi (6 km) north of the Town of Orick within Prairie Creek State Park (north of Gold Bluffs Beach campground), and is managed cooperatively with Redwood National Park, collectively known as Redwood National and State Parks (RNSP). This unit was occupied at the time of listing, is currently occupied, and incorporates the primary use area of a pair of Pacific Coast WSPs that nested in Prairie Creek State Park during the summer of 2005, and is commonly used by wintering Pacific Coast WSPs. Although not considered a main breeding location, unit CA 2 provides a fairly undisturbed location for breeding Pacific Coast WSP that lose nests to predation or other causes at various nest sites, and could offset habitat loss as sea-level rise prevents nesting at sites currently being used by plovers. One chick was fledged from the unit during 2004. Up to five Pacific Coast WSPs were observed within the unit in March 2007. The unit's primary value is as a wintering site (Service 2007, Appendix B). The site is often used as wintering habitat on an irregular basis (Service unpublished data). RNSP are actively managing the area for Pacific Coast WSP. The northeast portion of the unit is currently vegetated with European beach grass and is, therefore, currently unsuitable for nesting. However, with restoration, that portion of the unit would be considered suitable nesting habitat. We include that portion of the unit to help offset the anticipated effects of sea-level rise over time. RNSP have restored beach habitat by removing nonnative vegetation on other portions of Gold Bluffs Beach. We anticipate similar restoration within the unit to occur sometime in the future. The unit contains the following features essential to the conservation of the Pacific Coast WSP: Low lying sandy dunes; open, sandy areas that are relatively undisturbed by humans; and sandy beach above and below the hightide line that supports small invertebrates. Most visitor use in the area is in Fern Canyon, which is to the east of the unit and outside of suitable Pacific Coast WSP habitat. Visitation is light relative to other State and National Parks within the Pacific Coast WSP's range. Limited vehicle use of the beach is allowed for commercial and tribal fishing, and park administrative use. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human-related use from recreation and OHV use associated with commercial fishing, and European beach grass.

CA 3A, Stone Lagoon, 55 ac (22 ha). This subunit is approximately 0.9 mi (1.5 km) in length, and is located on the Stone Lagoon spit. Stone Lagoon borders the subunit on the east, and the Pacific Ocean makes up the subunit's western edge. Subunit CA 3A is located in Humboldt County, approximately 3 mi (5 km) south of the Town of Orick. The subunit was occupied at the time of listing and is currently occupied. Nesting has recently occurred within the subunit. In 2009, a single nest hatched three chicks, all of which fledged (Colwell, et al. 2009, p. 9). The Recovery Plan (Service 2007) estimates that up to 16 Pacific Coast WSPs can be supported within Unit CA 3; however, all are attributed to subunit CA 3B. Recent data indicate that the population management potential for subunit CA 3A is underestimated by the Recovery Plan (Service 2007, Appendix B), as it does contribute towards the species' reproductive success in northern California (Colwell et al. 2009, p. 9; Service unpublished data). The subunit contains the following physical or biological features essential to the conservation of the Pacific Coast WSP: Low-lying sandy dunes; open, sandy areas that are relatively undisturbed by humans; and sandy beach above and below the high-tide line that supports small invertebrates. Special management may be needed to control nonnative vegetation and enforce existing regulations to ensure the suitability of the subunit. With time, we anticipate that the entire subunit will be inundated with sea-level rise associated with climate change. CA 3B, Big Lagoon, 268 ac (108 ha) This subunit consists of a large sand spit that divides the Pacific Ocean from Big Lagoon. The northern extent of Big Lagoon Spit is located in Humboldt County and is approximately 6 mi (10 km) south of the Town of Orick. This subunit was occupied at the time of listing and is currently occupied. Big Lagoon Spit is historical nesting habitat (Page and Stenzel 1981, p. 9), and currently maintains a winter population of fewer than 10 Pacific Coast WSPs (Service unpublished data). Recent nesting occurred within the subunit during 2005, in which a single nest hatched and fledged three chicks. We estimate the subunit can support 16 breeding adults (Service 2007, Appendix B). The subunit is located on the Big Lagoon Spit, which is approximately 4 mi (7 km) in length. Most of the subunit is managed by the CDPR. Approximately 0.6 ac (0.3 ha) are managed by Humboldt County. Essential physical or biological features of the subunit that contribute towards the conservation of the Pacific Coast WSP include: Low-lying sandy dunes and open, sandy areas that are relatively undisturbed by humans; and sandy beach above and below the hightide line that supports small invertebrates. CDPR has conducted habitat restoration at this unit through the hand-removal of nonnative vegetation. The primary threat to wintering and breeding Pacific Coast WSPs that may require special management is disturbance from humans and pets from walking through winter flocks and potential nesting areas. Other threats requiring management include control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the subunit. With time, we anticipate that the entire subunit will be inundated with sea-level rise associated with climate change.

CA 4A, Clam Beach/Little River, 337 ac (136 ha). The subunit is located in Humboldt County immediately west and north of the Town of McKinleyville. The Clam Beach/Little River subunit's northern boundary is directly across from the south abutment of the U.S. Highway 101 Bridge that crosses the Little River. The southern subunit boundary is aligned with the north end of the southernmost, paved Clam Beach parking area. The length of the subunit is approximately 2 mi (3 km). Approximately 222 ac (90 ha) are State owned. This subunit was occupied at the time of listing and is currently occupied. During 2003, the subunit supported a breeding population of approximately 12 Pacific Coast WSPs, and a winter population of up to 55 plovers (Service unpublished data). This subunit is one of four primary nesting locations within northern California. Based on the Recovery Plan (Service 2007, Appendix B), we expect the subunit to be capable of supporting six pairs of breeding Pacific Coast WSPs. Essential physical or biological features of the subunit that contribute towards the conservation of the Pacific Coast WSP include large areas of sandy dunes, areas of sandy beach above and below the high-tide line, and generally barren to sparsely vegetated terrain. Special management is needed to control nonnative vegetation and enforcement of existing human-use regulations. With time, we anticipate that the lower portions of this subunit will be inundated with sea-level rise associated with climate change. CA 4B, Mad River Beach, 452 ac (183 ha) The subunit is located in Humboldt County immediately west of the Town of McKinleyville. This subunit was largely swept clean of European beach grass when the Mad River temporarily shifted north in the 1980s and 1990s. The Mad River Beach subunit is approximately 3 mi (5 km) long, and ranges from the U.S. Highway 101 Vista Point below the Arcata-Eureka Airport in the north, to School Road in the south. Approximately 161 ac (65 ha) are owned and managed by Humboldt County, and 143 ac (58 ha) are privately owned. The remaining 148 ac (60 ha) are managed by the State, and consist of the intertidal zone. Upon recalculation of ownership data, we discovered that the overall subunit area is approximately 4 ac (2 ha) smaller than proposed. This subunit was occupied at the time of listing and is currently occupied. We expect it to eventually support 12 breeding Pacific Coast WSPs with proper management (Service 2007, Appendix B). The current breeding population is believed to be less than five Pacific Coast WSPs, although plovers from this subunit readily intermix with plovers in CA 4A and elsewhere (Colwell et al. 2009, p. 9; Service unpublished data). Occasional winter use by Pacific Coast WSPs has been intermittently documented, with most wintering within the adjacent critical habitat subunit to the north (Service unpublished data). Essential physical or biological features of the subunit that contribute towards the conservation of the Pacific Coast WSP include large areas of sandy dunes, areas of sandy beach above and below the high-tide line, and generally barren to sparsely vegetated terrain. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the subunit. With time, we anticipate that the lower portions of this subunit will be inundated with sea-level rise associated with climate change. Potential threats to nests, chicks, and both wintering and breeding adult Pacific Coast WSPs that may require special management are: nonnative vegetation, OHV use, and disturbance caused by equestrians (i.e., people riding horses) and humans with accompanying pets.

CA 5A, Humboldt Bay South Spit Beach, 572 ac (231 ha). This subunit is located in Humboldt County adjacent to Humboldt Bay, less than 1 mi west of the City of Eureka, with the southern boundary being Table Bluff. Approximately 542 ac (219 ha) of the unit are owned by the CDFG and State Lands Commission, but are managed by BLM; 10 ac (4 ha) are owned and managed by Humboldt County; and 20 ac (8 ha) are owned by the USACE. The subunit is 5 mi (8 km) in total length. This subunit was occupied at the time of listing and is currently occupied. The Pacific Coast WSP wintering population within the subunit is estimated at fewer than 15 individuals. Three nests, from four breeders, were attempted within the subunit in 2003 (Service unpublished data). This subunit is capable of supporting 30 breeding Pacific Coast WSPs (Service 2007, Appendix B). The BLM has conducted habitat restoration within the subunit, in consultation with us. The following physical or biological features essential to the conservation of the Pacific Coast WSP can be found within the unit: Large areas of sandy dunes, areas of sandy beach above and below the high-tide line, and generally barren to sparsely vegetated terrain. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, OHV use, and disturbance from equestrians and humans with pets. CA 5B, Eel River North Spit and Beach, 464 ac (188 ha) This subunit is located in Humboldt County about 4 mi (7 km) east of the Town of Loleta and stretches from Table Bluff on the north to the mouth of the Eel River in the south. The subunit is estimated to be 3.9 mi (7 km) long, and is managed by the State, except for 7 ac (3 ha) of private land. This subunit was occupied at the time of listing and is currently occupied with a wintering population of Pacific Coast WSPs estimated at fewer than 20 (Service unpublished data). As many as 11 breeders have been observed during breeding season window surveys, with a breeding population estimated at less than 15 (Colwell et al. 2009, p. 9). We expect this subunit to eventually support 20 breeding Pacific Coast WSPs with proper management (Service 2007, Appendix B). Essential physical or biological features of the subunit include: Large areas of sandy, sparsely vegetated dunes for reproduction and normal behavior, and areas of sandy beach above and below the high-tide line supporting small invertebrates for foraging. Surfcast organic debris is an important component of the habitat in this subunit, providing shelter from the wind both for nesting Pacific Coast WSPs and for invertebrate prey species. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the subunit. With time, we anticipate that the lower portions of this subunit will be inundated with sea-level rise associated with climate change. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, predators, OHVs, and disturbance from equestrians and humans with pets. CA 5C, Eel River South Spit and Beach, 336 ac (136 ha) This subunit, located in Humboldt County, encompasses the beach segment from the mouth of the Eel River, south to Centerville Road, approximately 4 mi (7 km) west of the City of Ferndale. The subunit is 5 mi (8 km) long; 160 ac (65 ha) are private, with 4 ac (2 ha) managed by Humboldt County. Approximately 172 ac (70 ha) are managed by the State. This subunit was occupied at the time of listing, is currently occupied, and capable of supporting 20 breeding Pacific Coast WSPs. A single nest was found during the 2004 breeding season (Colwell et al. 2004, p. 7). The winter population is estimated at fewer than 80 plovers, many of which breed on the Eel River gravel bars (CA 5) (Service unpublished data). Essential physical or biological features of the subunit include: Large areas of sandy dunes, areas of sandy beach above and below the high-tide line, and generally barren to sparsely vegetated terrain for foraging. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the subunit. With time, we anticipate that the lower portions of this subunit will be inundated with sea-level rise associated with climate change. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, predators, OHVs, and disturbance from equestrians and humans with pets.

CA 6, Eel River Gravel Bars; 1,349 ac (546 ha). This unit, located in Humboldt County, is largely inundated during winter months due to high flows in the Eel River. The unit is 6.4 mi (8 km) from the City of Fernbridge, and includes gravel bars between Fernbridge and the confluence of the

Van Duzen River. The Eel River is contained by levees in this section, and consists of gravel bars and wooded islands. The unit contains a total of 1,349 ac (546 ha), of which 176 ac (71 ha) are owned and managed by Humboldt County, 304 ac (123 ha) are under the jurisdiction of the California State Lands Commission, and 869 ac (352 ha) are privately-owned. This unit was occupied at the time of listing, is currently occupied, and capable of supporting 40 breeding Pacific Coast WSPs. Surveys have documented 22 breeding birds in this unit; however, those numbers have dropped off in recent years (Colwell et al. 2009, p. 9; Service unpublished data). Essential physical or biological features of this unit include bare, open gravel bars comprised of both sand and cobble, which support reproduction and foraging. This unit harbors the most important breeding habitat in California north of San Francisco Bay, and has the highest fledging success rate of any area from Mendocino County to the Oregon border. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from predators, OHVs, disturbance from gravel mining, and humans with pets. Gravel mining is managed through a Clean Water Act permit issued by the USACE.

CA 7, MacKerricher Beach, 1,218 ac (493 ha). This unit is approximately 3.5 mi (5.6 km) long. The unit is just south of the Ten Mile River, and approximately 4 mi (6 km) north of the City of Fort Bragg located in Mendocino County. The State manages approximately 1,144 ac (463 ha), and 74 ac (30 ha) are privately owned. CDPR has been conducting removal of European beach grass to improve habitat for the Pacific Coast WSP and other sensitive dune species within the unit. This unit was occupied at the time of listing, is currently occupied, and is capable of supporting 20 breeding Pacific Coast WSPs (Service 2007, Appendix B). The current breeding population is estimated at fewer than 10 (Colwell et al. 2009, p. 9). The winter population of plovers is fewer than 45 (Service unpublished data). Essential physical or biological features of the unit include: large areas of sandy dunes, areas of sandy beach above and below the high-tide line, and generally barren to sparsely vegetated terrain. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, predators, and disturbance from equestrians and humans with pets.

CA 8, Manchester Beach, 505 ac (204 ha). The Manchester Beach unit is approximately 3.5 mi (6 km) long and located in Mendocino County about 1 mi (2 km) west of the Town of Manchester. The State manages 425 ac (172 ha) of the unit, 68 ac (28 ha) are federally managed, and the remaining 12 ac (5 ha) are privately owned. This unit is occupied and provides an important wintering site for Pacific Coast WSPs in the region (Service 2007, Appendix B). In 2003, a pair of Pacific Coast WSPs nested within the unit, and successfully hatched two chicks. However, those chicks did not survive (Colwell et al. 2004, p. 7). The current wintering population is estimated at fewer than 20 (Service unpublished data). Although occupancy at the time of listing has not been confirmed, we consider this unit essential for the conservation of the species based on the fluctuating use of areas by the species as a response to habitat and resource availability. The unit is located adjacent to currently occupied areas and provides dispersal habitat between units. This unit provides habitat to support breeding Pacific Coast WSPs, will facilitate interchange between otherwise widely separated units, and helps provide habitat within a Recovery Unit identified in the Recovery Plan (Service 2007). The unit contains large areas of sandy dunes, areas of sandy beach above and below the high-tide line, and generally barren to sparsely vegetated terrain, which are essential for the conservation of the Pacific Coast WSP.

CA 9, Dillon Beach, 39 ac (16 ha). This unit is located at the mouth of Tomales Bay, in Marin County, just south of the Town of Dillon Beach. It stretches for about 0.7 mi (1 km) north from Sand Point. The unit was occupied at the time of listing, is currently occupied, and is an important wintering area for the species. Seventy-five wintering Pacific Coast WSPs were counted at this location during the January 2007 winter window survey (Service 2007, p. 4). The unit does not extend as far north as did the unit proposed for Dillon Beach in 2004 (69 FR 75607, December 17, 2004), because subsequent site visits and discussions with local Pacific Coast WSP surveyors have established that Pacific Coast WSPs only rarely used the area north of the unit we are designating in this rule. The unit is entirely on private land. Essential physical or biological features provided by the unit include surf cast debris supporting small invertebrates for foraging, and large stretches of relatively undisturbed, sparsely vegetated, sandy beach, both above and below high-tide line, for foraging and potentially for nesting. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, predators, and disturbance by humans and their pets. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 10A, Point Reyes, 460 ac (186 ha). This subunit is located in Marin County to the west of the unincorporated Community of Inverness and occupies most of the west-facing beach between Point Reyes and Tomales Point. It is located entirely within the Point Reyes National Seashore, and consists primarily of dune-backed beaches. This unit was occupied at the time of listing, is currently occupied, supports both nesting and wintering Pacific Coast WSPs, and has the potential to support 50 breeding birds with proper management (Service 2007, Appendix B). The Point Reyes unit includes the following PCEs essential to Pacific Coast WSP conservation: sparsely vegetated sandy beach above and below high-tide for nesting and foraging, wind-blown sand dunes for nesting and predator avoidance, and tide-cast debris attracting small invertebrates for foraging. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the subunit. With time, we anticipate that the lower portions of this subunit will be inundated with sea-level rise associated with climate change. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, disturbance by humans and pets, and predators (particularly corvids). CA 10B, Limantour, 156 ac (63 ha) Limantour is a roughly 2.25-mi (4-km) sand spit at the north end of Drake’s Bay located in Marin County to the west of the unincorporated Community of Olema. The subunit includes the end of the spit, and narrows to include only the south-facing beach towards the base of the spit. It is completely within the Point Reyes National Seashore. This unit was occupied at the time of listing, is currently occupied, and can support both nesting and wintering Pacific Coast WSPs, although nesting has not been documented since 2000 (Stenzel in litt. 2004, p. 3; Service 2009, p. 3). Ninetyeight wintering plovers were counted at the site during the January 2007 window survey (Service 2007, p. 4). The subunit is expected to contribute significantly to plover conservation in the region by providing habitat capable of supporting 10 nesting birds (Service 2007, Appendix B). PCEs at the subunit include sparsely vegetated beach sand, above and below high-tide for nesting and foraging, and tide-cast debris supporting small invertebrates. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the subunit. With time, we anticipate that the lower portions of this subunit will be inundated with sea-level rise associated with climate change. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, disturbance by humans and pets, and nest predators such as crows and ravens.

CA 11, Napa-Sonoma Marshes, 618 ac (250 ha). This unit encompasses salt evaporation ponds 7 and 7A, in the Napa-Sonoma Marshes Wildlife Area, owned by the CDFG. It is situated in Napa County, about 2.3 mi (4 km) west of the Napa County Airport, and about 1.5 mi (2.4 km) south of Las Amigas Road. The unit was occupied at the time of listing and is currently occupied. Twelve Pacific Coast WSPs were identified at the location in the summer 2009, during window surveys (Service 2009, p. 2). This is the only location in the northern portion of the San Francisco Bay known to support nesting Pacific Coast WSPs. Essential physical or biological features provided by the unit include sparsely vegetated areas above daily high-tides, such as salt pans, artificial salt ponds, and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, flooding, and nest predators such as great egrets (Casmerodius albus) and common ravens (Corvus corax) (Robinson-Nilsen et al. 2009, p. 14). Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 12, Hayward, 1 ac (0 ha). This unit comprises Island 5 at the Hayward Regional Shoreline Park, located to the west of the City of Hayward in Alameda County. The area is managed by the East Bay Regional Park District (EBRPD) as a nesting area for shorebirds—primarily least terns (Sterna antillarum browni), but also Pacific Coast WSPs (Riensche 2007, p. 1). The unit was occupied at the time of listing and is currently occupied. Three Pacific Coast WSPs chicks from one nest successfully fledged from the unit in 2008 (Riensche 2008, p. 2; Robinson et al. 2008, pp. 19, 34), but since then seven plover nesting attempts in the area have failed, primarily due to predation (Robinson-Nilsen et al. 2009, pp. 16, 32; Robinson-Nilsen 2010, pers. comm.). The most commonly observed avian predators at the site have been California gulls (Larus californicus), although the only actual depredation observed was by a killdeer (Charadrius vociferus) (Robinson-Nilsen et al. 2009, pp. 14, 16). Essential physical or biological features provided by the unit include sparsely vegetated areas above daily high-tides, such as salt pans, artificial salt ponds, and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from predation, salt pond management, and non-native vegetation. The EBRPD is implementing a predator management program utilizing numerous volunteers as well as staff from the U.S. Department of Agriculture’s (USDA) Wildlife Services program (Riensche 2008, p. 2) to reduce predation at this site.

CA 13A, Eden Landing: 237 ac (96 ha). This subunit encompasses salt ponds E11, E15B, and E16B, just south of highway 92 and the San Mateo Bridge and west of Union City in Alameda County. This unit was occupied at the time of listing, is currently occupied, and supported a total of 30 Pacific Coast WSP nests in 2009, 15 of which hatched (Robinson-Nilsen et al. 2009, p. 32). Approximately 228 ac (92 ha) are State owned. Approximately 8 ac (3 ha) are privately owned. Essential features provided by the subunit include sparsely vegetated areas above daily high tides, such as salt pans, artificial salt ponds, and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from flooding and avian nest predators such as California gulls (RobinsonNilsen et al. 2009, p. 13). CA 13B, Eden Landing, 171 ac (69 ha) This subunit is located west of Union City in Alameda County and encompasses salt pond E14, just south of Eden Creek. This subunit was occupied at the time of listing, is currently occupied, supported nine Pacific Coast WSP nests in 2009, three of which hatched young (RobinsonNilsen et al. 2009, p. 32). The subunit does not include salt ponds E12 and E13 (just north of E14), because those are being converted to high salinity ponds for birds such as eared grebes (Podiceps nigricollis) and phalaropes (Phalaropus spp.) that forage well on such habitat (Strong 2010a, p. 1). The entire subunit is State owned. Essential features provided by the subunit include sparsely vegetated areas above daily high-tides, such as salt pans, artificial salt ponds and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from flooding and avian nest predators such as California gulls (RobinsonNilsen et al. 2009, p. 13). CA 13C, Eden Landing, 609 ac (246 ha) This subunit encompasses salt ponds E6A and E6B, and is located just north of Old Alameda Creek and west of Union City in Alameda County. This unit was occupied at the time of listing, is currently occupied, and supported a total of two Pacific Coast WSP nests in 2009, both of which hatched young (Robinson-Nilsen et al. 2009, p. 32). The subunit does not include a panhandleshaped area of potential habitat just north of pond E6A because it is being converted to tidal marsh as part of a restoration project started before the South Bay Salt Pond Restoration Project (Strong 2010b, p. 7; Strong 2010c, p. 1). Essential physical or biological features provided by the subunit include sparsely vegetated areas above daily high-tides, such as salt pans, artificial salt ponds, and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from flooding and avian nest predators such as California gulls (RobinsonNilsen et al. 2009, p. 13).

CA 14, Ravenswood, 89 ac (36 ha). This unit consists of the southwestern portion of salt pond SF2 located east of the City of East Palo Alto in San Mateo County near the western approach to the Dumbarton Bridge. Pond SF2 is undergoing renovations intended to provide ponded areas, islands, and salt pan for several species of shorebirds, including Pacific Coast WSPs (South Bay Salt Pond Restoration Project 2010, p. 3). The Ravenswood unit is drawn to encompass the salt pan area (Strong 2010b, pp. 3, 4). This unit was occupied at the time of listing and is currently occupied. In 2009, pond SF2 supported 23 Pacific Coast WSPs nests, 17 of which hatched young (Robinson-Nilsen et al. 2009, p. 32). The entire unit is privately owned. Essential physical or biological features provided by the unit include sparsely vegetated areas above daily high-tides, such as salt pans, artificial salt ponds and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from flooding and avian nest predators such as California gulls (RobinsonNilsen et al. 2009, p. 13).

CA 15, Warm Springs, 168 ac (68 ha). This unit encompasses the northeastern portion of salt evaporation ponds A22 and A23 in the Warm Springs area of the South San Francisco Bay near Foster City in San Mateo County. This unit was occupied at the time of listing and is currently occupied. Fourteen breeding Pacific Coast WSPs were identified at these ponds during the 2009 summer window surveys (Service unpublished data). Additionally, Robinson-Nilsen et al. (2009,

p. 32) found a total of 21 Pacific Coast WSPs nests at the ponds in 2009, 11 of which successfully hatched young. The southwestern portions of the ponds are excluded in keeping with tidal marsh restoration plans envisioned under the draft Tidal Marsh Recovery Plan (Service 2009, p. 266). The entire unit is federally owned. Essential physical or biological features provided by the unit include sparsely vegetated areas above daily high-tides, such as salt pans, artificial salt ponds, and adjoining levees, for nesting and foraging. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from flooding and avian nest predators such as California gulls (RobinsonNilsen et al. 2009, p. 13).

CA 16, Half Moon Bay, 36 ac (15 ha). This unit is located next to the City of Half Moon Bay in San Mateo County and stretches for about 1.25 mi (2 km) along Half Moon Bay State Beach, and is entirely within CDPR land. The essential features of this unit include sandy beach above and below the hightide line for nesting and foraging, and surf-cast debris to attract small invertebrates. This unit was occupied at the time of listing and is currently occupied. Small numbers of breeding Pacific Coast WSPs have been found at the location in the past five surveys (Service 2009, p. 3). The unit also supports a sizeable winter flock, consisting of 50 Pacific Coast WSPs in 2007 (Service 2007, p. 4). We expect the unit to eventually support 10 breeding Pacific Coast WSPs in the unit under proper management (Service 2007). The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, disturbance by humans and pets, and nest predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 17, Waddell Creek Beach, 25 ac (10 ha). This unit includes the mouth of Waddell Creek and is located about 20 mi (32 km) north of the City of Santa Cruz in Santa Cruz County. It extends about 0.6 mi (1 km) north along the coast from a point about 0.4 mi (0.6 km) south of the creek mouth to a point about 0.2 mi (1 km) north of the creek mouth. Unit CA 17 encompasses approximately 19 ac (8 ha) of State land and 6 ac (2 ha) of private land. This unit was occupied at the time of listing, and the unit has historically (prior to 2004) been an important breeding and wintering site, supporting up to 11 breeding and up to 50 wintering Pacific Coast WSPs (Service unpublished data). Although Pacific Coast WSPs have not been documented in recent years, we consider this unit presently occupied based on the fluctuating use of areas by the species as a response to habitat and resource availability. The unit is located between currently occupied areas and provides dispersal habitat between units. This unit provides habitat to support breeding plovers, will facilitate interchange between otherwise widely separated units, and helps provide habitat within Recovery Unit 4 (identified in the Recovery Plan, Service 2007) along the central California Coast. This unit includes the following physical or biological features essential to the conservation of the species: Wind-blown sand dunes, areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation and human disturbance. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 18, Scott Creek Beach, 23 ac (9 ha). This unit includes the mouths of Scott and Molino Creeks and is located about 13 mi (21 km) north of the City of Santa Cruz in Santa Cruz County. It extends about 0.7 mi (1 km) north along the coast from the southern end of the sandy beach, 0.3 mi (0.5 km) south of Molino Creek, to a point about 0.1 mi (0.2 km) north of Scott Creek. Unit CA 18 encompasses approximately 15 ac (6 ha) of State land and 8 ac (3 ha) of local jurisdictional land. This unit was occupied at the time of listing and is currently occupied, and recent surveys have found up to 4 breeding Pacific Coast WSPs, while historical surveys (prior to 2004) have found up to 12 breeding plovers occupying the area (Service unpublished data). Unit CA 18 is an important wintering area, with up to 129 Pacific Coast WSPs recorded in a single season (Service unpublished data). This unit is essential to the conservation of the species because, with proper management, and in conjunction with the other two relatively small units designated in Santa Cruz County (CA 17 and 19), it can attract additional breeding Pacific Coast WSPs and thereby facilitate interchange between the larger units at Half Moon Bay (CA 16). The unit includes the following habitat physical or biological features essential to the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 19, Wilder Creek Beach, 15 ac (6 ha). This unit is located at the mouth of Wilder Creek and is about 1 mi (1.6 km) west of the city of Santa Cruz, in Santa Cruz County. It extends about 0.25 mi (0.40 km) along the coast encompassing the sandy beach at the mouth of Wilder Creek. The unit is situated on Stateowned (14 ac (6 ha)) and private (1 ac (0.4 ha)) land. This unit was occupied at the time of listing and is currently occupied. Although nesting in this area has been uncommon in recent years, it has historically been an important snowy plover nesting area, with up to 16 birds nesting each year (Service 2007, Appendix B) and is also an important Pacific Coast WSP wintering area, with up to 52 birds each winter (Service 2007, Appendix B). Unit CA 19 is capable of supporting 16 breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). This unit is essential to the conservation of the species because, with proper management, and in conjunction with the other two relatively small units in Santa Cruz County (CA 17 and 18), it can attract additional breeding Pacific Coast WSPs and thereby facilitate interchange between the larger units at Half Moon Bay (CA 16) and Jetty Road to Aptos (CA 20). The unit includes the following features essential to the species: Areas of sandy beach above and below the high tide line with occasional surf-cast wrack supporting small invertebrates (for nesting and foraging) and generally barren to sparsely vegetated terrain (for foraging and predator avoidance). The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, development, OHV use, pets, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 20, Jetty Road to Aptos, 399 ac (161 ha). This unit is located about 5 mi (8 km) west of the City of Watsonville and includes Sunset State Beach located in Santa Cruz County and Zmudowski

State Beach and Moss Landing State Beach, both located in Monterey County. The mouth of the Pajaro River is located near the center of the subunit, and is designated as a Natural Preserve within Zmudowski State Beach. Elkhorn Slough is at the south end of the subunit. It extends about 8 mi (13 km) along the coast from Elkhorn Slough to Zils Road. Approximately 369 ac (149 ha) are State owned. The remaining 30 ac (12 ha) are privately owned. This unit was occupied at the time of listing; is currently occupied; is an important breeding area, with as many as 105 breeding Pacific Coast WSPs each year; and is also an important wintering area, with up to 250 plovers each winter (Service unpublished data). The unit includes the following habitat physical or biological features essential to the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, development, horses, OHV use, pets, predators, and habitat changes resulting from exotic vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 21, Elkhorn Slough Mudflats, 281 ac (114 ha). This unit is located about 3.5 mi (6 km) north of the City of Castroville along the north side of Elkhorn Slough east of Highway 1 located in Monterey County. This unit is 1.5 mi (2 km) long, extending about 1 mi (2 km) along the north shore of Elkhorn Slough east of Highway 1 and about 0.5 mi (1 km) north from Elkhorn Slough to Bennett Slough. The unit is situated entirely on State-owned land. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area, with as many as 41 breeding Pacific Coast WSPs each year, and is also an important wintering area, with up to 137 plovers each winter (Service unpublished data). This unit is capable of supporting 80 breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). The unit includes the following habitat physical or biological features essential to the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and mud flat and salt pan habitat with generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, development, horses, OHV use, pets, predators, and habitat changes resulting from exotic vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 22, Monterey to Moss Landing, 959 ac (388 ha). This unit includes the beaches along the southern half of Monterey Bay from the City of Monterey at the south end of the unit to Moss Landing and the mouth of Elkhorn Slough at the north end of the unit in Monterey County. The mouth of the Salinas River is a Natural Preserve under State Parks, and is located near the center of the unit. Both the Salinas River and Marina Dunes Natural Preserves are within the unit. The unit extends about 15 mi (24 km) north along the coast from Monterey to Moss Landing. Unit CA 22 includes approximately 285 ac (115 ha) of State lands, 36 ac (14 ha) of local lands, and 415 ac (168 ha) of Federal land. The remainder is privately owned. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area, with as many as 162 breeding Pacific Coast WSPs each year, and is also an important wintering area, with up to 363 plovers each winter (Service unpublished data). The unit includes the following physical or biological features essential to the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, development, horses, OHV use, pets, predators, and habitat changes resulting from exotic vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 23, Point Sur Beach, 72 ac (29 ha). This unit is about 17 mi (27 km) south of the City of Monterey and immediately north of Point Sur State Historic Park (SHP) in Monterey County. It extends about 0.7 mi (1 km) north along the coast from Point Sur SHP, and includes the Point Sur Dunes Natural Preserve. This unit encompasses approximately 38 ac (15 ha) of State land and 34 ac (14 ha) of private land. This unit was occupied at the time of listing, is currently occupied, and has supported up to 13 breeding Pacific Coast WSPs each year (Service unpublished data). This unit is capable of supporting 20 breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). Unit CA 23 is an important wintering area, historically supporting up to 65 plovers each winter (Service unpublished data). The unit includes the following habitat physical or biological features essential to the species: Wind-blown sand dunes, areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance and habitat changes resulting from exotic vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 24, San Carpoforo Creek, 24 ac (10 ha). This unit is located approximately 20 mi (32 km) north of the Town of Cambria and 2.5 mi (4 km) south of the San Luis Obispo/Monterey County boundary in San Luis Obispo County. It extends approximately 0.57 mi (1 km) along the coast. This unit contains approximately 4 ac (2 ha) of land owned by the USFS, 18 ac (7 ha) owned by the CDPR, and 2 ac (1 ha) of private land. The unit was occupied at the time of listing, is currently occupied, and has supported as many as nine breeding Pacific Coast WSPs; however, breeding does not occur here every year (Service unpublished data). This unit is capable of supporting 10 breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). This unit consistently supports 40 to 50 wintering plovers (Service unpublished data). San Carpoforo Creek is approximately 53 mi (84 km) south of the closest unit to the north (CA 23, Point Sur), and approximately 11 mi (18 km) north of the closest unit to the south (CA 25, Arroyo Laguna Creek). Therefore, this unit may facilitate interchange between widely separated habitats. This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, pets, and dune-stabilizing vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 25, Arroyo Laguna Creek, 28 ac (11 ha). This unit is located 11 mi (8 km) south of San Carpoforo Creek and 10 mi (16 km) north of the Town of Cambria in San Luis Obispo County. It extends approximately 0.9 mi (2 km) along the coast from a rocky headland 0.2 mi (0.3 km) south of Adobe Creek to 0.2 mi (0.3 km) north of Oak Knoll Creek. This unit encompasses approximately 18 ac (7 ha) of land owned by the CDPR and 10 ac (4 ha) of private land. This unit was occupied at the time of listing and is currently occupied. Arroyo Laguna Creek has historically (prior to 2000) been an important site, supporting as many as 6 breeding and 91 wintering Pacific Coast WSPs; however, neither breeding nor wintering occurs here every year (Service unpublished data). This unit is capable of supporting six breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). This unit is roughly equidistant between CA 24 (San Carpoforo Creek) and CA 26 (San Simeon State Beach) and may facilitate interchange between widely separated habitats. This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates (for nesting and foraging) and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, pets, and dune-stabilizing vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 26, San Simeon State Beach, 24 ac (10 ha). This unit is located about 2 mi (3 km) north of the Town of Cambria in San Luis Obispo County. It extends about 0.9 mi (2 km) along the coast from a point opposite the intersection of Highway 1 and Moonstone Beach Drive to the northwestern corner of San Simeon State Beach. Unit CA 26 is owned by the CDPR. The unit was occupied at the time of listing and is currently occupied. San Simeon State Beach has supported as many as seven breeding Pacific Coast WSPs; however, breeding does not occur here every year (Service unpublished data). This unit is an important wintering area with up to 143 plovers recorded in a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, pets, and dune-stabilizing vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 27, Villa Creek Beach, 20 ac (8 ha). This unit is located about 3.5 mi (6 km) northwest of the Community of Cayucos in San Luis Obispo County. It extends 0.3 mi (0.5 km) northwest along the beach from an unnamed headland 1.4 mi (2 km) north of Point Cayucos to an unnamed headland northwest of Villa Creek. This unit is owned by the CDPR. This unit was occupied at the time of listing, is currently occupied, and is an important breeding and wintering site. This unit has supported as many as 33 breeding Pacific Coast WSPs in a single season (Service unpublished data). Wintering numbers vary widely from year to year, with 10 to 112 plovers recorded over the last 7 seasons (Service unpublished data). This unit includes the following physical or biological features essential to the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, pets, horses, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 28, Toro Creek, 34 ac (14 ha). This unit is located about 3 mi (5 km) north of the City of Morro Bay in San Luis Obispo County, extending from 0.4 mi (1 km) north of Toro Creek Road to 0.5 mi (1 km) south of Toro Creek Road (total length: 0.9 mi (1 km)). This unit was occupied at the time of listing, is currently occupied, and was historically (prior to 2000) an important breeding area, having supported as many as 16 breeding Pacific Coast WSPs (Service unpublished data). Breeding has not occurred at this unit in the last 5 seasons; however, the unit is capable of supporting 25 breeding plovers under proper management (Service 2007, Appendix B). This unit is an important wintering area with up to 121 Pacific Coast WSPs recorded in a single season (Service unpublished data). The unit encompasses approximately 11 ac (4 ha) of State land and 23 ac (9 ha) of private land. This unit includes the following physical or biological features essential to the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, pets, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 29, Atascadero Beach/Morro Strand State Beach, 213 ac (86 ha). This unit is located at Morro Strand State Beach just north of the City of Morro Bay in San Luis Obispo County. It extends about 2.25 mi (4 km) north along the beach from the parking area northeast of Morro Rock to an unnamed rocky outcrop opposite the end of Yerba Buena Street at the north end of the City of Morro Bay. This unit encompasses approximately 64 ac (26 ha) of State land, 51 ac (21 ha) of local jurisdictional land, and 98 ac (40 ha) of private land. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area, having supported as many as 24 breeding Pacific Coast WSPs in a single season (Service unpublished data). The unit is capable of supporting 40 breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). This unit is also an important wintering area, with up to 249 plovers being recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the species: areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, pets, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 30, Morro Bay Beach, 1,076 ac (435 ha). This unit is located at Montana de Oro State Park south of Morro Rock and adjacent to the City of Morro Bay in San Luis Obispo County. It extends 5.5 mi (9 km) north along the beach from a rocky outcrop about 350 ft (105 m) north of Hazard Canyon to the northern tip of the sand spit. This unit encompasses approximately 948 ac (383 ha) of State land, 69 ac (28 ha) of local jurisdictional land, and 60 ac (24 ha) of private land. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area, supporting as many as 205 breeding Pacific Coast WSPs in a single season (Service unpublished data). Morro Bay Beach is also an important wintering area, supporting up to 104 plovers during a single over the last seven seasons (Service unpublished data). This unit includes the following physical or biological features essential to the species: Wind-blown sand dunes, areas of sandy beach above and below the high-tide line with occasional surfcast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, horses, pets, predators, and dune-stabilizing vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 31, Pismo Beach/Nipomo Dunes, 1,652 ac (669 ha). This unit is located south of the City of Grover Beach and west of the Town of Oceano and extends from San Luis Obispo County into northern Santa Barbara County west of the City of Guadalupe. The unit has approximately 242 ac (98 ha) of Federal land, 552 ac (223 ha) of State land, 377 ac (152 ha) of local jurisdictional land, and 481 ac (195 ha) of private land. This unit extends about 12 mi (19 km) along the beach from a point about 0.4 mi (1 km) north of Mussel Point to a point on the north side of Arroyo Grande Creek at the south end of Strand Way in the Town of Oceano. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area, having supported as many as 162 breeding Pacific Coast WSPs in a single season (Service unpublished data). This unit is capable of supporting 350 breeding Pacific Coast WSPs under proper management (Service 2007, Appendix B). Pismo Beach/Nipomo Dunes is an important wintering area, having supported up to 287 Pacific Coast WSPs during a single season over the last 7 years (Service unpublished data). The unit includes portions of Pismo State Beach and Oceano Dunes SVRA, owned and managed by the CDPR; the Guadalupe-Nipomo Dunes National Wildlife Refuge, owned and managed by the Service; the Guadalupe Oil Field, owned and managed by the Chevron Corporation; and Rancho Guadalupe County Park, owned and managed by the County of Santa Barbara. This unit includes the following physical or biological features essential to the species: Wind-blown sand dunes, areas of sandy beach above and below the high-tide line with occasional surfcast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, OHVs, horses, pets, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 34, Devereaux Beach, 52 ac (21 ha). This unit is located on the University of California's Coal Oil Point Natural Reserve, about 7 mi (11 km) west along the coast from the City of Santa Barbara in Santa Barbara County. The unit extends about 1.8 mi (3 km) north along the coast from the western boundary of Isla Vista County Park to a point along the beach opposite the end of Santa Barbara Shores Drive. This unit consists of 43 ac (17 ha) of State land and 9 ac (4 ha) of local jurisdictional land. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area with as many as 39 breeding Pacific Coast WSPs recorded in a single season (Service unpublished data). This unit is also an important wintering area with up to 360 Pacific Coast WSPs recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, pets, and predators. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated with sea-level rise associated with climate change.

CA 35, Santa Barbara Beaches, 65 ac (26 ha). This unit is located within the City of Santa Barbara in Santa Barbara County. It extends about 1.8 mi (3 km) along the coast from the Andree Clark Bird Refuge intersection with the Pacific Ocean to the Santa Barbara Harbor. This unit encompasses approximately 30 ac (12 ha) of State land, 35 ac (14 ha) of City of Santa Barbara lands, and 0.3 ac (0.1 ha) of private land. The unit was occupied at the time of listing and is currently occupied. The unit is an important wintering area with up to 111 Pacific Coast WSPs recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, development, and pets. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 36, Santa Rosa Island Beaches, 586 ac (237 ha). This unit is located on Santa Rosa Island about 31 mi (50 km) southwest of the City of Santa Barbara in Santa Barbara County. This unit is comprised of 11 different beaches (subunits CA 36A through CA 36K) around the island. This unit encompasses approximately 586 ac (237 ha) of Channel Islands National Park land. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area with as many as 37 breeding Pacific Coast WSPs recorded in a single season (Service unpublished data). This unit is capable of supporting 130 breeding plovers under proper management (Service 2007, Appendix B). This is also an important wintering area with up to 242 plovers recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, and direct disturbance from expanding marine mammal populations. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 37, San Buenaventura Beach, 70 ac (28 ha). This unit is located within the City of Ventura in Ventura County. It extends about 2 mi (3 km) north along the coast from rock groin, immediately north of Marina Park to the Ventura Pier. San Buenaventura State Beach is a unit that is owned by the CDPR. This unit was occupied at the time of listing and is currently occupied. It is an important wintering area with up to 72 Pacific Coast WSPs recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, and pets. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 38, Mandalay Beach to Santa Clara River, 672 ac (272 ha). This unit is located near the City of Oxnard in Ventura County. It extends about 6 mi (10 km) north along the coast from the north jetty of Channel Islands Harbor to a point about 0.5 mi (1 km) north of the Santa Clara River mouth. This unit encompasses approximately 213 ac (86 ha) of private land and 459 ac (186 ha) of State land within McGrath and Mandalay State Beaches. This unit was occupied at the time of listing and is currently occupied. It is an important breeding area with as many as 70 breeding Pacific Coast WSPs recorded in a single season (Service unpublished data). This unit is also an important wintering area with up to 129 plovers recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: Wind-blown sand dunes, areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human disturbance, development, pets, and dune-stabilizing vegetation. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 39, Ormond Beach, 320 ac (130 ha). This unit is located near the cities of Port Hueneme and Oxnard in Ventura County. It extends about 3 mi (5 km) northwest along the coast from Arnold Road and the boundary of Naval Base Ventura County, Point Mugu (NBVC, Point Mugu) to the south jetty of Port Hueneme. This unit encompasses approximately 161 ac (65 ha) of private land and 159 ac (65 ha) of State land. This unit was occupied at the time of listing, is currently occupied, and is an important breeding area with as many as 33 breeding Pacific Coast WSPs recorded in a single season (Service unpublished data). This unit is capable of supporting 50 breeding plovers under proper management (Service 2007, Appendix B). This unit is also an important wintering area with up to 117 plovers recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features essential to the conservation of the species: Wind-blown sand dunes, areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates, and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, and pets. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 43, Zuma Beach, 73 ac (30 ha). This unit is located about 8 mi (13 km) west of the City of Malibu in Los Angeles County. It extends about 3 mi (5 km) north along the coast from the north side of Point Dume to the base of Trancas Canyon. This unit encompasses approximately 72 ac (29 ha) of Los Angeles County lands, and 1 ac (0.5 ha) of State land. This unit was occupied at the time of listing and is currently occupied. It is an important wintering area with up to 213 Pacific Coast WSPs recorded during a single season over the last 7 years (Service unpublished data; Ryan et al. 2010, p. 19). This unit includes the following physical or biological features essential to the conservation of the species: Areas of sandy beach above and below the high-tide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, development, horses, and pets. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 44, Malibu Beach, 13 ac (5 ha). This unit is located within the City of Malibu in Los Angeles County. It extends about 0.5 mi (1 km) north along the coast from approximately 300 ft (94 m) north of the Malibu Pier to Malibu Point. Approximately 9 ac (4 ha) are within Malibu Lagoon State Beach. The ownership of the remaining 4 ac (1 ha) are not known; however, the State likely has jurisdiction over these lands. This unit was occupied at the time of listing and is currently occupied. It is an important wintering area with up to 67 Pacific Coast WSPs recorded during a single season over the last 7 years (Service unpublished data). This unit includes the following physical or biological features for the conservation of the species: Areas of sandy beach above and below the hightide line with occasional surf-cast wrack supporting small invertebrates and generally barren to sparsely vegetated terrain. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from nonnative vegetation, human disturbance, and pets. Control of nonnative vegetation and enforcement of existing human-use regulations are needed to ensure the suitability of the unit. With time, we anticipate that the lower portions of this unit will be inundated by sea-level rise associated with climate change.

CA 45A, Santa Monica Beach, 48 ac (19 ha). This subunit is located between the cities of Santa Monica and Los Angeles in Los Angeles County. It stretches roughly 1 mi (2 km) from Montana Avenue to the mouth of Santa Monica Canyon. This subunit consists of 29 ac (12 ha) of State owned land, and 19 ac (8 ha) are owned by the City of Santa Monica. This subunit was occupied at the time of listing, is currently occupied, and annually supports a significant wintering flock of Pacific Coast WSPs (an average wintering flock of 36 from 2003 to 2010 (Service unpublished data)) in a location with high-quality breeding habitat. This location also facilitates interchange between wintering locations. This location contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance, pets, and beach raking. CA 45B, Dockweiler North, 34 ac (14 ha) This subunit is located south of Ballona Creek and west of the El Segundo Dunes, and immediately west of the Los Angeles International Airport, in the City of Los Angeles, Los Angeles County. It stretches roughly 0.5 mi (0.8 km) centered at Sandpiper Street. This subunit is owned by the State of California. This subunit was occupied at the time of listing and is currently occupied. In conjunction with Subunits CA 45C and CA 45D, the subunit annually supports a significant wintering flock of Pacific Coast WSPs in a location with high quality breeding habitat (Page in litt. 2004) and facilitates interchange between wintering locations. This location contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance, pets, and beach raking. CA 45C, Dockweiler South, 65 ac (26 ha) This subunit is located immediately west of the Hyperion Wastewater Treatment Plant between the cities of Los Angeles and El Segundo in Los Angeles County. It stretches approximately 1 mi (1.6 km) along Vista del Mar from West Imperial Highway extending past East Grand Avenue. This subunit consists of 54 ac (22 ha) of State land and 11 ac (5 ha) of privately owned land. This subunit was occupied at the time of listing and is currently occupied. In conjunction with Subunits CA 45B and CA 45D, it annually supports a significant wintering flock of Pacific Coast WSPs in a location with high-quality breeding habitat (Page in litt. 2004) and facilitates interchange between wintering locations. This location contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance, pets, and beach raking. CA 45D, Hermosa State Beach, 27 ac (11 ha) This subunit is located immediately west of the City of Hermosa Beach in Los Angeles County. This subunit stretches roughly 0.5 mi (1 km) from Eleventh Street to First Street. This subunit consists of 8 ac (3 ha) State land and 19 ac (8 ha) are privately owned. This subunit was occupied at the time of listing and is currently occupied. The unit supported an average wintering flock of 25 Pacific Coast WSPs from 2003 to 2010 (Service unpublished data). In conjunction with subunits CA 45B and CA 45C, this subunit annually supports a large and significant wintering flock of Pacific Coast WSP and facilitates interchange between wintering locations. This location contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance, pets, and beach raking.

CA 46A, Bolsa Chica State Beach, 93 ac (38 ha). This subunit is located west of the Pacific Coast Highway, in the City of Huntington Beach, Orange County. It stretches roughly 2.4 mi (3.9 km) from north of the lagoon mouth channel (into Bolsa Chica Ecological Reserve) to just south of the Sunset Beach area near Warner Avenue. This subunit consists of 93 ac (38 ha) owned by the State of California. This subunit was occupied at the time of listing, is currently occupied, and supported an average wintering flock of 27 Pacific Coast WSPs from 2003 through 2010 (Service unpublished data). The subunit annually supports a significant wintering flock of Pacific Coast WSPs in a location with high-quality breeding habitat. This location contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates. The physical or biological features essential to the conservation of the species in this subunit may require special management considerations or protection to address threats from recreational disturbance and beach raking. CA 46 (Subunits B–F), Bolsa Chica Reserve, 475 ac (192 ha) These subunits are located east of the Pacific Coast Highway, in Orange County. They consist of 475 ac (192 ha), all of which are owned by the State of California. Bolsa Chica Reserve contains significant nesting areas (which we are labeling as individual subunits B, C, D, E, and F). This location supported 47 breeding adult Pacific Coast WSP in 2009 (Knapp and Peterson 2009, p. 8). These subunits were occupied at the time of listing, are currently occupied, and annually support one of the largest breeding populations of Pacific Coast WSP in the region. The Recovery Plan for the Pacific Coast WSP states that this location contributes to the conservation goal for the region by providing a management potential of 70 breeding birds (Service 2007, Appendix B). This location also supported an average wintering flock of 14 Pacific Coast WSP from 2003 through 2010 (Service unpublished data). This reserve is an active oil field that underwent significant reconstruction and restoration between 2004 and 2006, including the addition of three new nest sites and a new ocean inlet that allows the water level to rise and fall resembling the irregular semi-diurnal tidal range of southern California's ocean waters (Knapp and Peterson 2009, p. 1). This location contains the physical or biological features essential to the conservation of the species, including tidally influenced estuarine mud flats supporting small invertebrates, and seasonally dry ponds that provide nesting and foraging habitat for Pacific Coast WSP. The physical or biological features essential to the conservation of the species in these subunits may require special management considerations or protection to address threats from vegetation encroachment in nesting and foraging areas and predation of chicks and eggs.

CA 47, Santa Ana River Mouth, 19 ac (8 ha). This unit is located north of the Santa Ana River mouth, immediately west of the City of Huntington Beach in Orange County. This unit consists of 19 ac (8 ha), of which 18 ac (7 ha) are owned by the State of California, and 1 ac (0.4 ha) is privately owned. This unit was not occupied at the time of listing. However, we consider this unit essential for the conservation of the species based on the fluctuating use of areas by the species as a response to habitat and resource availability. The unit is located adjacent to currently occupied areas and provides dispersal habitat between units. This unit provides habitat to support breeding plovers, and will facilitate interchange between otherwise widely separated units, and helps provide habitat within the Recovery Unit identified in the Recovery Plan (Service 2007). This location contains habitat such as a wide sandy beach with surf-cast wrack supporting small invertebrates, and tidally influenced estuarine mud flats that provide nesting and foraging habitat for Pacific Coast WSPs. Primary threats in this unit are those associated with recreational disturbance and beach raking.

CA 48, Balboa Beach, 25 ac (10 ha). This unit is located on the Balboa Peninsula, immediately west of the City of Newport Beach in Orange County. This unit stretches roughly 0.3 mi (0.5 km) from A Street south to G Street, including a total of 25 ac (10 ha), all of which are owned by the City of Newport Beach. This unit was occupied at the time of listing, is currently occupied, and supported two breeding adult Pacific Coast WSPs in 2009 (P. Knapp, pers. comm. 2010) and three breeding adult Pacific Coast WSPs in 2010 (T. Ryan, in litt. 2010). It also supported an average wintering flock of 35 Pacific Coast WSPs from 2003 through 2010 (Service unpublished data). This location contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance, predation of chicks and eggs, and beach raking.

CA 51 (Subunits A–C), San Elijo Lagoon Ecological Reserve, 15 ac (6 ha). These subunits are located between the cities of Solana Beach and Encinitas in San Diego County. These subunits were occupied at the time of listing and are currently occupied. They consist of 15 ac (6 ha), of which 11 ac (4 ha) are owned by the State of California, and 4 ac (2 ha) are privately owned. San Elijo Lagoon includes three nest sites (which we are labeling as individual Subunits CA 51A, CA 51B, and CA 51C). The San Elijo Lagoon Restoration Working Group is planning to restore habitat at the San Elijo Lagoon Ecological Reserve, which may include nest sites for nesting sea birds and shorebirds, including Pacific Coast WSP and California least tern. Restoration and enhancement of coastal dune habitat at this site is ongoing, and the Service is currently participating in a cooperative agreement with the San Elijo Lagoon Conservancy to create suitable nesting areas for Pacific Coast WSPs, California least terns, and other shorebirds in the southwest corner of the West Basin of the lagoon. The Recovery Plan for the Pacific Coast WSP states that this location contributes significantly to the conservation goal for the region by providing a management potential of 20 breeding birds (Service 2007, Appendix B). This unit may facilitate interchange between wintering locations (see Criteria Used to Identify Critical Habitat section above). These subunits contain the physical or biological features essential to the conservation of the species, including sandy beaches and tidally influenced estuarine mud flats with tide-cast organic debris supporting small invertebrates. Restoration of degraded habitat within these subunits will improve the habitat. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance, vegetation encroachment in the intertidal zone, and predation of chicks and eggs.

CA 52A, San Dieguito Lagoon, 4 ac (2 ha). Subunit CA 52A is located at the west end of San Dieguito River Park within the city of Del Mar in San Diego County. This subunit was occupied at the time of listing, is currently occupied, and consists of 4 ac (1 ha), all of which are privately owned. This subunit is a nest site that was created for nesting seabirds and shorebirds including Pacific Coast WSP and California least tern. This subunit also facilitates interchange between wintering locations. The Recovery Plan for the Pacific Coast WSP states that San Dieguito Lagoon contributes significantly to the conservation goal for the region by providing a management potential of 20 breeding birds (Service 2007, Appendix B). Additionally, restoration of this site occurred in 2009, improving areas used by breeding and wintering shorebirds. Use of one nesting site by a pair of plovers was reported in 2010 (Foster, pers. comm. 2010b). Additional improvements to the nest sites are expected in the future. This subunit contains the physical or biological features essential to the conservation of the species, including wide sandy beaches and tidally influenced estuarine mud flats with tide-cast organic debris supporting small invertebrates. The physical or biological features essential to the conservation of the species in this subunit may require special management considerations or protection to address threats from human recreational disturbance, vegetation encroachment in the intertidal zone, and predation of chicks and eggs.

CA 55B, Coronado Beach, 74 ac (30 ha). This subunit is located immediately west of the City of Coronado in San Diego County. This subunit stretches roughly 0.6 mi (0.96 km) from the boundary with Naval Air Station North Island (NASNI) to the south end of the natural sand dunes at Coronado City Beach. This subunit includes a total of 74 ac (30 ha) owned by the State of California. This subunit was occupied at the time of listing, is currently occupied, and is adjacent to the sizable Pacific Coast WSP population at NASNI, which contained an average wintering flock of 69 Pacific Coast WSPs from 2003 to 2010 (Service unpublished data). Additionally, biologists recorded 17 breeding adults at NASNI during 2009 surveys (Service unpublished data). The Recovery Plan for the Pacific Coast WSP states that this location (in conjunction with adjacent military lands) contributes significantly to the conservation goal for the region by providing a management potential of 20 breeding birds (Service 2007, Appendix B). This unit also facilitates interchange between wintering locations. This subunit contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates, as well as wind-blown sand in dune systems immediately inland of the active beach face. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance and beach raking.

CA 55E, Sweetwater Marsh National Wildlife Refuge and D Street Fill, 79 ac (32 ha). Lands owned and managed by the Port of San Diego under the San Diego Bay Natural Resources Plan within subunit CA 55E (53 ac (21 ha)) have been excluded from critical habitat designation under section 4(b)(2) of the Act (see Exclusions section below). Federal lands (79 ac (32 ha)) within the subunit that are owned and managed by the Service (Sweetwater Marsh National Wildlife Refuge) are not excluded from critical habitat. This subunit is located on the east side of San Diego Bay in the City of Chula Vista in San Diego County. This subunit consists of approximately 79 ac (32 ha) of which all are owned by the Service. This subunit was occupied at the time of listing, is currently occupied, and supported nesting Pacific Coast WSPs in 2000 (R. Patton, pers. comm. 2010), and two adult Pacific Coast WSPs in 2009 (Service unpublished data). The Recovery Plan for the Pacific Coast WSP states that this location contributes significantly to the conservation goal for the region by providing a management potential of 25 breeding birds (Service 2007, Appendix B). Additionally, this subunit annually supports a large and significant wintering flock of Pacific Coast WSPs and facilitates interchange between wintering locations. This subunit contains the physical or biological features essential to the conservation of the species, including sandy beaches above and below mean high-tide line and tidally influenced estuarine mud flats that provide nesting and foraging habitat for Pacific Coast WSPs. The physical or biological features essential to the conservation of the species in this subunit may require special management considerations or protection to address threats from vegetation encroachment in the intertidal zone, and predation of chicks and eggs.

CA 55F, Silver Strand State Beach, 82 ac (33 ha). This subunit is located immediately north of the City of Imperial Beach, in the City of Coronado in San Diego County. This subunit consists of 82 ac (33 ha), of which approximately 78 ac (31 ha) are owned by the State of California, and the ownership of 4 ac (1 ha) are unknown, but may also be under the State's jurisdiction. This subunit was occupied at the time of listing and is currently occupied. The subunit stretches roughly 1.5 mi (2.4 km) west of Silver Strand Boulevard, and is centered roughly at Coronado Cays Park. This subunit, in conjunction with adjacent lands at Naval Amphibious Base Coronado, supported at least 10 breeding adults in 2009 (Service unpublished data) and 8 breeding adults in 2010 (Ryan, in litt. 2010). The Recovery Plan for the Pacific Coast WSP states that this location contributes significantly to the conservation goal for the region by providing a management potential of 65 breeding birds (Service 2007, Appendix B). This subunit contained an average wintering flock of 13 Pacific Coast WSPs from 2003 to 2010 (Service unpublished data). This subunit also facilitates interchange between wintering locations. This subunit contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates, as well as wind-blown sand in dune systems immediately inland of the active beach face. The physical or biological features essential to the conservation of the species may require special management considerations or protection to address the main threats from human recreational disturbance and predation of chicks and eggs.

CA 55I, San Diego National Wildlife Refuge, South Bay Unit, 5 ac (2 ha). This subunit is located at the southernmost end of San Diego Bay in a location that is operated by Western Salt Works as salt evaporation ponds. This subunit is immediately north of the City of Imperial Beach, in the City of San Diego in San Diego County. This subunit consists of 5 ac (2 ha), all of which are owned by the Service. This subunit was occupied at the time of listing, is currently occupied, and supported at least three breeding adults in 2009 (Collins, in litt. 2010), and seven breeding adults in 2010 (Ryan, in litt. 2010). The Recovery Plan for the Pacific Coast WSP states that this location contributes significantly to the conservation goal for the region by providing a management potential of 30 breeding birds (Service 2007, Appendix B). The subunit contains the physical or biological features essential to the conservation of the species, including sparsely vegetated areas on artificial salt flats and adjoining dikes, as well as tidally influenced estuarine mud flats with tide-cast organic debris supporting small invertebrates for foraging. The physical or biological features essential to the conservation of the species in this subunit may require special management considerations or protection to address threats from egg and chick predation.

CA 55J, Tijuana Estuary and Border Field State Park, 150 ac (61 ha). This subunit is located in the City of Imperial Beach in San Diego County. This subunit stretches roughly 2 mi (3.2 km) from the end of Seacoast Drive to the United States/Mexico border, extending across both the Tijuana Slough National Wildlife Refuge and Border Field State Park. This subunit consists of 150 ac (61 ha), of which 71 ac (29 ha) are owned by the Service and 79 ac (32 ha) are owned by the State of California. This subunit was occupied at the time of listing, is currently occupied, and supported at least 10 adult breeding Pacific Coast WSPs in 2009 (B. Collins, in litt. 2010), and 19 breeding adults in 2010 (Ryan, in litt. 2010). This location also supported an average wintering flock of 54 Pacific Coast WSPs from 2003 to 2010 (Service unpublished data). The Recovery Plan for the Pacific Coast WSP states that this location contributes significantly to the conservation goal for the region by providing a management potential of 40 breeding birds (Service 2007, Appendix B). This subunit contains the physical or biological features essential to the conservation of the species, including a wide sandy beach with occasional surfcast wrack supporting small invertebrates, as well as tidally influenced estuarine mud flats with tide-cast organic debris supporting small invertebrates for foraging. The physical or biological features essential to the conservation of the species in this subunit may require special management considerations or protection to address threats from human recreational disturbance and predation of chicks and eggs.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for: Washington—Grays Harbor and Pacific Counties; Oregon—Clatsop, Tillamook, Lane, Douglas, Coos, and Curry Counties; and California—Del Norte, Humboldt, Mendocino, Marin, Napa, Alameda, San Mateo, Santa Cruz, Monterey, San Luis

Obispo, Santa Barbara, Ventura, Los Angeles, Orange, and San Diego Counties. Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of the Pacific Coast population of the western snowy plover are sandy beaches, dune systems immediately inland of an active beach face, salt flats, mud flats, seasonally exposed gravel bars, artificial salt ponds and adjoining levees, and dredge spoil sites, with:

(i) Areas that are below heavily vegetated areas or developed areas and above the daily high tides;

(ii) Shoreline habitat areas for feeding, with no or very sparse vegetation, that are between the annual low tide or lowwater flow and annual high tide or highwater flow, subject to inundation but not constantly under water, that support small invertebrates, such as crabs, worms, flies, beetles, spiders, sand hoppers, clams, and ostracods, that are essential food sources;

(iii) Surf- or water-deposited organic debris, such as seaweed (including kelp and eelgrass) or driftwood located on open substrates that supports and attracts small invertebrates described in paragraph (ii) of this entry for food, and provides cover or shelter from predators and weather, and assists in avoidance of detection (crypsis) for nests, chicks, and incubating adults; and

(iv) Minimal disturbance from the presence of humans, pets, vehicles, or human-attracted predators which provide relatively undisturbed areas for individual and population growth and for normal behavior.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, roads, paved areas, boat ramps, and other developed areas) and the land on which such structures are directly located and existing within the legal boundaries on the effective date of this rule.

All areas included in the revision of critical habitat will require some level of management to address the current and future threats to the physical and biological features essential to the conservation of the Pacific Coast WSP. Special management considerations or protection may be required to minimize habitat destruction, degradation, and fragmentation associated with the following threats, among others: water diversions, stabilized dunes and watercourses associated with urban development, human recreational activities, off-highway vehicle (OHV) use, beach raking, pets, nonnative vegetation, resource extraction, and fishing.

Life History

Feeding Narrative

Adult: Western snowy plovers are invertivores and primarily visual foragers, using the run-stop-peck method of feeding typical of Charadrius species. They forage on invertebrates in the wet sand and amongst surf-cast kelp in the intertidal zone, in dry sand areas above the high tide, on salt pans, on spoil sites, and along the edges of salt marshes, salt ponds, and lagoons. Opportunities for foraging are directly dependent on salinity levels. Salt ponds of medium salinity seem to provide the best quality foraging habitat. They sometimes probe for prey in the sand and pick insects from low-growing plants (USFWS 2007).At the Bolsa Chica wetlands in California, western snowy plovers have been observed pecking small, flying insects from mid-air and shaking one foot in very shallow water to agitate potential prey. Western snowy plover food consists of immature and adult forms of aquatic and terrestrial invertebrates. In San Diego, California, invertebrates found in western snowy plover feces during the breeding season included rove beetles (Staphylinidae), long-legged flies (Dolichopodidae), shore flies (Ephydridae), water bugs (Saldidae), and hymenopterans (Braconidae). Other food items reported for coastal western snowy plovers include Pacific mole crabs (Emerita analoga), striped shore crabs (Pachygrapsus crassipes), polychaetes (Neridae, Lumbrineris zonata, Polydora socialis, and Scoloplos acmaceps), amphipods (Corophium ssp., Ampithoe spp., and Allorchestes angustus), tanadacians (Leptochelia dubia), shore flies (Ephydridae), beetles (Carabidae, Buprestidae, and Tenebrionidae), and clams (Transenella sp.) In salt evaporation ponds in San Francisco Bay, California, the following prey have been recorded: brine flies (Ephydra cinerea), beetles (Tanarthrus occidentalis, Bembidion sp.), moths (Perizoma custodiata), and lepidopteran caterpillars.Opportunities for foraging are directly dependent on salinity levels. Specifically, salt ponds of medium salinity seem to provide the best quality foraging habitat (USFWS 2007).

Reproduction Narrative

Adult: The Pacific coast population of the western snowy plover breeds on the Pacific coast from southern Washington to southern Baja California, Mexico. Western snowy plovers tend to exhibit high breeding site fidelity. Nesting western snowy plovers at coastal locations consist of both year-round residents and migrants. Migrants begin arriving at breeding areas in southern Washington in early March, and in central California as early as January; although the main arrival is from early March to late April. Because some individuals nest at multiple locations during the same year, birds may continue arriving through June. The nesting season of the western snowy plover extends through late September. Generally, the breeding season may be 2 to 4 weeks earlier in southern California than in Oregon and Washington. Mated birds from the previous breeding season frequently reunite. Pair bonds are associated with territorial defense by males and nest-scraping behavior; however, pair bonds can be established prior to overt displays. During courtship, males defend territories and usually make multiple scrapes.The usual clutch size is three, with a range from two to six. Both sexes incubate the eggs, with the female tending to incubate during the day and the male at night. Western snowy plovers will re-nest after loss of their eggs. Re-nesting occurs 2 to 14 days after failure of a clutch, and up to five re-nesting attempts have been observed for a pair. Double brooding with polyandry (meaning the female successfully hatches more than one brood in a nesting season with different mates) is common in coastal California and Oregon. On the California coast, the breeding season is long enough for some females to triple brood and for some males to double brood. Low clutch hatching success has been attributed to a variety of factors, including predation, human disturbance, high tides, and inclement weather. The first chick hatched remains in or near the nest until other eggs (or at least the second egg) hatch. The adult western snowy plover incubates the eggs while also brooding the first chick. The nonincubating adult also may brood the firstborn chick a short distance from the nest. If the third egg of a clutch is 24 to 48 hours behind the others in hatching, it may be deserted.Peak initiation of nesting is from mid-April to mid-June. Hatching lasts from early April through mid-August, with chicks reaching fledging age approximately 1 month after hatching. The earliest nests on the California coast occur during the first week of March in some years and by the third week of March in most years. Nests typically occur in flat, open areas with sandy or saline substrates; vegetation and driftwood are usually sparse or absent. Western snowy plovers also regularly nest on the gravel bars along the Eel River in northern California. In southern California, western snowy plovers nest in areas with 6 to 18 percent vegetative cover and 1 to 14 percent inorganic cover; vegetation height is usually less than 6 cm (2.3 in.). Nests consist of a shallow scrape or depression, sometimes lined with beach debris (e.g., small pebbles, shell fragments, plant debris, and mud chips). Driftwood, kelp, and dune plants provide cover for chicks that crouch near objects to hide from predators. Invertebrates are often found near debris, so driftwood and kelp are also important for harboring western snowy plover food sources. Nests were usually within 100 meters (m) (328 feet [ft.]) of water, but could be several hundred m away when there is no vegetative barrier between the nest and water. The approximate periods required for nesting events are: scrape construction (in conjunction with courtship and mating), 3 days to more than a month; egg laying, usually 4 to 5 days; and incubation, 26 to 31 days (mean 27 days). Western snowy plovers 1 year or older are considered to be breeding adults. The mean annual life span of western snowy plovers is estimated to be about 3 years, but at least one individual was at least 15 years old when last seen.Western snowy plover chicks are precocial, leaving the nest within hours after hatching to search for food. They are not able to fly for approximately 1 month after hatching; fledging requires 28 to 33 days. Broods rarely remain in the nesting area until fledging. Western snowy plover broods may travel along the beach as far as 6.4 kilometers (4 mi.) from their natal area. Fledging of late-season broods may extend into the third week of September throughout the breeding range (USFWS 2007).

Geographic or Habitat Restraints or Barriers

Adult: Vegetative barriers, habitat fragmentation, and beach recreation have limited some habitat for the western snowy plover.

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Moderate

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High (USFWS 2007)

Dependency on Other Individuals or Species for Habitat

Adult: No

Habitat Narrative

Adult: The Pacific coast population of the western snowy plover breeds primarily above the high-tide line on coastal beaches, sand spits, dune-backed beaches, sparsely vegetated dunes, beaches at creek and river mouths, and salt pans at lagoons and estuaries. Less common nesting habitats include bluff-backed beaches, dredged material disposal sites, salt pond levees, dry salt ponds, and river bars. In winter, western snowy plovers are found on many of the beaches used for nesting as well as on beaches where they do not nest, in manmade salt ponds, and on estuarine sand and mud flats (USFWS 2007).Western snowy plovers that breed on the coast and inland are very site-faithful in winter (USFWS 2007). Many populations are scattered and declining in many areas, due to habitat loss/degradation, disturbance of nesting areas, and/or impacts of nonnative predators (NatureServe 2015). Driftwood, kelp, and dune plants provide cover for chicks that crouch near objects to hide from predators (USFWS 2007).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Some migrate locally, seasonally, and long-distance. Others do not.

Dispersal

Adult: High

Immigration/Emigration

Adult: Immigrates/emigrates.

Dependency on Other Individuals or Species for Dispersal

Adult: During migration and winter, flocks of nonbreeding birds (adults and hatching-year birds from coastal and interior nesting areas) range in size from a few individuals to as many as 300 birds (USFWS 2007).

Dispersal/Migration Narrative

Adult: Although some Pacific coast western snowy plovers remain in their coastal breeding areas year-round, others migrate south or north for winter. In western North America, wintering (defined as late October to mid-February) occurs mainly in coastal areas from southern Washington to Central America. Both coastal and interior populations use coastal locations in winter. California coastal nesting areas are vacated by local Pacific coast migrants primarily from late June to late October. There is evidence of a late-summer (August/September) influx of western snowy plovers into Washington; it is suspected that these wandering birds are migrants. Thus, the flocks of nonbreeding birds that begin forming along the Pacific coast of the United States in early July are a mixture of adult and hatching-year birds from both coastal and interior nesting areas. During migration and winter, these flocks range in size from a few individuals to as many as 300 birds (USFWS 2007).A large amount of breeding data indicates that the Pacific coast population of the western snowy plover is distinct from western snowy plovers breeding in the interior. Banding and re-sighting data show that the Pacific Coast breeding populations and the western interior breeding populations experience limited or rare reproductive interchange. These results illustrate that the amount of interchange between coastal and interior populations is likely to be extremely low, though not zero. Movement of birds from coastal to interior populations has been documented more often than the reverse; the interior population birds breeding west of the Rockies overwinter in coastal California and Baja California often intermingle with birds from the Pacific coast breeding population. Genetic studies using mitochondrial DNA and microsatellite DNA markers have found no significant genetic differentiation between the Pacific coast and interior populations of the western snowy plover, and only a small number of dispersing individuals per generation is sufficient to prevent genetic differentiation between two semi-isolated populations (USFWS 2007).

Additional Life History Information

Adult: A large amount of breeding data indicates that the Pacific coast population of the coastal western snowy plover is distinct from interior western snowy plovers breeding in the interior (USFWS 2007).

Population Information and Trends

Population Trends:

Decreasing: 10 to 30 percent (NatureServe 2015).

Species Trends:

Decreasing; plover population sizes are low or absent throughout their historic range, although implementation of management actions in the early 2000s have led to overall increases in plover numbers (USFWS 2006).

Resiliency:

Moderate

Representation:

Moderate

Redundancy:

Moderate

Number of Populations:

21: four breeding areas in southern Washington, nine nesting locations in Oregon, and eight geographic areas that support more than three-quarters of the breeding population in California (USFWS 2007).

Population Size:

10,000 to 100,000 individuals (NatureServe 2015). In 2006, estimated populations were 70 adults along the Washington coast, 177 to 179 adults along coastal Oregon, and 2,231 adults in coastal California and San Francisco Bay. Over the past 30 years, populations in California have fluctuated between roughly 1,000 and 2,000 birds. No recent quantitative data exist on the western snowy plover population in Baja California, but it is probably roughly similar in size to the population along the Pacific coast of the United States (USFWS 2007).

Resistance to Disease:

Unknown, possibly susceptible to West Nile virus (USFWS 2007).

Adaptability:

Moderate

Additional Population-level Information:

The population is sparse in Washington, Oregon, and northern California. There is no quantitative information on the carrying capacity of beaches for western snowy plovers. Determining the carrying capacity of beaches is confounded by human use that affects the numbers of snowy plovers using the beaches (USFWS 2007).

Population Narrative:

The current Pacific coast breeding range of the western snowy plover extends from Damon Point, Washington, to Bahia Magdelena, Baja California, Mexico. Western snowy plovers concentrate in suitable habitat, with the number of adults at coastal breeding locations ranging from one to 315, depending in part on the size of the area. The largest number of breeding birds occurs from south San Francisco Bay to southern Baja California. The population is sparse in Washington, Oregon, and northern California (USFWS 2007). Plover population sizes are decreasing, with plover population numbers either lower or absent throughout their historic range, although implementation of management actions in the early 2000s have led to overall increases in plover numbers (USFWS 2006).The historic nesting range of the Pacific Coast population included 87 sites (five in Washington, 29 in Oregon, and 53 in California); currently, the western snowy plover nests apparently in only 28 sites (two in Washington, six in Oregon, and 20 in California) (NatureServe 2015). There are currently 21 populations: four breeding areas in southern Washington, nine nesting locations in Oregon, and eight geographic areas that support more than three-quarters of the breeding population in California. In 2006, the estimated population size was 2,480 adults, including 70 adults along the Washington coast, 177 to 179 adults along coastal Oregon, and 2,231 adults in coastal California and San Francisco Bay. Over the past 30 years, populations in California have fluctuated between roughly 1,000 and 2,000 birds. No recent quantitative data exist on the western snowy plover population in Baja California, but it is probably roughly similar in size to the population along the Pacific coast of the United States (USFWS 2007).There is no quantitative information on the carrying capacity of beaches for western snowy plovers. Determining the carrying capacity of beaches is confounded by human use that affects the numbers of snowy plovers using the beaches. Beaches vary substantially in their structure, width, vegetation, and level of human use, complicating such a measurement. The western snowy plover is possibly susceptible to West Nile virus (USFWS 2007).

Threats and Stressors

Stressor: Shoreline stabilization and development
Exposure: Coastal development, beach stabilization, and beach raking.
Response: Habitat degradation, erosion, pollution drift, increased levels of illumination at night, noise, increase in predators, and increased human activity causing disturbance.
Consequence: Loss of breeding habitat and wintering habitat, reduction of quality habitat, and mortality.
Narrative: The wide, flat, sparsely vegetated beach strands preferred by western snowy plovers are an unstable habitat, subject to the dynamic processes of accretion and erosion of sand, and dependent on natural forces for replenishment and renewal. These habitats are highly susceptible to degradation by construction of seawalls, breakwaters, jetties, piers, homes, hotels, parking lots, access roads, trails, bike paths, day-use parks, marinas, ferry terminals, recreational facilities, and support services that may cause direct and indirect losses of breeding and wintering habitat for the western snowy plover.Beach stabilization efforts may interfere with coastal dune formation and cause beach erosion and loss of western snowy plover nesting and wintering habitat. Shoreline stabilization features such as jetties and groins may cause significant habitat degradation by robbing sand from the downdrift shoreline. Construction of homes, resorts, and parking lots on coastal sand dunes constitutes irrevocable loss of habitat for western snowy plovers. Urban development has permanently eliminated valuable nesting habitat on beaches in southern Washington, Oregon, and California. In addition to causing direct loss of

habitat, there are additional potential adverse impacts to western snowy plovers from urban development. Increased development increases human use of the beach, thereby increasing disturbance to nesting plovers. When urban areas interface with natural habitat areas, the value of breeding and wintering habitat to native species may be diminished by increased levels of illumination at night (e.g., building and parking lot lights), increased sound and vibration levels, and pollution drift (e.g., pesticides).Beach raking removes habitat features for both plovers and their prey, and precludes nests from being established. Also, construction of residential development in or near western snowy plover habitat attracts predators (USFWS 2007).

Stressor: Sand removal and beach nourishment
Exposure: Mining sand, and sand removal by heavy machinery.
Response: Destruction of nests and chicks; loss of invertebrates, natural wave-cast kelp, and other debris.
Consequence: Mortality, reduction in population numbers, reduction in habitat, and reduced fitness.
Narrative: Sand is mined in coastal areas such as Monterey Bay, California. Mining sand from the coastal mid-dunes and surf zones can cause erosion and loss of western snowy plover breeding and wintering habitat. Sand removal by heavy machinery can disturb incubating western snowy plovers, destroy their nests or chicks, and result in the loss of invertebrates and natural wave-cast kelp and other debris that western snowy plovers use for foraging. Mining of surface sand from the 1930s through the 1970s at Spanish Bay in Monterey County degraded a network of dunes by lowering the surface elevations, removing sand to granite bedrock in many locations, and creating impervious surfaces that supported little to no native vegetation (USFWS 2007).

Stressor: Dredging and disposal of dredged materials
Exposure: Dredging, and placement of pipes.
Response: Increased noise, alteration of natural patterns of beach erosion and deposition, and increased recreational access.
Consequence: Eliminates or alters breeding and wintering habitat.
Narrative: Dredging is detrimental to western snowy plovers when it eliminates habitat or alters natural patterns of beach erosion and deposition that maintain habitat. Disturbances associated with dredging, such as placement of pipes, disposal of dredged materials, or noise, also may negatively affect breeding and wintering western snowy plovers. Dredging also is detrimental when it promotes water-oriented developments that increase recreational access to western snowy plover habitat (e.g., marinas, boat ramps, or other facilities to support water-based recreation (USFWS 2007).

Stressor: Driftwood removal and addition
Exposure: Removal of driftwood from western snowy plover habitat, chainsaw noise, vehicles used to haul wood, and addition of driftwood from prolonged storm events.
Response: Disruption of nesting, increased predation, and crushing of chicks or eggs.
Consequence: Reduction in the number of suitable nesting sites, mortalities, and reduction in population numbers.
Narrative: Driftwood can be an important component of western snowy plover breeding and wintering habitat. Driftwood contributes to dune-building and adds organic matter to the sand as it decays. Additionally, driftwood provides western snowy plovers with year-round protection from wind and blowing sand. Often, western snowy plovers build nests beside driftwood, so its removal may reduce the number of suitable nesting sites. Driftwood removed for firewood or

decorative items can result in destruction of nests and newly hatched chicks that frequently crouch by driftwood to hide from predators and people. Chainsaw noise may disrupt nesting, and vehicles used to haul wood may crush nests and chicks. Removal of driftwood has been documented as a source of nest destruction at Vandenberg Air Force Base, where two nests were crushed beneath driftwood dragged to beach fire sites. Also, driftwood beach structures built by visitors are used by avian predators of western snowy plover chicks, such as loggerhead shrikes (Lanius ludovicianus) and American kestrels (Falco sparverius); and predators of adults, such as merlins (Falco columbarius) and peregrine falcons (Falco peregrinus). Although driftwood is an important component of western snowy plover habitat, an excess of driftwood on a beach—which may occur after frequent and prolonged storm events—can be detrimental if there is not sufficient open habitat to induce the birds to nest (USFWS 2007).

Stressor: Beach fires and camping
Exposure: Beach fires.
Response: Light pollution, habitat and human disturbance, increased garbage and predators, and fire.
Consequence: Mortality, nest abandonment, reduction in population numbers, reduction in habitat, and disturbance.
Narrative: Beach fires and camping may be harmful to nesting western snowy plovers when valuable driftwood is destroyed (described above). Camping near breeding locations can cause greater impacts due to the prolonged disturbance and increased chance for possible direct mortality from associated dogs and children. Nighttime collecting of wood increases the risk of stepping on nests and chicks, which are difficult to see even during daylight hours. Fires near a western snowy plover nest could cause nest abandonment due to disturbance from human activities, light, and smoke. Fires have the potential to attract large groups of people and result in an increase of garbage, which attracts predators such as gulls (Larus sp.), coyotes (Canis latrans), American crows (Corvus brachyrhynchos), and common ravens (Corvus corax). Occasionally fires escape into nearby driftwood; fire suppression activities may disturb and threaten western snowy plover nests and chicks (USFWS 2007).

Stressor: Watercourse diversion, impoundment, or stabilization
Exposure: Construction of dams, irrigation, flood control, and municipal water development.
Response: Reduction in sand delivery to beaches, and degraded water quality.
Consequence: Reduction in number of suitable nesting sites, reduction of habitat, and reduction in population numbers.
Narrative: Water diversion and impoundment of creeks and rivers may negatively affect western snowy plover habitat by reducing sand delivery to beaches and degrading water quality. Hydrologic processes such as migration of creek and river mouths maintain open habitat by retarding the spread of introduced beach grass (Ammophila spp.) and other vegetation; water diversions that impair these processes are a major threat to western snowy plovers. Water diversion, impoundment, or stabilization activities can include construction of dams and irrigation, flood control, and municipal water development projects (USFWS 2007).

Stressor: Operation of salt ponds
Exposure: Artificial draining and flooding of salt ponds, and maintenance of salt ponds.
Response: Habitat alteration/destruction, and disturbance.
Consequence: Mortality, harassment, and nest failure.

Narrative: Salt ponds of San Francisco Bay and San Diego Bay, which are filled and drained as part of the salt production process, provide breeding and wintering habitat for western snowy plovers. Dry salt ponds and unvegetated salt pond levees are used as western snowy plover nesting habitat. Ponds with shallow water provide important foraging habitat for western snowy plovers, with ponds. Nesting western snowy plovers can be attracted to an area when ponds are drained during the breeding season, but flooding can then destroy the nests when the ponds are refilled.Human disturbance resulting from maintenance activities associated with the operation of commercial salt ponds can result in the loss of western snowy plovers and disturbance of their habitat. If conducted during the western snowy plover breeding season, reconstruction of salt pond levees can destroy western snowy plover nests. Maintenance activities that are conducted by vehicles, on foot, or through the use of dredging equipment could result in direct mortality or harassment of western snowy plovers (USFWS 2007).

Stressor: Encroachment of introduced beachgrass and other nonnative vegetation
Exposure: Introduction of nonnative species, and alteration of habitat to foredunes.
Response: Lack of species diversity, reduction in nesting habitat, increased habitat for predators, and reduced food availability.
Consequence: Reduction in habitat, mortality, and population reduction.
Narrative: One of the most significant causes of habitat loss for coastal breeding western snowy plovers has been the encroachment of introduced European beachgrass (Ammophila arenaria) and American beachgrass (Ammophila breviligulata). Foredunes dominated by introduced beachgrass have replaced the original low, rounded, open mounds formed by the native American dunegrass (Leymus mollis) and other dune plants. Native dune plants do not bind sand like beachgrasses (Ammophila sp.), and thus allow for sand movement and regenerating open expanses of sand; beachgrasses, however, form a dense cover that excludes many native taxa. On beaches dominated by this invasive grass, species richness of vegetation is halved in comparison with foredunes dominated by native dune grass. Similarly, American beachgrass greatly depresses the diversity of native dune plant species. Stabilizing sand dunes with introduced beachgrass has reduced the amount of unvegetated area above the tideline, decreased the width of the beach, and increased its slope. These changes have reduced the amount of potential western snowy plover nesting habitat on many beaches and may hamper brood movements. In Oregon, the beachgrass community may provide habitat for western snowy plover predators (e.g., skunks [Mephitis sp.], weasels [Mustela sp.], coyotes [Canis latrans], foxes [Urocyon cinereoargenteus and Vulpes vulpes], raccoons [Procyon lotor], and feral cats [Felis domesticus]) that historically would have been largely precluded by the lack of cover in the dune community. In addition to the loss of nesting habitat, introduced beachgrass also may adversely affect western snowy plover food sources. Beachgrass markedly depressed the diversity and abundance of sand-burrowing arthropods at coastal dune sites in central California. Because western snowy plovers often feed on insects well above the high-tide line, the presence of this invasive grass may also result in loss of food supplies for plovers. Other nonnative vegetation that has invaded coastal dunes, thereby reducing western snowy plover breeding habitat, includes Scotch broom (Cytisus scoparius), gorse (Ulex europaeus), South African iceplant (Carpobrotus edulis), pampas grass (Cortaderia jubata and Cortaderia selloana), and iceplant (Mesembryanthemum sp.) (USFWS 2007).

Stressor: Habitat conversion for other special-status species
Exposure: Tidal marsh restoration for other species.
Response: See narrative.

Consequence: See narrative.
Narrative: As part of the Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California, extensive tidal marsh restoration is identified as a recovery action for listed and other sensitive species of tidal salt marshes, including the California clapper rail (Rallus obsoletus) and salt marsh harvest mouse (Reithrodontomys raviventris). A large area of San Francisco Bay salt ponds, especially in the South Bay, is proposed for tidal marsh restoration for the benefit of federally listed tidal marsh species. Salt ponds are large, persistent hypersaline ponds that are intermittently flooded with South Bay water. Some of these ponds currently provide valuable breeding and wintering habitat for western snowy plovers. However, they occur in the historical areas of tidal salt marsh, which once dominated San Francisco Bay. Endangered tidal marsh species would benefit from conversion of these ponds back to salt marsh; however, western snowy plovers would lose suitable nesting and wintering areas. In southern California, unless carefully planned, conversion of western snowy plover habitat to tidal salt marsh may result in loss of western snowy plover habitat (USFWS 2007).

Stressor: Overuse for commercial, recreational, scientific, or education purposes
Exposure: Biological studies.
Response: See narrative.
Consequence: Harassment, and limited injury or mortality.
Narrative: Biologists and agency personnel monitor western snowy plovers to assess population status and evaluate management techniques. Egg collecting has been observed at several California nesting colonies. Occasionally, recreational birdwatchers also may harass western snowy plovers. The significance of these factors to nesting success is uncertain but probably relatively minor. Qualified individuals may obtain permits to conduct scientific research and population census activities on western snowy plovers under Section 10(a)(1)(A) of the Endangered Species Act. Specific activities that may be authorized include population censuses and presence/absence surveys; monitoring of nesting activity; capturing, handling, weighing, measuring, banding, and color-marking of young and adults on breeding and wintering grounds; radio-telemetry studies; translocation studies; genetic studies; contaminant studies; behavioral, ecological, and life history studies; and placing predator enclosures around active nests. Short-term impacts of these activities may include harassment and possible accidental injury or death of a limited number of individual western snowy plovers.Banding birds with metal and plastic bands to identify individuals and to monitor bird populations is a common practice. However, a number of leg injuries to western snowy plovers, possibly resulting from banding, have been reported (USFWS 2007).

Stressor: Disease
Exposure: West Nile and botulism.
Response: Neurological changes; see narrative.
Consequence: Mortality and reduction in population numbers.
Narrative: West Nile virus—a mosquito-borne disease which can infect birds, reptiles, and mammals—has spread rapidly across the United States from the initial introduction in New England. The disease has killed birds of various species in all coastal California counties since its arrival in the state in 2003. From 2004 to 2006, the disease was reported in two coastal counties (Lane and Lincoln) in Oregon, but has not been reported in any coastal counties in Washington. The deadliness of the disease varies by species; but the virus has been identified in dead piping plovers (Charadrius melodus) and killdeer (C. vociferus), both closely related to the western snowy plover. Since 2004, numerous western snowy plovers in southern California have been

found dead or exhibited neurological signs consistent with avian botulism. Confirmation of disease diagnosis is currently pending availability of specimens for autopsy. The USFWS is currently coordinating with the U.S. Geological Survey National Wildlife Health Center to better understand the causes of these mortalities and to develop a program for treatment of ill birds diagnosed with botulism. Additionally, 32 western snowy plovers died in 2006 from unknown causes in San Diego County (USFWS 2007).

Stressor: Predation
Exposure: Predation by nonnative and native species.
Response: See narrative.
Consequence: Mortality, nest abandonment or loss, and reduction in population numbers.
Narrative: Predator density is a significant factor affecting the quality of western snowy plover nesting habitat. Predation can result in the loss of adults, chicks, or eggs, and the presence of predators causes separation of chicks from adults. Predation accounted for most nest failures in 1994, 1996, and 1997 in San Diego County, California. Western snowy plovers generally cannot defend themselves or their nests against predation, but must rely on antipredator adaptation.Predation by both native and nonnative species has been identified as a major factor limiting western snowy plover reproductive success at many Pacific coast sites. Known mammalian and avian predators of western snowy plover eggs, chicks, or adults include the following native species: gray foxes (Urocyon cinereoargenteus), Santa Rosa Island foxes (Urocyon littoralis santarosae), coyotes, striped skunks (Mephitis mephitis), spotted skunks (Spilogale putorius), raccoons, California ground squirrels (Spermophilus beecheyi), long-tailed weasels (Mustela frenata), American crows (Corvus brachyrhynchos), common ravens (Corvus corax), ring-billed gulls (Larus delawarensis), California gulls (Larus californicus), western gulls (Larus occidentalis), glaucous-winged gulls (Larus glaucescens), gull-billed tern (Gelochelidon nilotica), American kestrels (Falco sparverius), peregrine falcons (Falco peregrinus), northern harriers (Circus cyaneus), loggerhead shrikes (Lanius ludovicianus), merlins (Falco columbarius), great horned owls (Bubo virginianus), burrowing owls (Speotyto cunic ularia), great blue herons (Ardea herodias); and the following nonnative species: eastern red foxes (Vulpes vulpes regalis), Norway rats (Rattus norvegicus), Virginia opossums (Didelphis marsupialis), and domestic and feral dogs (Canis familiaris) and cats (Felis domesticus). Loss or abandonment of eggs due to predation by fire ants and Argentine ants (Iridomyrmex humilis) has also been observed.Ravens have consistently been the most significant nest predator at Point Reyes, California, accounting for 69 percent of all predation events over 5 years and destroying approximately 50 percent of nests. Gulls pose a special threat to breeding western snowy plovers because they not only depredate nests and chicks, but also usurp and trample western snowy plover nesting habitat and crush eggs. Loggerhead shrikes are not known to take western snowy plover eggs, but do prey upon chicks and locally can have substantial effects on fledging success. In recent decades, alien eastern red foxes have become a serious new predator of endangered and threatened animals in coastal habitats. Domestic and feral cats are widespread predators. The threat of predation of western snowy plovers by cats increases when housing is constructed near western snowy plover breeding habitat. As natural-appearing beaches continue to be surrounded by urban areas, western snowy plovers will increasingly be subjected to this predator in the future. Predation by cats is difficult to measure because of the difficulty in finding evidence of bird remains, but they are known to take western snowy plover adults and eggs. Predation, although predominantly a natural phenomenon, is exacerbated through the introduction of nonnative predators and unintentional human encouragement of larger populations of native predators (USFWS 2007).

Stressor: Inadequacy of existing regulations
Exposure: Lack of regulatory protections for western snowy plovers.
Response: See narrative.
Consequence: See narrative.
Narrative: Listing of the western snowy plover under state endangered species laws generally provides some protection against direct take of birds, and may require state agencies to consult on their actions, but may not adequately protect habitat. State regulations, policies, and goals include mandates both for protection of beach and dune habitat and for public recreational uses of coastal areas; consequently, they may conflict with protection of western snowy plovers in some cases. Section 404 of the Clean Water Act (33 United States Code [U.S.C.] 1251 et seq.) and Section 10 of the Rivers and Harbors Act (33 U.S.C. 403) are the primary federal laws that could provide some protection of nesting and wintering habitat of the western snowy plover that is determined by the U.S. Army Corps of Engineers to be wetlands or historic navigable waters of the United States. These laws, however, would apply to only a small fraction of the nesting and wintering areas of the western snowy plover on the Pacific coast. Aside from the Migratory Bird Treaty Act, western snowy plovers have no protection status in Mexico (USFWS 2007)

Stressor: Natural events
Exposure: Storms, flooding, weather-related natural phenomena, and high tides.
Response: Destruction or washing away of nests, reduction and delay in nesting attempts.
Consequence: Reduction in habitat, mortality, and reduction in population numbers.
Narrative: Western snowy plover breeding and wintering habitat is subject to constant change from weather conditions. The quality and extent of western snowy plover nesting habitat is variable in both the short- and long-term. Coastal beaches increase in width and elevation during the summer through sand deposition, making marginal beaches more suitable for nesting later in the season. Over the longer term, an increase or decrease in habitat quality may occur after several years of winter storms. Based on the amount of flooding, the availability of dry flats at the edges of coastal ponds, lagoons, and manmade salt evaporators also varies within and between seasons. Therefore, the number of western snowy plovers breeding in some areas may change annually or even over one breeding season in response to natural alterations in habitat availability. Because most western snowy plover nesting areas occur on unstable sandy substrates, nest losses caused by weather-related natural phenomena commonly occur. High tides and strong winds cause many nest losses. Events such as extreme high tides, river flooding, and heavy rain have been reported to destroy or wash away nests. The annual percentage of total nest losses attributed to weather-related phenomenon has reached 15 to 38 percent at some locations. Stormy winters can adversely affect the western snowy plover. Additionally, a very wet spring results in a later than normal breeding initiation and fewer nesting attempts. The western snowy plover population naturally varies, both spatially and temporally, because of natural changes in weather and habitat conditions from year to year. However, as described above, human influences over the past century (e.g., habitat destruction, invasion of introduced beachgrass, and elevated predation levels) have reduced the western snowy plover's ability to respond to these natural perturbations (USFWS 2007).

Stressor: Disturbance of breeding plovers by humans
Exposure: Human recreation, pedestrians, trash, increased predators, military use of beaches, motorized vehicles, and fishing.

Response: Harassment of snowy plovers, crushing of eggs and chicks, egg collection, and entanglement.
Consequence: Nest abandonment, disturbance, mortality, and decreased habitat.
Narrative: The coastal zone is home to more than one-third of the human population of the United States, and that proportion is increasing. The southern California coastal area, which constitutes the central portion of the western snowy plover's coastal breeding range, attracts large crowds on a regular basis. The increasing level of human recreation is a major threat to the breeding success of the Pacific coast population of the western snowy plover. In addition, special events which attract large crowds, such as media events, sporting events, and beach cleanups, have a potential for significant adverse impacts when held in or near western snowy plover habitat. Potential threats from crowds of people attracted to special events include direct mortality and harassment of western snowy plovers. Expanding public access to the coast (e.g., State Coastal Trails) for recreation (e.g., walking, hiking, and biking) may adversely affect western snowy plovers and their breeding or wintering habitat. Expanded coastal access brings significantly greater numbers of people to the beach and other coastal habitats, exacerbating potential conflicts between human recreational activities and western snowy plover habitat needs. Expanded coastal access may exceed the threshold of beach visitors that public resource agencies (e.g., State Parks and National Park Service) can effectively manage while also meeting their responsibilities to protect natural resources.Pedestrians can cause both direct mortality and harassment of western snowy plovers, and may crush eggs or chicks and chase western snowy plovers off their nests. Separation of western snowy plover adults from their nests and broods can cause mortality through exposure of vulnerable eggs or chicks to heat, cold, blowing sand, and/or predators. Pedestrians have also been known to deliberately take eggs from nests and remove chicks from beaches, erroneously thinking they have been abandoned. People also may cause broods of western snowy plovers to run away from favored feeding areas. Trash left on the beach by pedestrians also attracts predators. Military personnel using the beach for maneuvers, boat launches, and landings have the potential to similarly cause adverse impacts to western snowy plovers. Beach-related recreational activities that are concentrated in one location can negatively affect incubating adult western snowy plovers when these activities occur too close to their nests. Recreational activities that occur in the wet sand area can adversely affect western snowy plovers when they disturb plover adults or broods, which feed at the edge of the surf along the wrack line. Recreational activities that occur in or over deep water may can potentially be detrimental to western snowy plovers when recreationists use the beach to take a break from these activities, or as access, exit, or landing points. Motorized vehicles may affect coastal dunes, and driving vehicles in breeding habitat may cause destruction of eggs, chicks, and adults; abandonment of nests; and considerable stress and harassment to western snowy plover family groups. In addition to recreational vehicles, vehicles used for military activities have also caused western snowy plover mortality.Impacts on western snowy plover nesting may be associated with surf fishing and shellfish harvesting in and near western snowy plover habitat. The improper disposal of offal, bait, and other litter attracts crows, ravens, and gulls, which are predators of western snowy plover eggs and chicks. Also, western snowy plovers may become entangled in discarded fishing lines. Concentrations of people may deter western snowy plovers and other shorebirds from using otherwise suitable habitats. Also, repeated intrusions by people into western snowy plover nesting areas may cause birds to move into marginal habitats where their chances of reproductive success are reduced (USFWS 2007).

Stressor: Domestic animal disturbances: dogs and horses
Exposure: Dogs chasing birds, and destroyed nests.

Response: Interruption in brooding, incubating, and foraging; flushing from nests; and displacement of chicks.
Consequence: Destroyed nests, mortality, and abandonment of nests and habitat.
Narrative: Dogs on beaches can pose a serious threat to western snowy plovers during both the breeding and nonbreeding seasons. Unleashed pets, primarily dogs, sometimes chase western snowy plovers and destroy nests. Repeated disturbances by dogs can interrupt brooding, incubating, and foraging behavior of adult western snowy plovers, and cause chicks to become separated from their parents. Pet owners frequently allow their dogs to run off-leash even on beaches where it is clearly signed that dogs are not permitted or are only permitted if on a leash. Enforcement of pet regulations on beaches by the managing agencies is often lax or nonexistent. Incubating birds have been flushed from nests by dogs, including nests inside areas protected by symbolic fencing. Dogs also have displaced adults from nests with newly hatched chicks. Roosting and feeding flocks, as well as individual birds, have been deliberately and persistently pursued by dogs. At Laguna Creek Beach, Zmudowski State Beach, and Salinas River State Beach, dogs partially or entirely destroyed western snowy plover nests, which in several cases were protected with symbolic fencing. Even when not deliberately chasing birds, dogs on a beach may disturb western snowy plovers and other shorebirds that are roosting or feeding. Western snowy plovers flushed more frequently and remained off their nests longer when a person was accompanied by a dog than when alone. Most equestrian use on beaches is directed to wet-sand areas. However, during high-tide periods, horseback riders on the beach sometimes enter coastal dunes or upper beach areas, where they may crush clutches or disturb western snowy plovers (USFWS 2007).

Stressor: Beach cleaning
Exposure: Mechanized beach cleaning, and foot traffic.
Response: Prolonged noise and disturbance to feeding and nesting habitat.
Consequence: Mortality, harassment, reduction of feeding habitat, and reduction in availability of food.
Narrative: Removal of human-created trash on the beach is desirable to reduce predation threats by eliminating food for predators of western snowy plovers; however, the indiscriminate nature of mechanized beach-cleaning adversely affects western snowy plovers and their habitat. Mechanized beach cleaning can be dangerous to western snowy plovers by crushing their clutches and chicks or causing prolonged disturbance from the machine's noise. Also, this method of beach cleaning removes the birds' natural wrackline (area of beach containing seaweed and other natural wave-cast organic debris) feeding habitat, reducing the availability of food. Kelp and driftwood, with their associated invertebrates, are regularly removed and the upper layer of sand is disturbed. Beach grooming also alters beach topography, removes objects associated with western snowy plover nesting, and prevents the establishment of native beach vegetation (USFWS 2007).

Stressor: Sky disturbances
Exposure: Kite flying, model airplanes, drones, and aircrafts.
Response: See narrative.
Consequence: See narrative.
Narrative: Biologists believe plovers perceive kites as potential avian predators. The reaction of western snowy plovers to kites at Ocean Beach in San Francisco, California, "ranged from increased vigilance while roosting in close proximity to the kite flying, to walking or running approximately 10 to 25 m (33 to 82 ft.) away and resting again while remaining alert." It is expected that stunt-kites would cause a greater response from western snowy plovers than

traditional, more stationary kites. Stunt kites include soaring-type, two-string kites with noisy, fluttering tails, which often exhibit rapid, erratic movements. It is expected that model airplanes may also have a detrimental impact to western snowy plovers because western snowy plovers may perceive them as potential predators.Low-flying aircraft (e.g., within 152 m [500 ft.] of the ground) can cause disturbances to breeding and wintering western snowy plovers. All types of low-flying aircraft potentially may be perceived by western snowy plovers as predators. The general response of roosting western snowy plovers to low-flying aircraft at Ocean Beach, San Francisco, California, was to increase vigilance and crouch in depressions on the beach, whereas foraging western snowy plovers frequently took flight (USFWS 2007).

Stressor: Fireworks
Exposure: Fireworks and loud noises.
Response: Nest abandonment, flushing from nests, and large crowds.
Consequence: Mortality and reduction in population numbers.
Narrative: Fireworks are highly disturbing to western snowy plovers. All western snowy plovers flushed from Coal Oil Point Reserve during a nearby July 4, 2005, fireworks display. At Del Monte Beach, California, a western snowy plover chick hatched on July 4, 1996, in an area demarcated by symbolic fencing, and was abandoned by its parents after a fireworks display. Disturbance from the noise of the pyrotechnics is exacerbated by disturbance caused by large crowds attracted to fireworks events (USFWS 2007).

Stressor: Livestock grazing
Exposure: Cattle and feral pigs.
Response: Flushing of nests, crushing of eggs, and introduction of invasive species.
Consequence: Mortality and reduction in habitat.
Narrative: Western snowy plover nests have been trampled by cattle, causing both direct mortality of eggs and flushing of adults from the nests. Additionally, feral pigs (Sus scrofa) may trample western snowy plover habitat and disturb nesting western snowy plovers. Cow and horse manure can introduce seeds of nonnative plants into the dunes (USFWS 2007).

Stressor: Oil spills
Exposure: Oil spills and oil spill cleanup.
Response: Loss of thermal insulation, ingestion of oil, impaired reproduction, change in behavior, and contaminated food sources.
Consequence: Mortality, reduced fitness, physiological changes, and starvation.
Narrative: The Pacific Coast population of the western snowy plover is vulnerable to oil spills. Western snowy plovers forage along the shoreline and in sea wrack (seaweed and other natural wave-cast organic debris) at the high-tide line and are thus at risk of direct exposure to oil during spills. The loss of thermal insulation is considered to be the primary cause of mortality in oiled birds. Oiled feathers lose their ability to keep body heat in and cold water out, causing reduced insulation, increased metabolic rate, and hypothermia. Ingestion of oil may lead to physiological changes in birds, including pathological effects on the alimentary tract, blood, adrenal glands, kidneys, liver, and other organs. Exposure of adult birds to oil also may impair reproduction, including reductions in egg laying and hatchability and in survival and growth of chicks. Oil transferred to eggs from plumage or feet of incubating birds can kill embryos. Oiled shorebirds may spend more time preening and less time feeding than unoiled birds, potentially impairing their body condition and ability to migrate to breeding grounds and reproduce. Oil spills may result in contamination or depletion of western snowy plover food sources. Following a southern

California oil spill, elevated concentrations of total petroleum hydrocarbons have been found in the sand crab (Emerita analoga), a potential western snowy plover food item. Oil or other chemicals washed onto mudflats or sand beaches may result in reduction in the availability of invertebrate prey. Elimination of shorebird food resources on intertidal flats of the Saudi Arabian Gulf coast as a result of the large oil spills associated with the 1991 Gulf War led to drastic reductions in the number of shorebirds supported by this habitat. Disturbance and other adverse impacts to western snowy plovers also may occur during oil cleanup activities if response teams are not careful when driving heavy equipment and vehicles or traversing on foot through western snowy plover habitat. Intensive oil spill cleanup operations, including the use of vehicles to deploy beach booms, move personnel, and remove debris, cause disturbance to nesting and foraging activities of western snowy plovers (USFWS 2007).

Stressor: Contaminants and trash
Exposure: Water quality issues, urban run-off, litter, garbage, and debris (fishing and cruise-ship-related).
Response: Ingestion of contaminated food and introduction of pollution into environments.
Consequence: Mortality and adverse effects on health and reproduction.
Narrative: Many coastal beaches contain channelized streams or outfalls receiving run-off from urban, industrial, and agricultural areas. Nonpoint sources of water pollution (including hydrocarbons, heavy metals, and household chemicals) could end up at coastal beaches used as western snowy plover foraging areas. Placement of litter, garbage, and debris in the coastal ecosystem can result in direct harm to western snowy plovers and degradation of their habitats. Litter and garbage feed predators and encourage their habitation at higher levels than would otherwise occur along the coast, making predators a greater threat to western snowy plovers. Marine debris and contaminated materials on the beach also adversely affect western snowy plovers. Marine debris is attributed to both ocean and shoreline sources. Ocean sources of marine debris and contamination include fishing boats, ships, and cruise lines. Cruise line debris may include small plastic shampoo, conditioner, hand lotion, and shoe polish containers, plastic cups, and balloons. Shoreline debris is usually from land sources.Western snowy plovers may become entangled in discarded fishing line, fishing nets, plastic rings that hold together six-packs of canned drinks, and other materials on the beach. Containers of contaminated materials (e.g., motor oil, cleaning fluid, and syringes) can introduce toxic chemicals to the beach.Western snowy plovers feed on aquatic and terrestrial insects, and the bioaccumulation of environmental contaminants on western snowy plover nesting and wintering grounds may adversely affect their health and reproduction. Organochlorines are known to have caused reduced avian egg production, aberrant incubation behavior, delayed ovulation, embryotoxicosis, and mortality of chicks and adults. Selenium has caused decreased hatchability of avian eggs, developmental abnormalities, altered nesting behavior, and embryotoxicosis in birds in field and laboratory studies. Mercury can cause decreased hatchability of avian eggs, boron has been shown to reduce hatchability of waterfowl eggs in laboratory experiments, and arsenic may also adversely affect avian reproduction (USFWS 2007).

Recovery

Reclassification Criteria:

Reclassification/uplisting criteria have not been established for this species. The western snowy plover is currently listed as a threatened species.

Delisting Criteria:
The Pacific coast population of the western snowy plover will be considered for delisting when the following criteria have been met:

Monitoring shows that an average of 3,000 breeding adults distributed among six recovery units as specified below have been maintained for a minimum of 10 years: Washington and Oregon - 250 breeding adults; Del Norte to Mendocino Counties, California - 150 breeding adults; San Francisco Bay, California - 500 breeding adults; Sonoma to Monterey Counties, California - 400 breeding adults; San Luis Obispo to Ventura Counties, California - 1,200 breeding adults; and Los Angeles to San Diego Counties, California - 500 breeding adults (USFWS 2007).

A yearly average productivity of at least one (1.0) fledged chick per male has been maintained in each recovery unit in the last 5 years prior to delisting (USFWS 2007).

Mechanisms have been developed and are in place to ensure long-term protection and management of breeding, wintering, and migration areas, to maintain the subpopulation sizes and average productivity specified in Criteria 1 and 2 (USFWS 2007).

Recovery Actions:
- Monitor breeding and wintering populations and habitats of the Pacific coast population of the western snowy plover to determine progress of recovery actions to maximize survival and productivity (USFWS 2007).
- Manage breeding and wintering habitat of the Pacific coast population of the western snowy plover to ameliorate or eliminate threats and maximize survival and productivity (USFWS 2007).
- Develop mechanisms for long-term management and protection of western snowy plovers and their breeding and wintering habitat (USFWS 2007).
- Undertake scientific investigations that facilitate the recovery efforts (USFWS 2007).
- Undertake public information and education programs (USFWS 2007).
- Review progress toward recovery of the western snowy plover and revise recovery efforts as appropriate (USFWS 2007).
- Dedicate sufficient USFWS staff for coordination of western snowy plover recovery implementation. (USFWS 2007).
- Establish an international conservation program with the government of Mexico to protect western snowy plovers and their breeding and wintering locations in Mexico (USFWS 2007).
- Coordinate with other survey, assessment, and recovery efforts for the western snowy plover throughout North America (USFWS 2007).

Conservation Measures and Best Management Practices:
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Additional Threshold Information:
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SPECIES ACCOUNT: *Charadrius melodus circumcinctus* (Piping Plover - Great Lakes)

Species Taxonomic and Listing Information

Listing Status: Endangered (wintering population: Threatened); 12/11/1985; Midwest Region (R3) (USFWS, 2017a).

Physical Description

Piping plover subspecies are phenotypically indistinguishable (USFWS, 2009). The Great Lakes piping plover, named for its melodic call, is a small North American shorebird, approximately 17 cm (6.7 in) in length (Palmer 1967) that weighs 40-65 g (1.4-2.3 oz) and has a wing span measuring about 38 cm (15 in) (Haig 1992). Light sand-colored upper plumage and white undersides blend in well with the piping plover's principal beach habitats. During the breeding season, the legs and bill are bright orange, and the bill has a black tip. Other distinctive markings include a single black band across the upper breast and a smaller black band across the forehead. In adult females, the breast band is often thin or incomplete, and plumage is frequently duller than in adult males (Wilcox 1959; Haig 1992). During winter, the legs pale, the bill turns black, and darker markings are lost. Chicks have speckled gray, buff, brown, and white down. The coloration of fledged young resembles that of adults in winter. Juveniles acquire adult plumage the spring after they fledge (Prater et al. 1977) (USFWS, 2017b).

Taxonomy

Miller et al. (2009) confirmed separate Atlantic and interior piping plover subspecies (C. m. melodus and C. m. circumcinctus, respectively). This study found that birds from the Great Lakes region were allied with the interior subspecies group and should be taxonomically referred to as C. m. circumcinctus. Very rare (perhaps completely absent) reproductive interchange between the Great Lakes and the Northern Great Plains populations constitutes a marked separation of breeding ranges, albeit insufficient or too recent to result in substantial genetic differences demonstrated by available studies (USFWS, 2009).

Historical Range

Piping plovers once nested on Great Lakes beaches in Illinois, Indiana, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin, and Ontario, Canada. Historically, as many as 492 to 682 breeding pairs may have nested in the Great Lakes region in the late 1800s (Russell 1983). Michigan may have had 215 pairs or more; Ontario and Illinois likely supported the next largest populations (152-162 and 125-130, respectively). Indiana, Ohio, and Wisconsin were estimated to have 100 or fewer breeding pairs each, and Minnesota, New York, and Pennsylvania fewer than 30 each. Piping plovers were extirpated from Great Lakes beaches in Illinois, Indiana, New York, Ohio, Pennsylvania, and Ontario by the late 1970s (Russell 1983). Few piping plovers nested in Wisconsin after the 1970s, and no nests were found in the state between 1983 and 1997 (S. Matteson, Wisconsin Department of Natural Resources, pers. comm. 1998). Similarly, the small number of pairs that nested in Duluth Harbor, Minnesota had abandoned the area by 1986 (B. Eliason, Minnesota Department of Natural Resources, pers. comm. 1999). In 1977, the Great Lakes population was estimated at 31 nesting pairs (Lambert and Ratcliff 1979) but declined to approximately 17 pairs by 1985 (USFWS 1985). When the piping plover was listed as endangered in 1986, the Great Lakes population nested exclusively at a few sites on the northeastern shore of Lake Michigan and southeastern shore of Lake Superior in Michigan, the state with the most remaining habitat (USFWS, 2017b).

Current Range

The wintering ranges of the three breeding populations of the piping plover overlap and extend from Virginia to Florida on the Atlantic Coast and from the Florida Gulf Coast west to Texas and into Mexico, the West Indies, and the Bahamas (Haig 1992). Great Lakes piping plovers winter primarily along the southeast Atlantic Coast and along the eastern Gulf Coast, although some individuals have been reported as far west as Texas and as far south as Mexico and the Bahamas. Along with the general range expansion since listing, breeding location distribution has recently shifted. Between 1986 and 2002, piping plovers routinely nested on several sites in Iosco and Alpena Counties. From 2003-2009, however, few, if any, of these beaches were used for nesting (Stucker et al. 2003; Stucker and Cuthbert 2004; Stucker and Cuthbert 2005; Westbrock et al. 2005; Cuthbert and Roche 2006, 2007b). In addition, traditional sites along the southern shore of Lake Superior such as Crisp Point, have gone unused in recent years. The reduced use of the shorelines of Lakes Huron and Superior, combined with the increasing use of the Lake Michigan shoreline, indicates a shift in distribution toward the Lake Michigan basin (USFWS 2009). In addition, the number of nest sites found in the Lower Peninsula of Michigan over the past few years has decreased, while at the same time increasing along the southern shoreline of the Upper Peninsula and at sites in Wisconsin and, more recently, Canada. There is also increased use of public land by nesting piping plovers. Since 2003, at least 70% of the nests have been located on publicly owned lands. In 2009 for example, nearly 35 % of all nests in the Great Lakes occurred in Michigan's Sleeping Bear Dunes National Lakeshore (Cuthbert and Roche 2009) (USFWS, 2017b). Seventy-five percent of Great Lakes breeders were found along the Atlantic Coast from North Carolina to the Florida Keys (also used by 77% of eastern Canada breeders) (USFWS, 2009).

Distinct Population Segments Defined

No; There are separate breeding populations in the Northern Great Plains and the Great Lakes areas (USFWS, 2009).

Critical Habitat Designated

Yes; 7/10/2001.

Legal Description

On May 19, 2009, the U.S. Fish and Wildlife Service (Service), designated revised critical habitat for the wintering population of the piping plover (Charadrius melodus) in 18 specific units in Texas under the Endangered Species Act of 1973, as amended (74 FR 23476 - 23600). In total, approximately 139,029 acres (56,263 hectares) fall within the boundaries of the revised critical habitat designation. Other previously designated critical habitat for the wintering piping plover in Texas or elsewhere in the United States remains unaffected.

On October 21, 2008, the U.S. Fish and Wildlife Service (Service), designated revised critical habitat for the wintering population of the piping plover (Charadrius melodus) in North Carolina under the Endangered Species Act of 1973, as amended (73 FR 62816 - 62841). In total, approximately 2,043 acres (ac) (827 hectares (ha)), in Dare and Hyde Counties, North Carolina, fall within the boundaries of the revised critical habitat designation.

On July 10, 2001, the Fish and Wildlife Service (Service), designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as

critical habitat for the wintering population of the piping plover (Charadrius melodus) (66 FR 36038 - 36143). This includes approximately 2,891.7 kilometers (km) (1,798.3 miles (mi)) of mapped shoreline and approximately 66,881 hectares (ha) (165,211 acres (ac)) of mapped area along the Gulf and Atlantic coasts and along margins of interior bays, inlets, and lagoons.
On September 11, 2002, the U.S. Fish and Wildlife Service (Service), designated critical habitat for the northern Great Plains breeding population of the piping plover (Charadrius melodus), pursuant to the Endangered Species Act of 1973, as amended (67 FR 57638 - 57717). The designation includes 19 critical habitat units containing prairie alkali wetlands, inland and reservoir lakes, totaling approximately 183,422 acres (ac) (74,228.4 hectares (ha)) and portions of 4 rivers totaling approximately 1,207.5 river miles (rm) (1,943.3 kilometers (km)) in the States of Minnesota, Montana, Nebraska, North Dakota, and South Dakota.
Critical habitat includes prairie alkali wetlands and surrounding shoreline, including 200 feet (ft) (61 meters (m)) of uplands above the high water mark; river channels and associated sandbars, and islands; reservoirs and their sparsely vegetated shorelines, peninsulas, and islands; and inland lakes and their sparsely vegetated shorelines and peninsulas. Section 7 of the Endangered Species Act requires Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to destroy or adversely modify critical habitat.

Critical Habitat Designation

18 units are designated as revised critical habitat in Texas for the wintering population of the piping plover. The units are divided into 24 areas: (1)Subunit TX–3A: South Padre Island – Gulf of Mexico Shoreline; (2)Subunit TX–3B: South Padre Island –Interior; (3)Subunit TX–3C: North Padre Island – Interior; (4)Subunit TX–3D: North Padre Island – Gulf of Mexico; (5)Subunit TX–3E: Mesquite Rincon; (6)Unit TX–4: Lower Laguna Madre Mainland; (7)Unit TX–7: Newport Pass/Corpus Christi Pass Beach; (8)Unit TX–8: Mustang Island Beach; (9)Unit TX–9: Fish Pass Lagoons; (10)Subunit TX–10A: Shamrock Island; (11)Subunit TX–10B: Mustang Island – Unnamed sand flat; (12)Subunit TX–10C: Mustang Island – Lagoon Complex; (13)Unit TX–14: East Flats; (14)Unit TX–15: North Pass; (15)Unit TX–16: San Jose Beach; (16)Unit TX–18: Cedar Bayou/Vinson Slough; (17)Unit TX–19: Matagorda Island Beach; (18)Unit TX–22: Decros Point; (19)Unit TX–23: West Matagorda Peninsula Beach; (20)Unit TX–27: East Matagorda Bay/ Matagorda Peninsula Beach West; (21)Unit TX–28: East Matagorda Bay/ Matagorda Peninsula Beach East; (22)Unit TX–31: San Bernard NWR Beach; (23)Unit TX–32: Gulf Beach Between Brazos and San Bernard Rivers; and (24)Unit TX–33: Bryan Beach and Adjacent Beach.

Unit TX–3: Padre Island Subunit. TX–3A: South Padre Island – Gulf of Mexico Shoreline. This subunit consists of 2,891 ac (1170 ha) in Cameron and Willacy Counties, Texas. It is a beach 30.0 mi (48.2 km) in length on the gulfside of South Padre Island, which is a barrier island. The subunit is located within an area bounded on the south by the southern boundary of Andy Bowie County Park, and on the north by the south jetty of Mansfield Channel, which divides North and South Padre Islands. The jetty itself is outside the boundary of the subunit. The eastern boundary is the estimated MLLW of the Gulf of Mexico, and the western boundary is the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. The vegetated dune and Park Road 100, which runs northsouth along the western side of the dune, separates Subunits TX–3A and 3B. This subunit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately one quarter of the subunit is in Federal ownership and managed by the Service's Laguna Atascosa National Wildlife Refuge (NWR), and approximately 64 percent is in private ownership. The Service does not own the subsurface mineral rights. Ten percent is State land managed by the GLO, and a small portion at the southern end is County park land managed by Andy Bowie County Park. Subunit TX–3A is the southernmost unit of the revised critical habitat for the wintering population of the piping plover. It was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this subunit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1), surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. These threats are of greatest magnitude at the southern end of the subunit where housing developments are to the west of the subunit. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area. Subunit TX–3B: South Padre Island –Laguna Madre side. This bayside subunit consists of 44,137 ac (17,862 ha) in Cameron and Willacy Counties, Texas. Its southern boundary extends along the north side of an existing earthen, manmade dike running from the edge of dense dune vegetation to the Laguna Madre along latitude 26° 09’ 19.00’’ N. The dike is not within the boundary of the subunit. The western boundary is the western edge of the intertidal mudflats bordering the eastern shore of the lower Laguna Madre, and the northern boundary is Mansfield Channel. The eastern boundary is dense vegetation of the dunes or, if there is no dense vegetation or dune, the western boundary of Park Road 100. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. Approximately 42 percent of the land is federally owned and managed by the Service’s Laguna Atascosa NWR, and approximately 38 percent is Stateowned and managed by the GLO. The remaining 20 percent is in private ownership along the western side of the subunit. The Service does not own the subsurface mineral rights beneath the refuge. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand and mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. These threats, particularly vehicle access, are of greatest magnitude at the southern portion of the subunit where roads are near or adjacent to PCE 1. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however, a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area. Subunit TX–3C: North Padre Island – Laguna Madre side. This bayside unit consists of 50,897 ac (20,597 ha) in Kenedy and Kleberg Counties, Texas. It is along and within the Laguna Madre and extends from the western boundary of Padre Island National Seashore (PAIS) to the Gulf Intracoastal Waterway (GIWW). The northern boundary of the subunit is a line extending westward from the PAIS (at latitude 27° 4′ 29.9′′ N), and its southern boundary is a line extending westward from the southern boundary of PAIS along the northern edge of the Mansfield Channel. The eastern boundary of this subunit is the western boundary of PAIS when the PCEs extend as far as PAIS or the eastern edge of the sand flats where the PCEs end. The portion of the western boundary north of longitude/latitude coordinate 26°48′38.2′′N, 97°28′11.6′′W is the eastern edge of the GIWW, and the portion of the western boundary south of the coordinate is the western edge of the intertidal mudflats bordering the eastern shore of the Laguna Madre. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. Most of the land is State-owned and managed by the GLO. A small portion is in private ownership. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This subunit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 8). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. At this time the Service is not aware of any management plans that address this species in this area. Subunit TX–3D: North Padre Island – Gulf of Mexico. This gulfside subunit consists of 270 ac (109 ha) of beach in Kleberg County, Texas. It extends along the gulf shore of North Padre Island from the northern boundary of PAIS northward 6.2 mi (10 km) to the Nueces County line. The southern boundary is the north boundary of the northeast section of the PAIS. The subunit extends eastward to the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This subunit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Most of the land is owned by the State and managed by the GLO. Approximately one-fifth is in private ownership. It was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this subunit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surfcast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. These threats are of greater magnitude at the north end of the subunit, where more roads provide easy access to the PCEs and the subunit is in close proximity to houses. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–3E: North Padre Island – Mesquite Rincon. This triangular bayside subunit of 9,6238 acres (3,894 hectares) lies on the western shore of the lower Laguna Madre in Kenedy County, Texas. The subunit is generally bounded by Rincon de la Soledad on the southwestern side, Mesquite Rincon on the north, and the GIWW and Rincon de San Jose on the east. The southwestern boundary is an irregular line along the PCEs between the latitude/longitude coordinate points: 26° 44′ 10.5′′ N, 97° 28′ 04.5′′ W at the southeastern point of Rincon de San Jose and 26° 50′ 58.1′′ N, 97° 34′ 19.5′′ W. The northern boundary is the line described between the latitude/longitude coordinate points: 26° 51′ 24.2′′ N, 97° 33′ 25.8′′ W and 26° 51′ 24.2′′ N, 97° 27′ 52.7′′ W. The northern portion of the eastern boundary is the western edge of the GIWW south to latitude/longitude coordinate point 26° 48′ 52.7′′ N, 97° 28′ 12.9′′ W. There the subunit curves westward and skirts a small horseshoeshaped inlet in the Laguna Madre to the northeastern point of Rincon de San Jose at latitude/longitude coordinate point 26° 48′ 43.9′′ N, 97° 29′ 4.7′′ W. There it continues south in an irregular line along the edge of the PCEs to the southeastern point of Rincon San Jose. Within that boundary (especially the southeastern portion of the subunit and northwestern-running edge), the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. Most of the land is in private ownership with a small portion that is State-owned and managed by the GLO. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This subunit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 7). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–4: Lower Laguna Madre Mainland. This bayside unit consists of 17,223 ac (6,970 ha) in Cameron and Willacy Counties, Texas, and lies along the western shoreline of the Lower Laguna Madre. The southern boundary is an east-west line at the northern tip of Barclay Island, approximately following latitude 26° 14′ 42.2′′ N. The northern boundary is an east-west line located near the northern tip of El Sauz Island, approximately 1.2 mi (1.9 km) south of the center of the city of Port Mansfield, Willacy County, Texas, and approximately following latitude 26° 32′ 7.8′′ N. The eastern boundary of the unit is the eastern edge of the line of dredge spoils that parallel the western side of the GIWW. The western boundary runs from southeast to northwest and is the western edge of sandy beach and mudflat habitat, approximately following the latitude/longitude coordinate points: latitude/longitude coordinate points: 26° 14′ 42.45′′ N, 97° 19′ 32.75′′ W; 26° 17′ 15.54′′ N, 97° 20′ 47.31′′ W; 26° 20′ 10.17′′ N, 97° 21′ 10.94′′ W; 26° 21′ 31.54′′ N, 97° 22′ 48.10′′ W; 26° 24′ 26.64′′ N, 97° 23′ 53.27′′ W; 26° 26′ 8.55′′ N, 97° 25′ 13.33′′ W; and 26° 32′ 5.44′′ N, 97° 27′ 6.91′′ W. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service has used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. Approximately one-third of this unit is within the Service's Laguna Atascosa NWR. Approximately half is Stateowned and managed by the GLO. The remainder is in private ownership. The Service does not own the subsurface mineral rights beneath the surface of the refuge. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand or mud flats above high tide for roosting (PCE 2). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This unit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 8). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however, a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–7: Newport Pass/Corpus Christi Pass Beach. This unit consists of 294 ac (119 ha) in Nueces County, Texas. It is a gulfside beach unit approximately 5.1-mi (8.2- km) long. The southern boundary is the gulfward extension of Saint Bartholomew Avenue, adjacent to the north end of the seawall. The northern boundary is the edge of the south jetty of the Fish Pass Structure at Mustang Island State Park. The eastern boundary is MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dune. Packery Channel cuts the beach approximately 0.3 mi (0.5 km) north of the south boundary. The seawall, jetty, bollards, and open water of Packery Channel are not within the boundaries of the unit. This unit is in State and private ownership; the State portion is managed by the Mustang Island State Park. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains PCEs in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. Due to its close proximity to Corpus Christi, this unit receives considerable recreational use and beach cleaning and nourishment. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–8: Mustang Island Beach. This unit consists of 623 ac (252 ha) in Nueces County, Texas. It is a gulfside beach unit approximately 12.5 mi (20.1 km) long. The southern boundary is the edge of the north jetty of the Fish Pass Structure at Mustang Island State Park. The northern boundary is the south side of the Horace Calder Pier in Port Aransas, Texas. The unit is bounded on the east by the MLLW of the Gulf of Mexico, and on the west by the dune line, where the habitat changes from lightly vegetated sandy beach to densely vegetated. The jetty and pier are not within the boundary of the unit. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The unit is in State and private ownership, with a small municipal park owned and managed by the City of Port Aransas. The State land is managed by the GLO. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. Due to its close proximity to Corpus Christi, this unit receives considerable recreational use and beach cleaning and nourishment. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–9: Fish Pass Lagoons. This bayside unit consists of 168 ac (68 ha) in Nueces County, Texas. This unit encompasses flats facing Corpus Christi Bay that extend 1.0 km (0.6 mi) on either side of Fish Pass. The inland boundary is a line of dense vegetation, and the bayside boundary is the northeast edge of the tidal sand flats that are a PCE. This unit includes all areas of habitat that contain PCEs 1, 2, 5, and 6 within the area described by a polygon with the following latitude/longitude coordinate points: 27° 42′ 14.63′′ N, 97° 10′ 44.70′′ W; 27° 41′ 56.97′′ N, 97° 10′ 8.13′′ W; 27° 41′ 24.35′′ N, 97° 10′ 36.89′′ W; 27° 41′ 18.98′′ N, 97° 11′ 16.79′′ W; 27° 41′ 23.51′′ N, 97° 11′ 31.32′′ W and 27° 42′ 14.63′′ N, 97° 10′ 44.70′′ W. Within that polygon, six moderate to large polygons from 5 to 64 ac (2 to 25 ha) each and two small polygons less than 1 ac (0.4 ha) each are PCEs and comprise the unit. Most of the unit is owned by the State and managed by the GLO. A few acres are in private ownership. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and/or mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–10: Shamrock Island and Adjacent Mustang Island Flats. Subunit TX–10A: Shamrock Island. This 12-ac (5-ha) island in Nueces County, Texas, was a peninsula extending off of Mustang Island in Corpus Christi Bay until erosion separated the island from the mainland. Five small polygons of sand flats from 1.1 to 6.8 ac (0.4 to 2.7 ha) comprise the subunit. Most of the land is State-owned and managed by the GLO; the remainder is privately owned. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–10B: Mustang Island: Unnamed sand flat. This 2-ac (1-ha) subunit in Nueces County, Texas, is a small, unnamed sand flat near the north edge of the mouth of Wilson's Cut in Corpus Christi Bay. The subunit is the western half of the island that is sand flats landward (easterly) to the western edge of tidal marsh. It is entirely Stateowned and managed by the GLO. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans and domestic animals; and increased predation due to recreational use. The location of the subunit, and the configuration of the polygons of PCEs that comprise this subunit, limit recreational access by vehicles to PCEs 1 and 2. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–10C: Mustang Island: Lagoon Complex. This 331-ac (134-ha) subunit in Nueces County, Texas, is an extensive lagoon complex that consists of 11 polygons within a larger polygon that extends 2.2 mi (3.5 km) south of Wilson's Cut in Corpus Christi Bay. The southern boundary of the larger polygon begins at the western end at latitude/ longitude coordinate point 27° 43' 2,4'' N, 97° 10' 19.4'' W at the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. It follows the dune line southeast approximately 830 ft (253 m) to a road, then follows the road approximately 945 ft (288 m) to the edge of the tidal sand flat PCE. It follows the southeastern edge of the sand flat northeast to the western edge of a northsouth road, where it follows the edge of the sand flat northward to the south edge of a road that runs east-west parallel to the southwestern edge of Wilson's Cut. The northern edge of the boundary is the south edge of the road or the northern extent of the sand flat when it does not reach the road. The western boundary follows the PCEs along their eastern edge at Corpus Christi Bay beginning 409 ft (125 m) southwest of the southwestern edge of Wilson's Cut to the coordinate point at the western edge of the southern boundary. A road transects the larger polygon described above, forming two polygons that exclude the road. The PCEs within the 11 polygons comprise the subunit. Within that boundaries of the 11 polygons, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the polygons that comprise the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundaries can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. The subunit consists of private and Stateowned lands. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to uncontrolled recreational access and beach cleaning and stabilization efforts. Road access to the PCEs is extensive. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–14: East Flats. This bayside unit consists of 591 ac (239 ha) in Nueces County, Texas. It is an irregularly shaped intertidal sand flat south of the Corpus Christi Ship Channel. The north boundary is the northern edge of the sand flat near or adjacent to dredge spoil areas bordering the south side of the Corpus Christi Ship Channel. The northwestern latitude/longitude coordinate is 27° 49′ 54.49′′ N, 97° 6′ 14.28′′ W, and the northeastern latitude/longitude coordinate is 27° 49′ 55.29′′ N, 97° 5′ 12.86′′ W. From there, the sand flat curves southward, and the southeastern edge of it forms a highly irregular line that ends in the southwest portion of the polygon at the eastern edge of a navigation channel from the Corpus Christi Ship Channel to Corpus Christi Bay at latitude/longitude coordinate 51.93′′ N, 97° 5′ 52.58′′ W. The sand flat continues on the western edge of the navigation channel in a northwesterly direction to latitude/longitude coordinate 27° 49′ 22.08′′ N, 97° 6′ 37.04′′ W. It then curves northeasterly and across the cut to the northern edge at the northwest coordinate. On the east, it abuts the City of Port Aransas. There is a small marshland within the sand flat that bisects the sand flat that is not a PCE and is not included in the unit. The unit is mostly in private ownership, with a small portion of State land managed by the GLO. This unit was occupied at the time of listing and is currently occupied. Current ocupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–15: North Pass. This bayside unit consists of 805 ac (326 ha) in Aransas County, Texas. The unit is bounded on the northeast by a line between latitude/longitude coordinates 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W and 27° 54′ 54.53′′ N, 97° 1′ 18.17′′ W, on the northwest and west by the edge of tidal sand flats in Aransas Bay, on the south by a line running east from coordinate 27° 53′ 16.96′′ N, 97° 2′ 22.44′′ W to unit TX–16, and on the southeast by the landward boundary of unit 16. The unit is all areas that contain the PCEs for the species within a larger area described by a polygon with the following sets of latitude/longitude coordinate points: 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W; 27° 53′ 10.68′′ N, 97° 1′ 21.36′′ W; 27° 53′ 16.96′′ N, 97° 2′ 22.44′′ W; 27° 53′ 33.08′′ N, 97° 2′ 33.05′′ W; 27° 54′ 42.68′′ N, 97° 2′ 4.83′′ W; 27° 54′ 47.59′′ N, 97° 1′ 51.73′′ W; 27° 54′ 54.53′′ N, 97° 1′ 18.17′′ W and 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale, so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. This unit is a remnant of a hurricane washover on San Jose Island. Approximately 18 percent is Stateowned and managed by the GLO; the remainder is in private ownership. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–16: San Jose Beach. This unit consists of 1,378 ac (558 ha) in Aransas County, Texas. It is a gulfside beach unit approximately 19.8 mi (31.9 km) long. The southern boundary is the edge of the north jetty of Aransas Pass. The jetty is not within the boundary of the unit. The south edge of Cedar Bayou Pass is the northern boundary. The eastern boundary is the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. A small section is in Federal ownership and managed by the Service's Matagorda Island NWR. The Service does not own the subsurface mineral rights. Approximately half of the unit is State-owned and managed by the GLO, and nearly as much is in private ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, the CCP is not yet available. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–18: Cedar Bayou/Vinson Slough. This bayside unit consists of 2,465 ac (998 ha) in Aransas County, Texas. It is a remnant of a hurricane washover area and includes the highly dynamic area of Cedar Bayou, the pass that separates San Jose Island and Matagorda Island. Beginning at the confluence of Vinson Slough and Cedar Bayou, the boundary follows the shore of Spalding Cove to Long Reef, then continues along a line extending 2.5 miles southwest of Long Reef to the shore of San Jose Island, then along the shore of the island to the landward boundary of Unit TX–16. Within that area, the unit consists of numerous polygons of PCEs; areas that are not PCEs within the described area are not within the boundaries of the unit. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. The southern and southeastern boundary of the unit is described by a line with the following sets of latitude/longitude coordinate points: 28° 1′ 21.76′′ N, 96° 57′ 51.24′′ W; 28° 1′ 12.77′′ N, 96° 57′ 31.18′′ W; 28° 2′ 3.07′′ N, 96° 56′ 45.84′′ W; 28° 2′ 15.92′′ N, 96° 56′ 25.10′′ W; 28° 2′ 30.32′′ N, 96° 56′ 11.97′′ W; 28° 3′ 15.62′′ N, 96° 54′ 20.01′′ W; 28° 3′ 58.58′′ N, 96° 53′ 24.65′′ W; 28° 4′ 1.15′′ N, 96° 52′ 14.65′′ W; 28° 3′ 31.74′′ N, 96° 51′ 38.29′′ W and 28° 3’ 17.69’’ N, 96° 51’ 38.47’’ W. The specific northern boundary is described by a line with the following sets of latitude/longitude coordinate points: 28° 5’ 44.24’’ N, 96° 54’ 8.16’’ W; 28° 5’ 13.23’’ N, 96° 52’ 44.85’’ W; 28° 4’ 33.99’’ N, 96° 50’ 46.55’’ W; 28° 4’ 38.92’’ N, 96° 50’ 40.79’’ W and 28° 4’ 22.98’’ N, 96° 50’ 22.94’’ W. The eastern boundary at the northeastern end of the unit is units TX–16 and TX–19 on the gulfside. The western boundary is the western edge of tidal sand flats in Aransas Bay. This area includes a small section of federally owned land managed by the Service’s Matagorda Island NWR and a small section of State-owned land. The remaining area is privately owned. The Service does not own the subsurface mineral rights beneath the NWR. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use. Vehicle use of the unit may be limited somewhat by accessibility. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, the CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–19: Matagorda Island Beach. This unit consists of 2,413 ac (976 ha) in Calhoun County, Texas. It is a gulfside beach unit approximately 37.1 mi (59.7 km) long. The southern boundary is the northern edge of Cedar Bayou Pass, and the northern boundary is the southern edge of Pass Cavallo. At Pass Cavallo, the unit curves from the eastern gulfside passing between the south edge of the pass and the north edge of the dunes to a small area on the bayside. The eastern boundary is the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The federally owned land in this unit is managed by the Service’s Matagorda Island NWR, which does not own the subsurface mineral rights. This unit also includes a small section of land in State ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and access by refuge staff and others for sea turtle monitoring efforts. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, a CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–22: Decros Point. This unit consists of 544 ac (220 ha) at the Matagorda/Calhoun County line, in Texas. It is a gulfside beach unit approximately 4.8 mi (7.7 km) long that wraps around to the bayside. This unit was originally the southern tip of the Matagorda Peninsula. It was made into an island by the dredging of the Matagorda Ship Channel, the edge of which is the northern boundary of the unit. The unit is horseshoe in shape with the east side along the Gulf of Mexico and the west side along Matagorda Bay; the two are connected at their southern boundary by habitat from the north edge of Pass Cavallo northward to the dune line. Densely vegetated sand dunes run north to south in the center of the horseshoe and are not within the boundary of the critical habitat because they are not a PCE. The eastern boundary is the MLLW of the Gulf of Mexico (see the Methods section for our derivation of MLLW), and the western boundary is the western edge of tidal sand flats on the east side of Matagorda Bay. Within the bayside of the boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately 60 percent of the unit is in State ownership managed by the GLO. The remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach (PCE 4) for roosting and sheltering. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. Due to a lack of road access, this unit does not receive much recreational vehicle use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–23: West Matagorda Peninsula Beach. This unit consists of 1,808 ac (732 ha) of shoreline in Matagorda County, Texas. It is a gulfside beach unit approximately 23.9 mi (38.5 km) long. The southern boundary is the northern jetty of the Matagorda Ship Channel. The northern boundary is the Old Colorado River channel. The MLLW of the Gulf of Mexico is the eastern boundary, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Just under half of the unit is Stateowned and managed by the GLO; the remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–27: East Matagorda Bay/ Matagorda Peninsula Beach West. This unit consists of 905 ac (366 ha) of shoreline in Matagorda County, Texas. It is a gulfside beach unit approximately 14.1 mi (22.8 km) long. The southwestern boundary is the northeastern edge of the Old Colorado River channel. The unit runs along the beach 14 mi (23 km) to the northeastern boundary opposite Eidelbach Flats described by a line between the latitude/longitude coordinate points: 28° 41′ 2.26′′ N, 95° 46′ 29.04′′W and 28° 41′ 6.74′′ N, 95° 46′ 32.46′′ W. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Just over half of the unit is Stateowned and managed by the GLO; the remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–28: East Matagorda Bay/ Matagorda Peninsula Beach East. This gulfside unit consists of 481 ac (194 ha) in Matagorda County, Texas. It extends along the Gulf beach southwest and northeast of Brown Cedar Cut. The cut is not within the boundary of the unit. This unit abuts portions of the southeastern edges of units TX–29 and TX–30, which are on the East Matagorda Bay side. The southwestern boundary is approximately 4 mi (6.5 km) southwest of Brown Cedar Cut at a line described by the following sets of latitude/ longitude coordinate points: 28° 43′ 11.91′′N, 95° 42′ 25.47′′W and 28° 43′ 17.09′′N, 95° 42′ 28.56′′W. The northeastern boundary is approximately 2.8 mi (4.5 km) northeast of Brown Cedar Cut to the point where Texas Farm to Market Road 457 intersects the beach. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat boundaries, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately onethird is in State ownership and managed by the GLO; the remaining two-thirds is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied.

Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–31: San Bernard NWR Beach. This gulfside unit consists of 401 ac (162 ha) in Matagorda and Brazoria Counties, Texas. It is a 6.2-mi (10-km) segment of beach on the Gulf of Mexico near the mouth of the San Bernard River. The northeastern boundary is at the southwestern edge of the mouth of the San Bernard River. The southwestern boundary follows a line described by the following sets of latitude/longitude coordinate points: 28° 47′ 54.39′′ N, 95° 33′ 26.21′′ W, and 28° 47′ 57.69′′ N, 95° 33′ 27.75′′ W. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. There is a cut through the beach from the Gulf of Mexico to a lake 3.5 mi (5.6 km) southwest of the San Bernard River, which is not within the unit. Bollards also are not within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately 30 percent of this unit is in Federal ownership and managed by the Service’s San Bernard NWR, which does not own the subsurface mineral rights. Approximately 48 percent is Stateowned and managed by the GLO with the remaining area in private ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. The federally owned portion has pedestrian recreational access, but no vehicle access. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, a CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–32: Gulf Beach Between Brazos and San Bernard Rivers. This gulfside unit consists of 556 ac (225 ha) of shoreline in Brazoria County, Texas. This unit is a 6.1-mi (9.8-km) segment of beach on the Gulf of Mexico between the mouths of the San Bernard and Brazos Rivers. The southwestern boundary is the northeastern edge of the mouth of the San Bernard River. The northeastern boundary is the western edge of the mouth of the Brazos River. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. It is entirely in State ownership and managed by the GLO. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–33: Bryan Beach and Adjacent Beach. This unit consists of 211 ac (85 ha) in Brazoria County, Texas. It is gulfside beach approximately 3.5 mi (5.7 km) in length on the Gulf of Mexico near the mouth of the Brazos River. The southwestern boundary is the northeastern edge of the Brazos River. The northeastern boundary is Farm-toMarket Road 1495 (Bryan Beach Rd). The southeastern boundary is the MLLW. The northwestern boundary follows along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The unit is entirely in State ownership and managed by the Texas Department of Parks and Wildlife. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Four units are designated as critical habitat for the wintering population of the piping plover in North Carolina. The four areas designated as critical habitat are: (1) Unit NC–1, Oregon Inlet; (2) Unit NC–2, Cape Hatteras Point; (3) Unit NC–4, Hatteras Inlet; and (4) Unit NC–5, Ocracoke Island.

Unit NC–1: Oregon Inlet. Unit NC–1 is approximately 8.0 km (5.0 mi) long, and consists of about 196 ha (485 ac) of sandy beach and inlet spit habitat on Bodie Island and Pea Island in Dare County, North Carolina. This is the northernmost critical habitat unit within the wintering range of the piping plover. Oregon Inlet is the northernmost inlet in coastal North Carolina, approximately 19.0 km (12.0 mi) southeast of the Town of Manteo, the county seat of Dare County. The unit is bounded by the Atlantic Ocean on the east and Pamlico Sound on the west and includes lands from the mean lower low water (MLLW) on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by piping plovers and where the PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The unit begins at Ramp 4 near the Oregon Inlet Fishing Center on Bodie Island and extends approximately 8.0 km (5.0 mi) south to the intersection of NC Highway 12 and Salt Flats Wildlife Trail (near Mile Marker 30, NC Highway 12), approximately 5.0 km (3.0 mi) from the groin, on Pea Island, and includes Green Island and any emergent sandbars south and west of Oregon Inlet, and the lands owned by the State of North Carolina, specifically islands DR–005–05 and DR– 005–06. However, this unit does not include the Oregon Inlet Fishing Center, NC Highway 12, the Bonner Bridge and its associated structures, the terminal groin, the historic Pea Island Life-Saving Station, or any of their ancillary facilities (e.g., parking lots, out buildings). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. Oregon Inlet has reported consistent use by wintering piping plovers dating from the mid-1960s. As many as 100 piping plovers have been reported from a single day survey during the fall migration (NCWRC unpublished data). Christmas bird counts regularly recorded 20 to 30 plovers using the area. Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). The overall number of piping plovers reported using the area has declined since the species was listed in 1986 (NCWRC unpublished data), which corresponds to increases in the number of human users (NPS 2005) and off-road vehicles (Davis and Truett 2000). Oregon Inlet is one of the first beach access points for off-road vehicles within Cape Hatteras National Seashore when traveling from the developed coastal communities of Nags Head, Kill Devil Hills, Kitty Hawk, and Manteo. As such, the inlet spit is a popular area for off-road vehicle users to congregate. The majority of the Cape Hatteras National Seashore users in this area are off-road vehicle owners and recreational fishermen. In fact, a recent visitor use study of Cape Hatteras National Seashore reported that Oregon Inlet is the second most popular off-road vehicle use area in the park (Vogelsong 2003). Furthermore, the adjacent islands are easily accessed by boat, which can be launched from the nearby Oregon Inlet Fishing Center. Pea Island National Wildlife Refuge (PINWR) does not allow off-road vehicle use; however, Pea Island regularly receives dredged sediments from the maintenance dredging of Oregon Inlet by the Corps. The disposal of dredged sediments on PINWR has the potential to disturb foraging and roosting plovers and their habitats. As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–2: Cape Hatteras Point. Unit NC–2 consists of 262 ha (646 ac) of sandy beach and sand and mud flat habitat in Dare County, North Carolina. Cape Hatteras Point (also known as Cape Point or Hatteras Cove) is located south of the Cape Hatteras Lighthouse. The unit extends south approximately 2.8 mi (4.5 km) from the ocean groin near the old location of the Cape Hatteras Lighthouse to the point of Cape Hatteras, and then extends west 4.7 mi (7.6 km) along Hatteras Cove shoreline (South Beach) to the edge of Ramp 49 near the Frisco Campground. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by piping plovers and where PCEs do not occur). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. This unit does not include the ocean groin. Consistent use by wintering piping plover has been reported at Cape Hatteras Point since the early 1980s, but the specific area of use was not consistently recorded in earlier reports. Often piping plovers found at Cape Hatteras Point, Cape Hatteras Cove, and Hatteras Inlet were reported as a collective group. However, more recent surveys report plover use at Cape Hatteras Point independently from Hatteras Inlet. These single day surveys have recorded as many as 13 piping plovers a day during migration (NCWRC unpublished data). Christmas bird counts regularly recorded 2 to 11 plovers using the area. Cape Hatteras Point is located near the Town of Buxton, the largest community on Hatteras Island. For that reason, Cape Hatteras Point is a popular area for ORV use and recreational fishing. A recent visitor use study of the park found that Cape Hatteras Point had the most ORV use within the park (Vogelsong 2003). As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–4: Hatteras Inlet. Unit NC–4 is approximately 8.0 km (5.0 mi) long, and consists of 166 ha (410 ac) of sandy beach and inlet spit habitat on the western end of Hatteras Island and the eastern end of Ocracoke Island in Dare and Hyde Counties, North Carolina. The unit begins at the first beach access point at Ramp 55 at the end of NC Highway 12 near the Graveyard of the Atlantic Museum on the western end of Hatteras Island and continues southwest to the beach access at the ocean-side parking lot near Ramp 59 on the northeastern end of Ocracoke Island. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which itself is not used by the piping plover and where PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The Hatteras Inlet unit includes all emergent sandbars within Hatteras Inlet including lands owned by the State of North Carolina, specifically Island DR–009–03/04. The unit is adjacent to, but does not include, the Graveyard of the Atlantic Museum, the ferry terminal, the groin on Ocracoke Island, NC Highway 12, or their ancillary facilities (e.g., parking lots, out buildings). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. Hatteras Inlet has reported consistent use by wintering piping plovers since the early 1980s, but the specific area of use was not consistently recorded in earlier reports. Often piping plovers found at Cape Hatteras Point, Cape Hatteras Cove, and Hatteras Inlet were reported as a collective group. However, more recent surveys report plover use at Hatteras Inlet independently from Cape Hatteras Point. These single-day surveys have recorded as many as 40 piping plovers a day during migration (NCWRC unpublished data). Christmas bird counts regularly recorded 2 to 11 plovers using the area. Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). The overall numbers of piping plovers reported using the area has declined in the last 10 years (NCWRC unpublished data), corresponding with increases in the number of human users (NPS 2005) and off-road vehicles (Davis and Truett 2000). Hatteras Inlet is located near the Village of Hatteras, Dare County, and is the southernmost point of Cape Hatteras National Seashore that can be reached without having to take a ferry. As such, the inlet is a popular off-road vehicle and recreational fishing area. In fact, a recent visitor use study of the park found Hatteras Inlet the fourth most used area by off-road vehicles in the park (Vogelsong 2003). Furthermore, the adjacent islands are easily accessed by boat, which can be launched from the nearby marinas of Hatteras Village. As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–5: Ocracoke Island. This unit consists of 203 ha (502 ac) of sandy beach and mud and sand flat habitat in Hyde County, North Carolina. The unit includes the western portion of Ocracoke Island beginning at the beach access point at the edge of Ramp 72 (South Point Road), extending west approximately 2.1 mi (3.4 km) to Ocracoke Inlet, and then back east on the Pamlico Sound side to a point where stable, densely vegetated dune habitat meets the water. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by the piping plover and where PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The unit includes all emergent sandbars within Ocracoke Inlet. This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. The unit is adjacent to but does not include NC Highway 12, any portion of the maintained South Point Road at Ramp 72, or any of their ancillary facilities. Ocracoke Island had inconsistent recorded use by wintering piping plovers in the early 1980s, and Christmas bird counts recorded only 1 to 6 plovers using the area throughout the early 1990s. However, since the late 1990s when regular and consistent surveys of the area were conducted, as many as 72 piping plovers have been recorded during migration, and 4 to 18 plovers have been regularly recorded during the overwinter period (NCWRC unpublished data). Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). Ocracoke Inlet is located near the Village of Ocracoke, and is the southernmost point of the Cape Hatteras National Seashore. Ocracoke Island is only accessible by ferry. As such, the island is a popular destination for vacationers and locals interested in seclusion. The inlet is also a popular recreational fishing and ORV area. A recent visitor use study of the park reported Ocracoke Inlet was the third most popular ORV use area in the park (Vogelsong 2003). As a result, the primary threat to the wintering piping plover and its habitat within this unit is disturbance to and degradation of foraging and roosting areas by ORVs and by people and their pets. Therefore, sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

The lands designated as critical habitat were divided into 142 critical habitat conservation units that contain areas with the primary constituent elements for the piping plover in the wintering range of the species. These units are found in all eight States where piping plovers winter. See above for revised critical habitat in NC and TX (Units TX– 3, TX–4, TX–7, TX–8, TX–9, TX–10, TX–14, TX–15, TX–16, TX–18, TX–19, TX–22, TX–23, TX–27, TX–28, TX–31, TX–32, and TX–33).

Unit SC–1: Waites Island-North. 75 ha (186 ac) in Horry County. This unit includes the northern tip of Waites Island from the MLLW at Little River Inlet and runs west along the Atlantic Ocean shoreline 2.0 km (1.25 mi) and includes land from the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The unit continues north and west of Little River Inlet stopping at Sheephead Creek, including land from MLLW to dense vegetation line. The majority of the unit is privately owned.

Unit SC–2: Waites Island-South. 58 ha (142 ac) in Horry County.This unit includes the southern tip of Waites Island from the MLLW at Hog Inlet and runs east along the Atlantic Ocean shoreline 0.80 km (0.50 mi) and includes MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. It continues north and west of the Hog inlet, stopping at the first major tributary. Critical habitat includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Emerging sandbars within Hog Inlet and adjacent to the tip if eastern Cherry Grove Beach are also included from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begins and where the constituent elements no longer occur. The majority of this unit is privately owned.

Unit SC–3: Murrells Inlet/Huntington Beach. 135 ha (334 ac) in Georgetown County. The majority of the unit is within Huntington Beach State Park. This unit extends from the southern tip of Garden City Beach, just south of the groins (a rigid structure or structures built out from a shore to protect the shore from erosion or to trap sand) north of Murrells Inlet from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begins and where the constituent elements no longer occur stopping perpendicular with the southern end of Inlet Point Drive. It includes from MLLW south of Murrells Inlet to the northern edge of North Litchfield Beach approximately 4.5 km (3.0 mi). The unit includes the MLLW from the Atlantic Ocean up to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The lagoon at the north end of Huntington Beach State Park is also included.

Unit SC–4: Litchfield. 11 ha (28 ac) in Georgetown County. This unit includes the southern tip of Litchfield Beach beginning 0.50 km (0.30 mi) north of Midway Inlet and stopping at the MLLW at Midway Inlet. It includes from the MLLW on the Atlantic Ocean shoreline across and including land to the MLLW on the back bayside. This unit is mostly privately owned.

Unit SC–5: North Inlet. 99 ha (245 ac) in Georgetown County. The majority of the unit is within Tom Yawley Wildlife Center Heritage Preserve. This unit extends from MLLW to 1.0 km (.62 mi) north of North Inlet on Debidue Beach. It includes shoreline on the Atlantic Ocean from MLLW to the MLLW on the western side of the peninsula. This unit also includes from the MLLW south of North Inlet 1.6 km (1.0 mi). It includes the shoreline on the Atlantic Ocean from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. It includes shoreline running south and west of the inlet from the MLLW stopping at the MLLW at the first large tributary (no name).

Unit SC–6: North Santee Bay Inlet. 305 ha (753 ac) in Georgetown County. The majority of the unit is within the Tom Yawley Wildlife Center Heritage Preserve and the Santee-Delta Wildlife Management Area. This unit is at the North Santee Bay inlet and includes lands of South Island, Santee Point, Cedar Island, and all of North Santee Sandbar. This unit includes from MLLW at North Santee Bay Inlet running north along the Atlantic Ocean side of South Island 7.2 km (4.5 mi), stopping 0.60 km (0.4 mi) north of an unnamed inlet. It includes areas from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. This unit includes the eastern side of Cedar Island adjacent to the

North Santee Bay Inlet from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of North Santee Sandbar to MLLW is included.

Unit SC–7: Cape Romain. 315 ha (777 ac) in Charleston County.The majority of the unit is within Cape Romain National Wildlife Refuge. This unit includes the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur on the southern and southeastern most 1.9 km (1.2 mi) portion of Cape Island, the southernmost portion of Lighthouse Island from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur, all of Lighthouse Island South to MLLW, and the southern side of the far eastern tip of Raccoon Key from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–8: Bull Island. 134 ha (332 ac) in Charleston County. The majority of the unit is within Cape Romain National Wildlife Refuge and land owned by the South Carolina Department of Natural Resources. This unit includes from Schooner Creek on north and south of the river to north of Price's Inlet on the southern portion of Bull Island along the Atlantic Ocean 1.6 km (1.0 mi) and south of Price's Inlet on the northeast tip of Capers Island Heritage Preserve 1.4 km (.86 mi) along the Atlantic Ocean. All areas begin at MLLW and extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–9: Stono Inlet. 495 ha (1223 ac) in Charleston County.Most of this unit is privately owned. It includes the eastern end of Kiawah Island (approximately 4.0 km (2.5 mi)) from MLLW on Atlantic Ocean running north to MLLW on first large tributary connecting east of Bass Creek running northeast into Stono River. It includes MLLW up to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur along Stono Inlet and River. All of Bird Key-Stono Heritage Preserve and all of Skimmer Flats to MLLW are included. The Golf course and densely vegetated areas are not included.

Unit SC–10: Seabrook Island. 117 ha (290 ac) in Charleston County.This unit runs from just 0.16 km (0.10 mi) north of Captain Sams Inlet to the southwest approximately 3.4 km (2.1 mi) along the Atlantic Ocean shoreline. It includes land areas from the MLLW on the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Most of this unit is privately owned.

Unit SC–11: Deveaux Bank. 130 ha (322 ac) in Charleston County. The entire unit is within Deveaux Bank Heritage Preserve. This unit includes all of Deveaux Island to the MLLW and is State-owned.

Unit SC–12: Otter Island. 68 ha (169 ac) in Colleton County.The majority of the unit is within St. Helena Sound Heritage Preserve. This unit includes the southern portion of Otter Island to the eastern mouth of Otter Creek. It includes the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The entire unit is State-owned.

Unit SC–13: Harbor Island. 50 ha (122 ac) in Beaufort County. The majority of the unit is State-owned. This unit extends from the northeastern tip of Harbor Island and includes all of Harbor Spit. It begins at the shoreline east of Cedar Reef Drive running south, stopping at the mouth of Johnson Creek. It includes the MLLW on the Atlantic Ocean and St. Helena Sound to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Harber Spit to MLLW is included.

Unit SC–14: Caper's Island. 238 ha (589 ac) in Beaufort County. Most of this unit is privately owned. This unit includes the southern-most 4.5 km (2.8 mi) along the Atlantic Coast shoreline of Little Caper's Island beginning at MLLW on south side of the inlet (un-named). It includes the MLLW on the Atlantic Ocean shoreline to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–15: Hilton Head. 43 ha (106 ac) in Beaufort County. The majority of this unit is State-owned. This unit includes the northeastern tip (Atlantic Ocean side) of Hilton Head Island and all of Joiner Bank. It begins at the shoreline east of northern Planters Row and ends at the shoreline east of Donax Road. It includes the MLLW of Port Royal Sound and the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Joiner Bank to MLLW is included.

Unit GA–1: Tybee Island. 37 ha (91 ac) in Chatham County. The majority of the unit is privately owned. This unit extends along the northern tip of Tybee Island starting from 0.8 km (0.5 mi) northeast from the intersection of Crab Creek and Highway 80 to 0.7 km (0.41 mi) northeast from the intersection of Highway 80 and Horse Pen Creek. The unit includes MLLW on Savannah River and Atlantic Ocean to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit GA–2: Little Tybee Island. 719 ha (1776 ac) in Chatham County. The majority of the unit is within Little Tybee Island State Heritage Preserve. This unit extends just south of the first inlet to Wassaw Sound along the Atlantic Ocean coastline, extending north along the sound 1.7 km (1.1 mi). It includes habitat from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–3: North Wassaw Island. 108 ha (267 ac) in Chatham County. The entire unit is within Wassaw National Wildlife Refuge. This unit includes the north-east tip of Wassaw Sound, 1.6 km (1.0 mi) along the inlet side and extending south along the Atlantic Ocean shoreline for 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–4: South Wassaw Island. 61 ha (151 ac) in Chatham County. The entire unit is within Wassaw National Wildlife Refuge. This unit extends from the last southern 1.6 km (1.0 mi.) on Atlantic Ocean side, around the southern tip of Wassaw Island, up to mouth of Odingsell River. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–5: Ossabaw Island. 434 ha (1072 ac) in Chatham County. entire unit is within Ossabaw Island State Heritage Preserve. This unit includes the northeastern tip from the mouth of the Bradley River east and 12 km (7.5 mi) south along the Atlantic Ocean shoreline to a point 0.4 km

(0.25 mi) past the south-center inlet. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–6: St. Catherine's Island Bar. 54 ha (135 ac) in Liberty County. The entire unit is State owned and located east-northeast of St. Catherine's Island. This unit includes the entire St. Catherine's Island Bar to MLLW.

Unit GA–7: McQueen's Inlet. 215 ha (532 ac) in Liberty County. The majority of the unit is private land along the eastern-central coastline on St. Catherine's Island. This unit extends from McQueen's Inlet north approximately 3.5 km (2.2 mi) and south approximately 1.8 km (1.1 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–8: St. Catherine's Island. 60 ha (147 ac) in Liberty County. The majority of the unit is private land on the southern tip of St. Catherine's Island. This unit starts 1.2 km (0.75 mi) north of Sapelo Sound (along Atlantic Ocean shoreline) and stops inland at Brunsen Creek. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–9: Blackbeard Island. 129 ha (319 ac) in McIntosh County. The entire unit is within the Blackbeard Island National Wildlife Refuge. This unit includes the northeastern portion of the island beginning just east of the mouth of the confluence of McCloy Creek and Blackbeard Creek and continuing east and running south along the Atlantic Ocean shoreline for 1.4 km (.90 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–10: Sapelo Island. 85 ha (210 ac) in McIntosh County. The entire unit is State-owned and within Sapelo Island. The unit extends south of Cabretta Tip approximately 0.2 km (0.13 mi) and north of Cabretta Tip 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–11: Wolf Island. 238 ha (590 ac) in McIntosh County. The majority of the unit is within Wolf Island National Wildlife Refuge and private lands just north of the Refuge. This unit includes the southeastern tip of Queen's island adjacent to the Doboy Sound and includes the eastern shoreline of Wolf Island. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–12: Egg Island Bar. 61 ha (151 ac) in McIntosh County. This unit is State owned and includes all of Egg Island Bar to the MLLW.

Unit GA–13: Little St. Simon's Island. 609 ha (1505 ac) in Glynn County. The majority of the unit is private land on Little St. Simon's Island. This unit includes the entire eastern coastline along Little St. Simon's Island. It begins 1.1 km (.70 mi) west of the northeast tip of Little St. Simon's Island and runs east and then south along the Atlantic Ocean shoreline stopping at the minor tributary (no name) on the southeast tip of Little St. Simon's Island north of Hampton Creek. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Pelican Spit to MLLW is included when this sand bar is emergent.

Unit GA–14: Sea/St. Simon's Island. 191 ha (471 ac) in Glynn County. The majority of the unit is private land on the south tip of Sea Island and on the east beach of St. Simons Island. This unit extends north of Gould's Inlet (Sea Island) 2.5 km (1.54 mi) starting just south of the groin and extends south of Gould's Inlet (St. Simons Island) 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–15: Jekyll Island. 49 ha (121 ac) in Glynn County. The majority of the unit is within State lands on Jekyll Island. This unit includes the southern region of Jekyll Island beginning at the mouth of Beach Creek, running towards the tip of Jekyll Island and includes the shoreline running north along the Atlantic Ocean shoreline 1.9 km (1.20 mi) from the southern tip of Jekyll Island. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–16: Cumberland Island. 1454 ha (3591 ac) in Camden County. The majority of the unit is along Cumberland Island Wilderness Area and Cumberland Island National Seashore. This unit includes the majority of the eastern Atlantic Ocean shoreline of Cumberland Island. It begins .50 km (.31 mi) north of the inlet at Long Point, continues south along the Atlantic Ocean shoreline stopping 1.8 km (1.1 mi) west of the southern tip of Cumberland Island National Seashore. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Escambia County. The majority of the unit is within Big Lagoon State Recreation Area. This unit includes the peninsula and emerging sand and mudflats between 0.33 km (0.21 mi) west of the lookout tower along the shoreline and 0.24 km (0.15 mi) east of the lookout tower along the shoreline. Land along the shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All emerging sandbars to MLLW are included.

Unit FL–2: Big Sabine. 182 ha (450 ac) in Escambia County. The majority of the unit is owned by the University of West Florida. This unit includes areas adjacent to Santa Rosa Sound of Big Sabine Point and adjacent embayment between 8.0 km (5.0 mi) and 11.6 (7.2 mi) east of the Bob Sike's Bridge. It begins 0.10 km (.06 mi) north of SR 399 to MLLW on the Santa Rosa Sound.

Unit FL–3: Navarre Beach. 48 ha (118 ac) in Escambia and Santa Rosa Counties. The majority of the unit is owned by Eglin Air Force Base and Santa Rosa Island Authority. This unit includes lands on Santa Rosa Island Sound side, between 0.09 and 0.76 mi east of the eastern end of SR 399 to MLLW on Santa Rosa Sound side.

Unit FL–5: Shell/Crooked Islands. 1789 ha (4419 ac) in Bay County.The majority of the unit is within Tyndall Air Force Base and St. Andrews State Recreation Area. This unit includes all of Shell Island, Crooked Island West, and Crooked Island East from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–6: Upper St. Joe Peninsula. 182 ha (449 ac) in Gulf County.The majority of the unit is within St. Joseph State Park. This unit includes the northern portion of the peninsula from the tip to 8.0 km (5.0 mi) south along the Gulf of Mexico from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–7: Cape San Blas. 158 ha (390 ac) in Gulf County.The entire unit is within Eglin Air Force Base. This unit includes the area known as the Cape between the eastern boundary of Eglin and mile marker 2.1, including the peninsula and all emerging sandbars. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–8: St. Vincent Island. 146 ha (361 ac) in Franklin County.The majority of the unit is within St. Vincent National Wildlife Refuge. This unit includes the western tip of St. Vincent Island that is adjacent to Indian Pass (0.80 km (0.50 mi) east of tip along Indian Pass, and 1.9 km (1.2 mi) from tip southeast along Gulf of Mexico). The unit also includes St. Vincent Point from the inlet at Sheepshead Bayou east 1.6 km (1.0 mi) to include emerging oysters shoals and sand bars and extends south 0.21 km (0.13 mi) of St. Vincent Point. The unit includes the southeastern tip of St. Vincent Island extending north 1.4 km (0.90 mi) and south and west 2.1 km (1.3 mi). The western tip of Little St. George Island 0.80 km (0.50 mi) from West Pass is included (state owned lands). All sections of this unit include land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–9: East St. George Island. 1433 ha (3540 ac) in Franklin County. The majority of the unit is within St. George State Park. This unit begins 5.3 km (3.3 mi) east of the bridge and extends to East Pass. Shell Point, Rattlesnake Cove, Goose Island, East Cove, Gap Point, and Marsh Island are included. This unit includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur on the Gulf of Mexico, East Pass and St. George Sound.

Unit FL–10: Yent Bayou. 153 ha (378 ac) in Franklin County. The majority of the unit is State owned. This unit is adjacent to the area known as Royal Bluff. It includes the St. George Sound shoreline between 5.9 km (3.7 mi) and 9.5 km (5.9mi) east of SR 65. It includes from MLLW to where densely vegetated habitat or developed structures such as SR 65, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–11: Carabelle Beach. 56 ha (139 ac) in Franklin County. The area within this unit is privately owned. This unit is the peninsula created by Boggy Jordan Bayou. It includes St. George Sound shoreline (south of US 98) 1.6 km (1.0 mi) southwest along US 98 from the Carrabelle River Bridge and extends 1.9 km (1.2 mi) east along the St. George Sound shoreline. It includes from MLLW to where densely vegetated habitat or developed structures such as US 98, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–12: Lanark Reef. 260 ha (643 ac) in Franklin County. The entire unit is State owned. This unit includes the entire island and emerging sandbars to MLLW.

Unit FL–13: Phipps Preserve. 42 ha (104 ac) in Franklin County. This unit includes all of Phipps Preserve (owned by The Nature Conservancy) and any emerging sandbars from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–14: Hagens Cove. 486 ha (1200 ac) in Taylor County. The majority of the unit is within Big Bend Wildlife Management Area. This unit includes all of Hagens Cove and extends from MLLW on north side of Sponge Point to MLLW on south side of Piney Point. The eastern boundary of this unit ends (0.20 mi) west of SR 361. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–15: Anclote Key and North Anclote Bar. 146 ha (360 ac) in Pasco and Pinellas Counties. The majority of the unit is within Anclote Key State Preserve. This unit includes all of North Anclote Bar to the MLLW and the north, south and western sides of Anclote Key from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–16: Three Rooker Bar Island. 76 ha (188 ac) in Pinellas County. The majority of the unit is within Pinellas County Aquatic Preserve. This unit includes all the islands and emerging sandbars of this complex to MLLW.

Unit FL–17: North Honeymoon Island. 45 ha (112 ac) in Pinellas County. The majority of the unit is within Honeymoon Island State Recreation Area. This unit includes from Pelican Cove north to the far northern tip of Honeymoon Island. It includes the western shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur or the MLLW on the eastern shoreline.

Unit FL–18: South Honeymoon Island. 28 ha (70 ac) in Pinellas County.The majority of the unit is private land. This unit includes the southern end (southern-most 0.32 km (0.20 mi) on western side) of Honeymoon Island and encompasses the far southeastern tip and includes any emerging islands or sandbars to Hurricane Pass. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–19: Caladesi Island. 120 ha (296 ac) in Pinellas County.The majority of the unit is within Caladesi Island State Park. This unit extends from Hurricane Pass to Dunedin Pass on the Gulf of Mexico side. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–20: Shell Key and Mullet Key. 190 ha (470 ac) in Pinellas County. The majority of the unit is within Fort Desoto Park. This unit includes the Shell Key island complex. It also includes the northwest portion of Mullet Key including the western shorelines from Bunces Pass extending south, stopping 1.4 km (.86 mi) north of Ft. Desoto County Park pier. It includes from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–21: Egmont Key. 153 ha (377 ac) Hillsborough County. The majority of the unit is within Egmont Key National Wildlife Refuge. This unit includes the entire island to MLLW.

Unit FL–22: Cayo Costa. 175 ha (432 ac) in Lee County. The majority of the unit, including its northern and southern boundaries, is within Cayo Costa State Park, and nearly all of the remaining area is in the Cayo Costa Florida Conservation and Recreation Lands (CARL) acquisition project. This unit begins at the northern limit of sandy beaches at the northern end of the island, extends through Murdock Point, which at present has a sandbar and lagoon system, and ends at the former entrance to Murdock Bayou. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–23: North Captiva Island. 36 ha (88 ac) in Lee County.The unit is within the Cayo Costa CARL land purchase project. This unit includes the western shoreline extending from 0.80 km (0.50 mi) south of Captiva Pass to approximately Foster Bay. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–25: Bunche Beach. 187 ha (461 ac) in Lee County. This unit is mostly within a CARL Estero Bay acquisition project. Bunche Beach (also spelled Bunch) lies along San Carlos Bay, on the mainland between Sanibel Island and Estero Island (Fort Myers Beach), extending east from the Sanibel Causeway past the end of John Morris Road to a canal serving a residential subdivision. The unit also includes the western tip of Estero Island (Bodwitch Point, also spelled Bowditch Point), including Bowditch Regional Park, operated by Lee County and, on the southwest side of the island facing the Gulf, the beach south nearly to the northwesterly intersection of Estero Boulevard and Carlos Circle. It includes land from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur or, along the developed portion of Estero Island.

Unit FL–26: Estero Island. 86 ha (211 ac) in Lee County. The majority of the unit is privately owned. The unit consists of approximately the southern third of the island's Gulf-facing shoreline starting near Avenida Pescadora to near Redfish Road. The unit excludes south-facing shoreline at the south end of the island that faces Big Carlos Pass rather than the Gulf. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–27: Marco Island. 245 ha (606 ac) in Collier County. Most of the unit is at the Tigertail Beach County Park. The unit's northern border is on the north side of Big Marco Pass, including Coconut Island and all emerging sand bars. On the south side of Big Marco Pass, the boundary starts at the north boundary of Tigertail Beach County Park and extends to just south of the fourth condominium tower south of the County Park. The placement of the southern boundary assures that the unit includes all of Sand Dollar Island, the changeable sandbar off Tigertail Beach. The western boundary includes all the sand bars in Big Marco Pass but excludes Hideaway Beach. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–28: Marquesas Keys. 2,937 ha (7,256 ac) in Monroe County. The unit comprises the roughly circular atoll that encloses Mooney Harbor, including Gull Keys and Mooney Harbor Key. The entire unit is within Key West National Wildlife Refuge. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–29: Boca Grande/Woman/ Ballast Keys. 56 ha (138 ac) in Monroe County. These Keys are east of the Marquesas Keys and west of Key West. Boca Grande and Woman Keys are within Key West National Wildlife Refuge. Ballast Key is privately owned. This unit consists only of sandy beaches and flats between the MLLW and to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–30: Bahia Honda/Ohio Keys. 372 ha (918 ac) in Monroe County. This unit comprises Bahia Honda Key (including a small island off its southwest shore), which is almost entirely owned by Bahia Honda State Park, plus Ohio Key, which is privately owned. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–31: Lower Matecumbe Key. 19 ha (48 ac) in Monroe County. Part of the unit is at Anne's Beach park, an Islamorada village park. The remaining parts are at Sunset Drive (Lower Matecumbe Beach) and at Costa Bravo Drive (Port Antiqua Homeowners Beach) on the Florida Bay side of the island. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–32: Sandy Key/Carl Ross Key. 67 ha (165 ac) in Monroe County. This unit consists of two adjoining islands in Florida Bay, roughly south of Flamingo in Everglades National Park. The entire area is owned and managed by the National Park Service. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–33: St. Lucie Inlet. 114 ha (282 ac) in Martin County. The unit includes a small area south of the jetty on the north shore of St. Lucie Inlet, from the jetty west 0.42 km (0.26 mi). While the two sides of the inlet are privately owned, the great majority of the unit is on public land in the Saint Lucie Inlet State Preserve, administered by Jonathan Dickinson State Park. It begins on the sandy shoreline south of Saint Lucie Inlet and extends along the Atlantic Ocean shoreline 2.6 km (1.6 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur. The unit does not include sandbars within the inlet.

Unit FL–34: Ponce de Leon Inlet. 68 ha (168 ac) in Volusia County. The majority of the unit is within Smyrna Dunes Park and Lighthouse Point Park. This unit includes shoreline extending from the jetty north of Ponce de Leon Inlet west to the Halifax River and Inlet junction. It includes shoreline south of Ponce de Leon Inlet from the inlet and Halifax River junction, extending east and south along the Atlantic Ocean shoreline 1.2 km (.70 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–35: Nassau Sound-Huguenot. 950 ha (2347 ac) in Duval County. The majority of the unit is within Big Talbot Island State Park, Little Talbot Island State Park, and the Timucuan Ecological and Historical Preserve. This unit includes all emergent shoals and shoreline east of Nassau River bridge and extends to the inlet of the St. John's River. Amelia Island and the northern 2.7 km (1.7 mi) shoreline along Talbot Island are not included. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–36: Tiger Islands. 53 ha (130 ac) in Nassau County. This unit is privately owned. This unit extends from the mouth of Tiger Creek and runs north along Tiger Island 0.8 km (0.5 mi) and south along Little Tiger Island 1.4 km (0.9 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur. Emerging sandbars to MLLW are also included.

Unit AL–1: Isle Aux Herbes. 227 ha (561 ac) in Mobile County. This unit includes the entire Isle Aux Herbes island where primary constituent elements occur to MLLW and is Stateowned.

Unit AL–2: Dauphin, Little Dauphin, and Pelican Islands. 880 ha (2,174 ac) in Mobile County. This unit includes all of Dauphin Island where primary constituent elements occur from St. Stephens Street approximately 17.6 km (10.9 mi) west to the western tip of the island to MLLW and all of Little Dauphin and Pelican Islands to MLLW. The area is mostly privately owned but includes State and Federal lands.

Unit AL–3: Fort Morgan. 67 ha (166 ac) in Baldwin County. This area includes Mobile Bay and Gulf of Mexico shorelines within Bon Secour National Wildlife Refuge, Fort Morgan Unit. This unit extends from the west side of the pier on the northwest point of the peninsula, following the shoreline approximately 2.8 km (1.74 mi) southwest around the tip of the peninsula, then east to the terminus of the beach access road and is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The area is State-owned but is leased by the Federal Government.

Unit MS–1: Lakeshore through Bay St. Louis. 41 ha (101 ac) in Hancock County. This unit extends from the north side of Bryan Bayou outlet and includes the shore of the Mississippi Sound following the shoreline northeast approximately 15.0 km (9.3 mi) and ending at the southeast side of the Bay Waveland Yacht Club. The landward boundary of this unit follows the Gulf side of South and North Beach Boulevard and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–2: Henderson Point. 34 ha (84 ac) in Harrison County. This unit extends from 0.2 km (0.12 mi) west of the intersection of 3rd Avenue and Front Street and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.4 km (2.7 mi) to the west side of Pass Christian Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–3: Pass Christian. 77 ha (190 ac) in Harrison County. This unit extends from the east side of Pass Christian Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 10.5 km (6.5 mi) to the west side of Long Beach Pier and Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–4: Long Beach. 38 ha (94 ac) in Harrison County. This unit extends from the east side of Long Beach Pier and Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.4 km (2.7 mi) to the west side of Gulfport Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–5: Gulfport. 39 ha (96 ac) in Harrison County. This unit extends from the east side of Gulfport Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.8 km (3.0 mi) to the west side of the groin at the southern terminus of Courthouse Road, Mississippi City, MS. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–6: Mississippi City. 62 ha (153 ac) in Harrison County. This unit extends from the east side of the groin at the southern terminus of Courthouse Road, Mississippi City, MS, and includes the shore of the Mississippi Sound following the shoreline northeast approximately 7.9 km (4.9 mi) to the west side of President Casino. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–10: Ocean Springs West. 11 ha (27 ac) in Jackson County. This unit extends from U.S. 90 and includes the shore of Biloxi Bay following the shoreline southeast approximately 1.9 km (1.2 mi) to the Ocean Springs Harbor inlet. The landward boundary of this unit follows the Bay side of Front Beach Drive and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–11: Ocean Springs East. 7 ha (17 ac) in Jackson County. This unit extends from the east side of Weeks Bayou and includes the shore of Biloxi Bay following the shoreline southeast approximately 1.8 km (1.1 mi) to Halstead Bayou. The landward boundary of this unit follows the Bay side of East Beach Drive and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–12: Deer Island. 194 ha (479 ac) in Harrison County. This unit includes all of Deer Island, where primary constituent elements occur to the MLWW . Deer Island is privately owned.

Unit MS–13: Round Island. 27 ha (67 ac) in Jackson County. This unit includes all of Round Island to the MLWW and is privately owned.

Unit MS–14: Mississippi Barrier Islands. 3,168 ha (7,828 ac) in Harrison and Jackson Counties. This unit includes all of Cat, East and West Ship, Horn, Spoil, and Petit Bois Islands where primary constituent elements occur to MLLW. Cat Island is privately owned, and the remaining islands are part of the Gulf Islands National Seashore.

Unit MS–15: North and South Rigolets. 159 ha (393 ac) in Jackson County, MS, and 12 ha (30 ac) in Mobile County, AL. This unit extends from the southwestern tip of South Rigolets Island and includes the shore of Point Aux Chenes Bay, the Mississippi Sound, and Grand Bay following the shoreline east around the western tip, then north to the south side of South Rigolets Bayou; then from the north side of South Rigolets Bayou (the southeastern corner of North Rigolets Island) north to the northeastern most point of North Rigolets Island. This shoreline is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Approximately 4.4 km (2.7 mi) are in Mississippi and 2.9 km (1.8 mi) are in Alabama. Almost half the Mississippi shoreline length is in the Grand Bay National Wildlife Refuge.

Unit LA–1: Texas/Louisiana border to Cheniere au Tigre. 2,650 ha (6,548 ac) in Cameron and Vermilion Parishes. This unit extends from the east side of Sabine Pass (Texas/Louisiana border) and includes the shore of the Gulf of Mexico from the MLLW following the shoreline east 25.7 km (16.0 mi) to the west end of Constance Beach [approximately 2 km (1.2 mi) east of the intersection of Parish Road 528 and the beach]; it extends from the east end of the town of Holly Beach [0.25 km (0.16 mi) east of the intersection of Baritarick Boulevard and the beach] following the shoreline approximately 97 km (60.3 mi) east to the eastern boundary line of Rockefeller Wildlife Refuge [3.4 km (2.1 mi) east of Rollover Bayou]; and it extends from the east side of Freshwater Bayou Canal following the shoreline east for approximately 15 km (9.3 mi) to 1.3 km (0.81 mi) east of where the boundary of Paul J. Rainey Wildlife Sanctuary (National Audubon Society) meets the shoreline. All three sections of this unit include the land from the seaward boundary of MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The shoreline in this unit is both state and privately owned.

Unit LA–2: Atchafalaya River Delta. 921 ha (2,276 ac) in St. Mary Parish, LA. This unit is located in the eastern portion of the State-owned Atchafalaya Delta Wildlife Management Area (WMA) and includes all exposed land and islands where primary constituent elements occur east and southeast of the main navigation channel of the Atchafalaya River to the MLLW. The islands located south and southeast of the deltaic splay, Donna, T-Pat, and Skimmer Islands and the un-named bird island, are also included in this unit. This unit includes the entire islands where primary constituent elements occur to the MLLW.

Unit LA–3: Point Au Fer Island. 195 ha (482 ac) in Terrebonne Parish. This unit includes the entire small island at the northwest tip of Point Au Fer Island to MLLW, then extends from the northwest tip of Point Au Fer Island following the shoreline southeast approximately 7.7 km (4.8 mi) to the point where the un-named oil and gas canal extending southeast from Locust Bayou meets the shoreline [0.8 km (0.5 mi) southeast from Locust Bayou]. This shoreline is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. This entire unit is privately owned.

Unit LA–4: Isles Dernieres. 795 ha (1,964 ac) in Terrebonne Parish. This unit includes the State-owned Isles Dernieres chain, including Raccoon, Whiskey, Trinity and East Islands. This unit includes the entire islands where primary constituent elements occur to the MLLW.

Unit LA–5: Timbalier Island to East Grand Terre Island. 2,321 ha (5,735 ac) in Terrebonne, Lafourche, Jefferson, and Plaquemines Parishes. This unit includes: all of Timbalier Island where primary constituent elements occur to the MLLW, all of Belle Pass West [the ‘‘peninsula’’ extending north/northwest approximately 4.8 km (3.0 mi) from the west side of Belle Pass] where primary constituent elements occur to MLLW; the Gulf shoreline extending approximately 11 km (6.8 mi) east from the east side of Belle Pass bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur; all of Elmers Island peninsula where primary constituent elements occur to MLLW and the Gulf shoreline from Elmers Island to approximately 0.9 km (0.56 mi) west of Bayou Thunder Von Tranc bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur; the Gulf shoreline of Grand Isle from the Gulf side of the hurricane protection levee to MLLW; and all of East Grand Terre Island where primary constituent elements occur to the MLLW.

Unit LA–6: Mississippi River Delta. 105 ha (259 ac) in Plaquemines Parish, LA. This unit is part of the State-owned Pass a Loutre Wildlife Management Area and includes un-named sand (spoil) islands off South Pass of the Mississippi River near Port Eads. The entire islands to MLLW are included in this unit.

Unit LA–7: Breton Islands and Chandeleur Island Chain. 3,116 ha (7,700 ac) in Plaquemines and St. Bernard Parishes, LA. This unit includes Breton, Grand Gosier, and Curlew Islands and the Chandeleur Island chain. Those islands are part of the Breton National Wildlife Refuge or are state owned. The entire islands where primary constituent elements occur to MLLW are included in this unit.

Unit TX–1: South Bay and Boca Chica. 2,920 ha (7,217 ac) in Cameron County. The boundaries of the unit are: starting at the Loma Ochoa, following the Brownsville Ship Channel to the northeast out into the Gulf of Mexico to MLLW, then south along a line describing MLLW to the mouth of the Rio Grande, proceeding up the Rio Grande to Loma de Las Vacas, then from that point along a straight line north to Loma Ochoa. The unit does not include densely vegetated habitat within those boundaries. It includes wind tidal flats that are infrequently inundated by seasonal winds, and includes the tidal flats area known as South Bay. Beaches within the unit reach from the mouth of the Rio Grande northward to Brazos Santiago Pass, south of South Padre Island. The southern and western boundaries follow the change in habitat from wind tidal flat, preferred by the piping plover, to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include areas used for roosting by the piping plover. Portions of this unit are owned and managed by the Lower Rio Grande Valley National Wildlife Refuge, the South Bay Coastal Preserve, Boca Chica State Park, and private citizens.

Unit TX–2: Queen Isabella Causeway. 2 ha (6 ac) in Cameron County. The area extends along the Laguna Madre west of the city of South Padre Island. The southern boundary is the Queen Isabella State Fishing Pier, and the northern boundary is at the shoreline due west of the end of Sunny Isles Street. The Queen Isabella causeway bisects this shore but is not included within critical habitat. The eastern boundary is the where developed areas and/or dense vegetation begins, and the western boundary is MLLW. This unit contains lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–5: Upper Laguna Madre. 436 ha (1,076 ac) in Kleberg County. The southern boundary is the northern boundary of PAIS, and the northern boundary is the Kleberg/Nueces County line. The eastern boundary is the line where dense vegetation begins, and the western boundary is MLLW. This unit includes a series of small flats along the bayside of Padre Island in the Upper Laguna Madre. It includes wind tidal flats and sparsely-vegtated upland areas used for roosting by the piping plover. These boundaries receive heavy use by large numbers of shorebirds, including piping plovers. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur, and include upland areas used for roosting by the piping plover.

Unit TX–6: Mollie Beattie Coastal Habitat. 241 ha (596 ac) in Nueces County. This unit will be described as two subunits: (1) Subunit is bounded on the north by Beach Access Road 3, on the east by the inland boundary of critical habitat Unit TX–7, on the south by Zahn road, and on the west by Zahn Road. (2) The subunit is bounded on the north by Corpus Christi Pass, on the east by US 361, on the south by the north side of Packery Channel, and on the west by the Gulf Intercoastal Watersay. Some of the uplands are privately owned and the remaining are owned and managed by the TGLO. This unit includes two hurricane washover passes known as Newport and Corpus Christi Passes, and wind tidal flats that are infrequently inundated by seasonal winds. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include upland areas used for roosting by the piping plover.

Unit TX–11: Blind Oso. 2 ha (5 ac) in Nueces County. This unit is the flats of the Blind Oso, part of Oso Bay, from Hans and Pat Suter Wildlife Refuge (owned and managed by the City of Corpus Christi) northeast to Corpus Christi Bay and then southeast along the edge of Texas A&M University—Corpus Christi. The landward boundaries extend to where densely vegetated habitat, not used by the piping plover, begins, and extends out from the landward boundaries to MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–12: Adjacent to Naval Air Station-Corpus Christi. 2 ha (6 ac) in Nueces County. This unit is along the shore of Oso Bay on flats bordered by Naval Air Station-Corpus Christi and Texas Spur 3 to a point 2.5 km (1.5 mi) south of the bridge between Ward Island and the Naval Air Station. The landward boundary is the line where dense vegetation begins, and the boundary in the Bay is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–13: Sunset Lake. 176 ha (435 ac) in San Patricio County. This unit is triangle shaped, with State Highway 181 as the northwest boundary, and the limits of the City of Portland as the northeast boundary. The shore on Corpus Christi Bay is the third side of the triangle, with the actual boundary being MLLW off this shore. This unit is a large basin with a series of tidal ponds, sand spits and wind tidal flats. This unit is owned and managed by the City of Portland within a system of city parks. Some of the described area falls within the jurisdiction of the TGLO. It includes two city park units referred to as Indian Point and Sunset Lake. Much of the unit is a recent acquisition by the city, and management considerations for the park include the area’s importance as a site for wintering and resident shorebirds. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–17: Allyn's Bight. 5 ha (14 ac) in Aransas County. This unit includes shoreline of San Jose Island on Aransas Bay from Allyn's Bight to Blind Pass, the channel between San Jose Island and Mud Island. The inland boundary is where the line of dense vegetation begins, and the bay-ward boundary is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–20: Ayers Point. 397 ha (982 ac) in Calhoun County. This unit is an unnamed lake on Matagorda Island between Shell Reef Bayou and Big Brundrett Lake, with San Antonio Bay to the north. The unit boundary extends landward from the lake to the line where dense vegetation begins and where the constituent elements no longer occur and includes upland areas used for roosting by the piping plover. This unit includes marsh and flats at Ayers Point on Matagorda Island National Wildlife Refuge. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–21: Panther Point to Pringle Lake. 863 ha (2,133 ac) in Calhoun County. This unit represents a narrow band of bayside habitats on Matagorda Island from Panther Point to the northeast end of Pringle Lake. The landward boundary is the line indicating where dense vegetation begins, and the bayward boundary is MLLW. The unit is entirely within Matagorda Island National Wildlife Refuge. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–24: West Matagorda Bay/ Western Peninsula Flats. 756 ha (1,868 ac) in Matagorda County. This unit extends along the bayside of Matagorda Peninsula from 7.5 southwest of Greens Bayou to 2.5 km (1.6 mi) northwest of Greens Bayou. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–25: West Matagorda Bay/ Eastern Peninsula Flats. 232 ha (575 ac) in Matagorda County. This unit follows the bayside of Matagorda Peninsula from Maverick Slough southwest for 5 km (3 mi). The unit begins at Maverick Slough to the northeast and extends 5 km (3 mi) to the southwest, enclosing a series of flats along Matagorda Bay. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–26: Colorado River Diversion Delta. 5 ha (13 ac) in Matagorda County. This unit consists follows the shore of the extreme eastern northeast corner of West Matagorda Bay from Culver Cut to Dog Island Reef. The southeastern tidally emergent portion of Dog Island Reef is included within the unit. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. The upland areas includes upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–29: Brown Cedar Cut. 119 ha (294 ac) in Matagorda County. This unit extends 2 km (1.2 m.) both southwest and northeast of the main channel of Brown Cedar Cut along the bayside of Matagorda Peninsula in East Matagorda Bay, and abuts unit TX–28 to the southeast. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. The eastern boundary of TX–29 follows the change in habitat from mud flats preferred by the piping plover, to slightly vegetated dune system adjacent to TX–28. This unit includes upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–30: Northeast Corner East Matagorda Bay. 120 ha (297 ac) in Matagorda County. This is a unit bounded on the north by the Gulf Intercoastal Waterway, on the east by the northeast limit of Matagorda bay up the line where dense vegetation begins, on the south by the boundary of Unit TX–28, and on the west by MLLW. It is a system of flats associated with tidal channels. This unit includes upland areas used for roosting by the piping plover and lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–34: San Luis Pass. 110 ha (272 ac) near the Brazoria/Galveston County line. This unit extends along the Gulf side of Galveston Island from San Luis Pass to the cite of the former town of Red Fish Cove (USGS 1:24,000 map, San Luis Pass, Texas; 1963, photorevision 1974). The landward boundary is the line indicating the beginning of dense vegetation, and the gulfside boundary is MLLW. Approximately 57 percent of the unit includes flats in the floodtide delta that are State-owned and managed by the TGLO. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–35: Big Reef. 47 ha (117 ac) in Galveston County. This unit consists of beach and sand flats on the north, west, and east shore of Big Reef, down to MLLW. South Jetty is not included. The area is currently managed by the City of Galveston. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–36: Bolivar Flats. 160 ha (395 ac) in Galveston County. This unit extends from the jetties on the southwest end of the Bolivar Peninsula to a point on the Gulf beach 1 km (0.6 mi) north of Beacon Bayou. It includes 5.0 km (3 mi) of Gulf shoreline. The landward boundary is the line indicating the beginning of dense vegetation, and the gulfside boundary is MLLW. The area is leased from TGLO by Houston Audubon Society and managed for its important avian resources. The upland areas are used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–37: Rollover Pass. 6 ha (16 ac) in Galveston County. This unit consists of Rollover Bay on the bayside of Bolivar Peninsula. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. It includes flats on State-owned land managed by the TGLO. This unit captures the intertidal complex of the bay, and is bounded by the towns of Gilchrist to the east and the Gulf beach of the Bolivar Peninsula to the south. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

The critical habitat designation for the northern Great Plains breeding population of Charadrius melodus circumcinctus includes 19 units totaling approximately 183,422 ac (74,228.4 ha) of habitat in Minnesota, Montana, and North Dakota, and approximately 1,207.5 mi (1,943.3 km) of river in Montana, North Dakota, South Dakota, and Nebraska (67 FR 57638 - 57717).

Minnesota: Unit MN–1, Rocky Point, Pine and Curry Island, and Morris Point—This unit includes approximately 235.2 ac (95.1 ha) of unique habitat, including sparsely vegetated windswept islands, peninsulas, and sandy points or spits that interface with Lake of the Woods in Lake of the Woods County. Although this unit is small in size, there have been up to 50 plovers found during the breeding season. Numbers have declined since the mid-1980s and there is a continued need for habitat and predator management. This unit represents the most eastern portion of the northern Great Plains population of breeding piping plovers and may be an important link between the Great Lakes and northern Great Plains breeding populations. It is the only remaining breeding site for piping plovers in Minnesota. Approximately 100.4 ac (40.6 ha) are designated within the 697- ac (282.3-hectare) Rocky Point Wildlife Management Area, which is in public ownership, managed by the Minnesota Department of Natural Resources. Rocky Point is located just east of Arneson on Lake of the Woods. Unit 1 also includes approximately 134.8 ac (54.5 ha) within the Pine and Curry Island Scientific and Natural Area which is in public ownership, managed by the Minnesota Department of Natural Resources. Pine and Curry Island Scientific and Natural Area includes approximately 112.6 ac (45.6 ha) of a sandy barrier island (Pine and Curry Island) and 22.2 ac (8.9 ha) of an adjacent peninsula (Morris Point) located at the mouth of the Rainy River on Lake of the Woods.

Montana: Unit MT–1, Sheridan County—This unit includes approximately 19,222.9 ac (7,779.4 ha) of 20 alkali lakes and wetlands in Sheridan County, located in the extreme northeast corner of Montana. These alkali lakes and wetlands are characterized as follows— shallow, seasonally to permanently flooded; mixosaline to hypersaline chemistry; sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; 200 ft (61 m) of uplands above the wetlands' high water mark including springs and fens, which provide foraging and protective habitat for piping plovers. Sites included in this unit are occupied by piping plovers. This unit requires special management including increasing reproductive success through predator exclusion devices, such as nest cages and electric fences, and reducing vegetation encroachment on nesting beaches through prescribed burning or grazing. Essential breeding habitat is dispersed throughout this unit which represents the largest portion (approximately 66 percent) of the plovers surveyed in Montana. This unit also links similar habitat in Canada and North Dakota. Approximately 5,571 ac (2,254.5 ha) are in private ownership and 13,651.9 ac (5,524.8 ha) are in public ownership. Of the lands in public ownership, 13,356.8 ac (5,405.4 ha) are in Federal ownership and 295.1 ac (119.4 ha) are in State ownership. Federal lands designated include piping plover populations on Medicine Lake National Wildlife Refuge and several Waterfowl Production Areas, both owned and managed by the Service. State lands designated include land owned and managed by the Montana Department of Natural Resources and Conservation. Unit MT–4, Bowdoin National Wildlife Refuge—This unit encompasses approximately 3,294.5 ac (1,333.2 ha) on Bowdoin National Wildlife Refuge with sparsely vegetated shoreline beaches, peninsulas, and islands composed of sand gravel, or shale that interface with these water bodies. The site is located in east-central Phillips County, approximately 170.8 mi (275 km) west of the North Dakota border and 37.3 mi (60 km) south of Canada. This unit represents the western edge of the northern Great Plains breeding population of the piping plover and requires special management including water level and predator management. Bowdoin National Wildlife Refuge is in public ownership (Federal) and managed by the Service. Lake Bowdoin is an off stream facility receiving water from the Milk River.

Nebraska: Unit NE–1, Platte, Loup, and Niobrara Rivers—This unit encompasses approximately 440 mi (707.9 km) of river. The river habitat includes sparsely vegetated channel sandbars, sand and gravel beaches on islands within the high bank for nesting, temporary pools on sandbars and islands, and the interface of sand and river where plovers forage. All three of these rivers are occupied by and provide essential habitat for the piping plover. Niobrara River—The Niobrara River is a tributary of the Missouri River, originating in Wyoming and flowing through the northern part of the Nebraska Sandhills region. The portion of the Niobrara included in as Critical Habitat starts at the bridge south of Norton, Nebraska, and extends downstream 120 mi (193 km) to its confluence with the Missouri River. The Niobrara River is one of the most undeveloped rivers in the northern Great Plains and represents one of the last rivers with largely untouched piping plover habitats. The source of water for this river is largely groundwater discharge which helps to provide a year-round base flow with few flood events which are essential to successful plover nesting. Essential nesting habitat is dispersed throughout this unit and this unit represents about 36 percent of Nebraska's plover population. Five miles of the Niobrara are within the Ponca Tribe reservation boundary. In 1991, Congress designated 76 mi (122.3 km) of the Niobrara River as a ''National Scenic River,'' 50 mi (80.5 km) of which are included in the Critical Habitat designation. The National Scenic River reach ends where Highway 137 crosses the river. The Nature Conservancy owns and manages 9.5 mi (15.3 km) along the Niobrara River that falls within both the National Scenic River reach and the piping plover Critical Habitat. Other ownership and interests are principally private. The primary land use along the Niobrara River is farming (east along the river) and ranching (west along the river). Loup River—The Loup River flows 68 mi (109.4 km) to its confluence with the Platte River near Columbus. Ownership interests within this reach of Critical Habitat are primarily private. Habitat on the Loup River designation is part of the larger Platte River watershed and provides productive habitat for piping plovers. The Loup River is one of the Platte River's principal tributaries. Platte River—The North and Middle Platte Rivers each originate in the Rocky Mountains of Colorado with snow melt, and flow east into Nebraska where they join forming the Platte River near the town of North Platte. The reach included in the piping plover Critical Habitat begins at the Lexington bridge and extends to the Platte's confluence with the Missouri River 252 mi (405.5 km) downstream. About one-fourth of this part of the Platte is already designated as critical habitat for the whooping crane (Grus americana), including a 3-mi wide (4.8-km) northsouth buffer starting at a western boundary south of Lexington east to south of Shelton. Ownership is primarily private, including 28.5 mi (45.9 km) which is managed as conservation land by The Nature Conservancy, Platte River Whooping Crane Habitat Maintenance Trust, Central Nebraska Public Power and Irrigation District, Nebraska Public Power District, and the National Audubon Society's Lillian Annette Rowe Sanctuary. The State of Nebraska owns 8 mi (12.9 km) along the Platte River, which is primarily under the jurisdiction of the Nebraska Game and Parks Commission. Essential nesting habitat is dispersed throughout this unit.

North Dakota: Units 1–10 in North Dakota (described below) include prairie alkali lakes and wetlands. These alkali lakes and wetlands are characterized as follows— shallow; seasonally to permanently flooded; mixosaline to hypersaline chemistry; sandy to gravelly, sparsely vegetated beaches, salt-encrusted mudflats, and/or gravelly salt flats; 200 ft (61 m) of uplands above the wetlands' high water mark, including springs and fens which provide foraging and protective habitat for piping plovers. Sites included in this unit are occupied (determined to have nesting piping plovers in more than 1 year) by piping plovers. This unit requires special management including increasing reproductive success through predator exclusion devices, such as nest cages and electric fences, and reducing vegetation encroachment on nesting beaches through prescribed burning or grazing. These essential breeding habitats in North Dakota can support more than 50 percent of the current known population of the northern Great Plains Piping Plover. The proximity of Units 1–10 to the Missouri River provides an important ecological link that may allow birds extra protection from a severe drought that results in dry wetlands basins. As birds experience drought in these units biologists believe birds move to the river. Conversely, birds may move to these units when Missouri River flows are high. Unit ND–1—This unit encompasses approximately 7,456.9 ac (3,017.7 ha) of 13 alkali lakes and wetlands in Divide and Williams Counties, located in the extreme northwestern corner of North Dakota. Approximately 1,765.2 ac (714.3 ha) are in public ownership and 5,691.7 ac (2,303.4 ha) are in private ownership. Of the lands in public ownership 1,337.9 ac (541.4 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 427.2 ac (172.9 ha) are in State ownership. State lands designated include 3.1 ac (1.2 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 424.1 ac (171.6 ha) of school lands owned and managed by the North Dakota Land Department. Unit ND–2—This unit encompasses approximately 20,683.8 ac (8,370.6 ha) of 14 alkali lakes and wetlands in Burke, Renville, and Mountrail Counties, in northwestern North Dakota. Approximately 13,986.5 ac (5,660.2 ha) are in public ownership and 6,697.3 ac (2,710.3 ha) are in private ownership. Of the lands in public ownership, 13,251.8 ac (5,362.9 ha) are in Federal ownership and 734.6 ac (297.3 ha) are in State ownership. Federal lands designated include Lostwood and Upper Souris National Wildlife Refuges and Waterfowl Productions Areas, both owned and managed by the Service. State lands designated include 320.1 ac (129.5 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 414.4 ac (167.7 ha) of school lands owned and managed by the North Dakota Land Department. Unit ND–3—This unit encompasses approximately 2,524.5 ac (1,021.6 ha) of 11 alkali lakes and wetlands in Mountrail and Ward Counties in northwestern North Dakota. Approximately 615.9 ac (249.2 ha) are in public ownership and 1,908.5 ac (772.3 ha) are in private ownership. Of the lands in public ownership, 615.7 ac (249.2 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 0.2 ac (0.08 ha) are in State ownership. State lands designated are owned and managed by the North Dakota Game and Fish Department as a Wildlife Management Area. Unit ND–4—This unit encompasses approximately 5,150.7 ac (2,084.4 ha) of eight alkali lakes and wetlands in McLean County in north-central North Dakota. Approximately 1,292.6 ac (523.1 ha) are in public ownership and 3,858 ac (1,561.3 ha) are in private ownership. Of the lands in public ownership, 752.1 ac (304.3 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 540.5 ac (218.7 ha) are in State ownership. State lands designated include 435.5 ac (176.2 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 104.9 ac (42.4 ha) of school lands owned and managed by the North Dakota Land Department. The John E. Williams Preserve, owned and managed by The Nature Conservancy (private), also is included in this unit. Unit ND–5—This unit encompasses approximately 3,925.6 ac (1,588.7 ha) of 10 alkali lakes and wetlands in McHenry and Sheridan Counties in north-central and central North Dakota. Approximately 406.8 ac (164.6 ha) are in public ownership and 3,518.8 ac (1,424 ha) are in private ownership. All public lands are in Federal ownership with 34.4 ac (13.9 ha) owned and managed by the Service as Waterfowl Production Areas and 372.4 ac (150.7 ha) owned by the BOR and managed by the North Dakota Game and Fish Department as a Wildlife Management Area. Unit ND–6—This unit encompasses approximately 6,075.2 ac (2,458.6 ha) of 11 alkali lakes and wetlands in Benson and Pierce Counties, in northeastern North Dakota. Approximately 767.3 ac (310.5 ha) are in public ownership and 5,307.9 ac (2,148 ha) are in private ownership. Of the lands in public ownership, 724.8 ac (293.3 ha) are in Federal ownership and 42.5 ac (17.2 ha) are in State ownership. State lands designated include 20.7 ac (8.4 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 21.7 ac (8.79 ha) of school lands owned and managed by the North Dakota Land Department. Unit ND–7—This unit encompasses approximately 30,125.7 ac (12,191.7 ha) of nine alkali lakes and wetlands in Burleigh and Kidder Counties, in southcentral North Dakota. Approximately 20,012.1 ac (8,089.8 ha) are in public ownership and 10,113.5 ac (4,092.9 ha) are in private ownership. Of the lands in public ownership, 18,113.1 ac (7,330.3 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 1,898.9 ac (768.5 ha) are in State ownership. State lands designated include 1,247.9 ac (505 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 650.9 ac (263.4 ha) of school lands owned and managed by the North Dakota Land Department. Federal lands designated include Long Lake National Wildlife Refuge and Waterfowl Production Areas owned and managed by the Service. Unit ND–8—This unit encompasses approximately 4,056.7 ac (1,641.7 ha) of three alkali lakes and wetlands in Stutsman County, in south-central North Dakota. Approximately 3,593.6 ac (1,454.3 ha) are in public ownership and 463.1 ac (187.4 ha) are in private ownership. Of the lands in public ownership, 3,583.8 ac (1,450.3 ha) are in Federal ownership and 9.7 ac (3.9 ha) are in State ownership. Federal lands designated include Chase Lake and Arrowwood National Wildlife Refuges and Waterfowl Production Areas owned and managed by the Service. State lands designated include 7.9 ac (3.2 ha) of school lands owned and managed by the North Dakota Land Department and 1.8 ac (0.7 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department. Unit ND–9—This unit encompasses approximately 2,658 ac (1,075.6 ha) of six alkali lakes and wetlands in Logan and McIntosh Counties in south-central North Dakota. Approximately 732.5 ac (296.4 ha) are in public ownership and 1,925.5 ac (779.2 ha) are in private ownership. Of the lands in public ownership, 497.7 ac (201.4 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 234.7 ac (95 ha) are in State ownership (Wildlife Management Areas managed by the North Dakota Game and Fish Department. Unit ND–10—This unit encompasses approximately 641.6 ac (259.6 ha) of one alkali lake in Eddy County in northeastern North Dakota. Approximately 6.8 ac (2.7 ha) are in public ownership as a Waterfowl Production Area managed by the Service and 634.7 ac (256.8 ha) are in private ownership.

Missouri River Units: Missouri River Units—Missouri River units consist of riverine and reservoir (Fort Peck Lake, Lake Sakakawea and Lake Audubon, Lake Oahe, and Lewis and Clark Lake) reaches. All reservoirs except Lake Audubon are mainstem impoundments, constructed by dams, and regulated by the Corps. Lake Audubon is a sub-impoundment of Lake Sakakawea and is regulated by the BOR through operation of the Snake Creek Pumping Plant. Overall the Missouri River has accounted for up to 31 percent of the northern Great Plains population of piping plovers. All of the units are occupied. Piping plover habitat within reservoir reaches is composed of shorelines, peninsulas, and islands, below the top of the maximum operating pool and is owned by the Federal government. These reservoir habitats include sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, grave, or shale, and their interface with the water. These reservoir reaches provide habitat for about 42 percent of the piping plovers on the Missouri River. Piping plover habitat within riverine reaches consists of inter-channel islands and sandbars including their temporary pools and interface with the river. These habitats are sparsely vegetated and consist of sand and gravel substrates. Riverine reaches provide habitat for about 58 percent of the piping plovers on the Missouri River. Ownership of these sites varies by State. In Montana, islands and sandbars are recognized as owned by the State except along the reservation boundaries of the Assiniboine and Sioux Tribes of Fort Peck. The Assiniboine and Sioux Tribes of Fort Peck own land to the midchannel of the Missouri River adjacent to the Reservation boundary. In North Dakota and South Dakota, islands and sandbars are recognized as owned by the State. Four Tribes along the Missouri River in North Dakota and South Dakota have critical habitat designated within the boundary of their reservation including the Standing Rock Sioux Tribe, and the Three Affiliated Tribes (Mandan, Hidatsa, and Arikara Tribes) of the Ft. Berthold Reservation, the Cheyenne River Sioux Tribe, and the Yankton Sioux Tribe. Additionally, these Tribes have land or Tribal trust land on submerged sites or sandbars/ islands within the critical habitat designation of the Missouri River in North and South Dakota. In Nebraska, islands and sandbars are owned by the adjacent landowner including the Santee Sioux Tribe.

Montana: Unit MT–2—This unit encompasses approximately 125.4 mi (201.8 km) from just west of Wolf Point, McCone County, Montana, at RM 1712.0 downstream to the Montana/North Dakota border, Richland County, Montana, and McKenzie County, North Dakota, at RM 1586.6. The Missouri River in this unit flows through reservation land of the Assiniboine and Sioux Tribes of Fort Peck (81.7 mi (131.5 km)), State land, and privately owned land. Unit MT–3, Fort Peck Reservoir—This unit encompasses approximately 77,370 ac (31,311 ha) of Fort Peck Reservoir, located entirely within the Charles M. Russell National Wildlife Refuge which is in Federal ownership, managed by the Service.

North Dakota: Unit ND–11, Missouri River— Approximately 354.6 mi (570.6 km) from the Montana/North Dakota border just west of Williston, McKenzie County, North Dakota, at RM 1586.6 downstream to the North Dakota/South Dakota border in Sioux and Emmons Counties, North Dakota, and Corson and Campbell Counties, South Dakota, at RM 1232.0. Lake Sakakawea, Lake Audubon, and Lake Oahe are included in this unit, along with a free-flowing stretch of the Missouri River from RM 1389 to 1302 (Garrison Reach). The North Dakota Game and Fish Department manages the north half of Audubon Reservoir and the Service manages the south half of Audubon Reservoir. The Missouri River and associated reservoirs in this unit include 6.83 mi (11 km) of shoreline (right and left bank) of trust land and 77 liner rm (123.9 km) within the reservation boundary of the Three Affiliated Tribes of Fort Berthold and 23.22 mi (37.37 km) of shoreline on trust land and 38 linear rm (61.16 km) within the reservation boundary of Standing Rock Sioux Tribe and 20 mi (32.19 km) of shoreline on trust land. A mix of State and privately owned lands also are included in this unit.

South Dakota Unit SD–1 Missouri River— Approximately 159.7 mi (257 km) from the North Dakota/South Dakota border northeast of McLaughlin, Corson County, South Dakota, at RM 1232.0 downstream to RM 1072.3, just north of Oahe Dam (Oahe Reservoir). The Missouri River and associated reservoirs in this unit include 3.22 mi (5.18 km) of shoreline (right bank) on trust land and 41 linear mi (65.98 km) within the reservation boundary of the Standing Rock Sioux and 23.44 mi (37.72 km) of shoreline (right bank) on trust land and 77 linear mi (123.92 km) within the reservation boundary of Cheyenne River Sioux Tribe. A mix of State and privately owned lands also are included in this unit. Unit SD–2, Missouri River— Approximately 127.8 mi (204.4 km) from RM 880.0, at Fort Randall Dam, Bon Homme and Charles Mix Counties, South Dakota, downstream to RM 752.2 near Ponca, Dixon County, Nebraska. One mainstem Missouri River reservoir, Lewis and Clark Lake, and two riverine reaches (Fort Randall and Gavins Point) are included in this unit. In addition to the 127.8 mi (204.4 km) that border South Dakota on the left bank there are approximately 7.8 mi (12.4 km) of river bordering South Dakota on the right bank. All islands and sandbars in South Dakota are in State ownership with the exception of 60.36 mi (97.14 km) of shoreline (left bank) on trust land and 34 linear miles (54.72 km) within the reservation boundary of the Yankton Sioux Tribe. Approximately 120 mi (192 km) (right bank) of river border Nebraska. Sandbars and islands in Nebraska (State line extends to midchannel) belong to the adjacent landowner. Approximately 16 linear mi (25.75 km) (right bank) of river below Ft. Randall Dam are within the boundary of the Santee Sioux Reservation, including 0.05 mi (0.08 km) of shoreline on trust land.

Primary Constituent Elements/Physical or Biological Features

Wintering piping plover's PCEs are the habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. The primary constituent elements are:

(1) Intertidal sand beaches (including sand flats) or mud flats (between the MLLW and annual high tide) with no, or very sparse, emergent vegetation for feeding. In some cases, these flats may be covered or partially covered by a mat of blue-green algae.

(2) Unvegetated or sparsely vegetated sand, mud, or algal flats above annual high tide for roosting. Such sites may have debris or detritus and may have micro-topographic relief (less than 20 in (50 cm) above substrate surface) offering refuge from high winds and cold weather.

(3) Surf-cast algae for feeding.

(4) Sparsely vegetated backbeach, which is the beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road. Backbeach is used by plovers for roosting and refuge during storms.

(5) Spits, especially sand, running into water used for foraging and roosting.

(6) Salterns, or bare sand flats in the center of mangrove ecosystems that are found above mean high water and are only irregularly flushed with sea water.

(7) Unvegetated washover areas with little or no topographic relief for feeding and roosting. Washover areas are formed and maintained by the action of hurricanes, storm surges, or other extreme wave actions.

(8) Natural conditions of sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites).

See above.

See above.

The one overriding primary constituent element (biological) required to sustain the northern Great Plains breeding population of piping plovers that must be present at all sites is the dynamic ecological processes that create and maintain piping plover habitat. Without this biological process the physical component of the primary constituent elements would not be able to develop. These processes develop a mosaic of habitats on the landscape that provide the essential combination of prey, forage, nesting, brooding and chick-rearing areas. The annual, seasonal, daily, and even hourly availability of the habitat patches is dependent on local weather, hydrological conditions and cycles, and geological processes. The biological primary constituent element, i.e., dynamic ecological processes, creates different physical primary constituent elements on the landscape. These physical primary constituent elements exist on different habitat types found in the northern Great Plains, including mixosaline to hypersaline wetlands (Cowardin et al. 1979), rivers, reservoirs, and inland lakes. These habitat types or physical primary constituent elements that sustain the northern Great Plains breeding population of piping plovers are described as follows:

i. On prairie alkali lakes and wetlands, the physical primary constituent elements include—(1) shallow, seasonally to permanently flooded, mixosaline to hypersaline wetlands with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; (2) springs and fens along edges of alkali lakes and wetlands; and (3) adjacent uplands 200 ft (61 m) above the high water mark of the alkali lake or wetland.

ii. On rivers the physical primary constituent elements include—sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river.

iii. On reservoirs the physical primary constituent elements include—sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies.

iv. On inland lakes (Lake of the Woods) the physical primary constituent elements include—sparsely vegetated and windswept sandy to gravelly islands, beaches, and peninsulas, and their interface with the water body.

Special Management Considerations or Protections

Activities that may destroy or adversely modify critical habitat are those for which the affected critical habitat would not remain functional to serve its intended conservation role for the species. More specifically, such activities could eliminate or reduce the habitat necessary for foraging by eliminating or reducing the piping plovers' food base; destroying or removing available upland habitats necessary for protection of the birds during storms or other harsh environmental conditions; increasing the amount of vegetation to levels that make foraging or roosting habitats unsuitable; and/or increasing recreational activities to such an extent that the amount of available undisturbed foraging or roosting habitat is reduced, with direct or cumulative adverse effects to individuals and completion of their life cycles. Examples of actions that have effects on wintering piping plover habitats include, but are not limited to: (1) Disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; (2) Predation, especially by falcons, hawks, coyotes, bobcats and feral cats; (3) Beach maintenance (e.g., nourishment (adding sand) and cleaning) and stabilization efforts (e.g., construction of jetties and other hard structures). (4) Oil and other hazardous materials spills and cleanup; (5) Discharge of freshwater from oil and gas activities; (6) Construction of dwellings, roads, marinas, and other structures, and associated activities including staging of materials and equipment; and/or (7) Dredging and dredge spoil placement, and associated activities including staging of equipment and materials.

See above.

See above.

Critical habitat does not include existing developed areas such as mainstem dam structures, buildings, marinas, boat ramps, bank stabilization and breakwater structures, row cropped or plowed agricultural areas, roads and other lands (e.g., high bank bluffs along Missouri River) unlikely to contain primary constituent elements essential for northern Great Plains piping plover conservation.

Life History

Feeding Narrative

Adult: Most foraging is diurnal. Piping plovers utilize numerous areas within breeding and wintering habitats for foraging, including wet sand in the wash zone, intertidal ocean beach, wrack lines, washover passes, mud, sand and algal flats, and shorelines of streams, ephemeral ponds, lagoons, and salt marshes (Powell and Cuthbert 1991; Hoopes et al. 1992; Loegering 1992; Zonick et al. 1998) (USFWS, 2017b).

Reproduction Narrative

Adult: Piping plovers return to their breeding grounds in late April to early May and initiate nesting by mid- to late May (Pike 1985). Courtship behavior includes aerial displays, digging of several nest scrapes, and a ritualized stone-tossing display (Cairns 1977, 1982; Haig 1992). Piping plover nests are shallow scrapes in the sand that are lined with pebbles, shells, and driftwood. Both adults actively defend nest territories and share incubation duties that last 25-31 days (Wilcox 1959; Cairns 1977; Prindiville 1986; Wiens 1986; Haig and Oring 1988). Females lay an egg approximately every other day; clutches are complete at three or four eggs. Eggs hatch from late May to late July at Great Lakes nesting sites (Lambert and Ratcliff 1981; Pike 1985). Precocial chicks usually hatch within one-half to one day of each other and are able to feed themselves within a few hours, following their parents and plucking invertebrates, including insects, spiders, marine worms, crustaceans, and mollusks, from the sand (Haig 1992). Piping plover eggs and young are so well camouflaged that they may go unnoticed. When predators or intruders are near, the young remain motionless while the parents attempt to attract the attention of the intruders to themselves, often by feigning a broken wing or false brooding. Chicks are especially vulnerable to predators after hatching until they are able to fly in 21-30 days. Fledging success in 2009 was 1.79 chicks fledged per pair, while overall fledging success from 1984 to 2009 has averaged 1.49 chicks fledged per pair, not including those chicks fledged from the salvage captive rearing program. Primary constituent elements for both C. m. circumcinctus breeding populations include sparsely vegetated beaches; however, those for the Great Lakes place a much greater emphasis on sandy substrates associated with wide, unforested systems of dunes and inter-dune wetlands (66 FR 22960). Similarly, Wemmer (2000) and Price (2002) found Great Lakes breeding sites to be largely restricted to Great Lakes shoreline areas (USFWS, 2017b).

Site Fidelity

Adult: High (USFWS, 2017b; 2009)

Habitat Narrative

Adult: See reproduction narrative for breeding habitat. The recent ESA status review for piping plovers concluded that inter- and intra-annual fidelity of piping plovers to migration and wintering sites as described in the 1996 Atlantic Coast and 2003 Great Lakes recovery plans was accurate. Great Lakes piping plovers on the breeding grounds exhibit nest site fidelity. In Michigan, adults returned to beaches where they nested previously approximately 65% of the time (Wemmer 2000) (USFWS, 2017b). Piping plovers in the Great Lakes have demonstrated a high degree of fidelity to this ecological setting, with little to no dispersal into breeding ranges of other populations. Several studies identified wrack (organic material including seaweed, seashells, driftwood, and other materials deposited on beaches by tidal action) as an important component of roosting habitat for nonbreeding piping plovers (USFWS, 2009). On the wintering grounds, piping plovers forage and roost along barrier and mainland beaches, sand, mud, and algal flats, washover passes, salt marshes, and coastal lagoons. Wintering plovers are dependent on a mosaic of habitat patches, and move among these patches depending on local weather and tidal conditions (K. R. Drake 1999). The integrity of the habitat components depends upon daily tidal events and regular sediment transport processes, as well as episodic, high-magnitude storm events; these processes are associated with the formation and movement of barrier islands, inlets, and other coastal landforms (USFWS, 2003).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2009)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2009)

Dispersal

Adult: High (USFWS, 2009)

Dispersal/Migration Narrative

Adult: Piping plovers depart their Great Lakes breeding areas anywhere from mid-July to early September (Pike 1985; Wemmer 2000) (USFWS, 2017b). Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean (USFWS, 2009).

Additional Life History Information

Adult: Migrate to wintering grounds July - September (USFWS, 2017b)

Population Information and Trends

Population Trends:

Increasing (USFWS, 2017b)

Resiliency:

High (USFWS, 2017b)

Population Size:

71 breeding pairs, 26 non-nesting individuals (USFWS, 2017b)

Minimum Viable Population Size:

150 breeding pairs (USFWS, 2017b)

Resistance to Disease:

Moderate (see threats)

Additional Population-level Information:

First year survival rate ~ 24%, > 1 year survival rate ~ 77% (USFWS, 2017b); population is sensitive to individual survival rates (USFWS, 2009)

Population Narrative:

From 1986 to 2009, the population increased from 12 to 71 breeding pairs and also expanded its breeding distribution within the Great Lakes basin. In 2009, breeding pairs were found in Michigan (59), Wisconsin (4), Illinois (1), and in the Great Lakes area of Ontario, Canada (7). The nest occurrence in Illinois in 2009 was the first nest in the state since 1979. Over the past 20 years, piping plover nests have been found in one county in Illinois, three counties in Wisconsin, 18 counties in Michigan, and in the province of Ontario, Canada. Between 2003 to 2008, an annual average of approximately 26 non-nesting piping plovers were observed, based on limited data from 2003, 2006, 2007, and 2008 (Cuthbert and Roche 2009). Cuthbert and Roche (2007a) determined an average after-hatch year survival rate of 77% and an average hatch year survival rate of approximately 24% (based on data collected from 1993-2005). The current recovery goal is 150 breeding pairs for the Great Lakes population (USFWS, 2017b). The most consistent finding in the various population viability analyses (PVAs) conducted for piping plovers (Ryan et al. 1993, Melvin and Gibbs 1996, Plissner and Haig 2000, Wemmer et al. 2001, Larson et al. 2002, Calvert et al. 2006, Brault 2007) is the sensitivity of extinction risk to even small declines in adult and/or juvenile survival rates (USFWS, 2009).

Threats and Stressors

Stressor: Shoreline development (USFWS, 2017b)
Exposure:
Response:
Consequence:
Narrative: Shoreline development represents the leading cause of piping plover habitat loss in the Great Lakes, and remains a major threat. Over one-quarter of available breeding habitat lies on private lands that are particularly vulnerable to development. Activities, such as homebuilding, shoreline stabilization, and jetty, pier, and rip rap installation, are common examples of coastal changes that occur within the Great Lakes, and these activities continue to threaten piping plover habitat to varying degrees. Loss of habitat due to development pressure also occurs to a limited degree on Federal lands, which currently support approximately 55% of the breeding sites. Disturbance in the form of recreational uses also continues at these sites, although nearly all Federal land management agencies currently participate in the ongoing recovery program and actively support various recovery actions. These include management of current nesting sites, limiting recreational uses, conducting regular outreach activities, and managing habitat conditions (USFWS, 2017b).

Stressor: Disturbance by humans and pets (USFWS, 2017b)
Exposure:
Response:
Consequence:
Narrative: Human activities, such as illegal off-road vehicle usage, unleashed pets, bike riding, bonfires, horseback riding, camping, and beach walking, are known to disturb piping plover nesting habitat and behaviors (Cuthbert and Roche 2008a). Although an arrangement of

educational signs, posts, and twine typically enclose a large section of beach around each nest, pedestrians and unleashed pets sometimes ignore this psychological boundary (USFWS, 2017b).

Stressor: Predation (USFWS, 2107b)
Exposure:
Response:
Consequence:
Narrative: Predation remains one of the most significant threats to the Great Lakes population. A number of different species in the Great Lakes prey upon piping plovers. The routine use of predator exclosures (cages which keep larger predators out while allowing the attending adults free access to and from the nest) has reduced egg predation and increased hatching success from 37% to approximately 85%. To date, few observations have been made to suggest predators have "keyed" into exclosures and increased rate of adult predation. As a result, nest exclosures are used at all sites throughout the Great Lakes. Although the use of predator exclosures has reduced egg predation, chicks and adults remain vulnerable to a variety of terrestrial and avian predators (Melvin et al. 1992). In 2003, the NPS and U.S. Department of Agriculture (USDA) Wildlife Services initiated a joint program to control predator populations on North Manitou Island in the Sleeping Bear Dunes National Lakeshore. Increases in the number of pairs nesting on the island reflect the relative success of this program (Stucker et al. 2003; Stucker and Cuthbert 2004; Westbrock et al. 2005; Cuthbert and Roche 2006, 2007b; Cuthbert and Roche 2008b). Finally, merlins (Falco columbarius) are a notable concern to piping plover recovery. Since 2005, merlins are suspected of killing a total of 18 individuals (approximately six per year) (Cuthbert and Roche 2007b). Most of the instances of predation by merlins occurred at sites in the northwestern portion of Michigan's Lower Peninsula, an area with high densities of nesting plovers (USFWS, 2017b).

Stressor: Disease (USFWS, 2017b)
Exposure:
Response:
Consequence:
Narrative: Although not considered a major threat at the time of listing, two disease-related mortality events have occurred in the Great Lakes population since 2003. In 2004, two young-of-the-year piping plovers were found dead in Benzie County, Michigan. The USGS National Wildlife Health Center (NWHC) determined the cause of death was aspergillosis, a fungal disease of the airway. No further cases of aspergillosis in the Great Lakes have been reported. In 2007, two chicks and two adult piping plovers succumbed to Type E botulism poisoning at Sleeping Bear Dunes National Lakeshore in Benzie and Leelanau Counties in Michigan. Type E botulism is a paralytic, typically fatal disease of birds. Outbreaks have occurred at various times in the Great Lakes basin, with some of the earliest outbreaks documented in Michigan in 1963. Significant outbreaks also occurred in 1976 and 1981 (T. Cooley, Michigan Department of Natural Resources, pers. comm. 2008). The recent outbreak began in 2006, when several thousand waterbirds succumbed to the disease in the northern Lake Michigan area. Although fewer waterbird and shorebird mortalities associated with Type E botulism were reported in 2008 compared to 2007 and 2006, potential disease-related mortality remains a concern for the Great Lakes piping plover population (USFWS, 2017b).

Stressor: Small population size/genetic diversity (USFWS, 2017b)
Exposure:

Response:
Consequence:
Narrative: An analysis of the Great Lakes population in 2003 found up to 29% of adult plovers remained unmated, suggesting a possible Allee effect (Wemmer 2000 in USFWS 2003). On average, from 2003-2008, 18% of adult piping plovers remained unmated (based on limited figures from 2003 and 2006-2008). This decrease may reflect increased nesting densities in areas of high quality habitat or the overall increase in the population. Other factors, such as uneven sex ratios, may also contribute to this condition. Increased susceptibility to stochastic events also occurs with a small population size. Small populations are less able to recover from losses associated with events such as severe weather, oil spills, and disease outbreaks. The population-level impacts of threats already mentioned, such as human disturbance, increase when there are fewer individuals in the population. The potential for low and/or declining genetic diversity represents another factor often associated with small population size. In 2007, Cuthbert and Roche (2007a) performed a pedigree analysis that suggested a substantial loss of at least 14 of the 17 founder lineages and an over-representation of the remaining three. In addition, they established that the number of observed pairs known to be closely related increased from 1997-2007. Although these are somewhat alarming, Cuthbert and Roche (2007a) also acknowledged that a large percentage of the Great Lakes piping plover pedigree is unknown, and their results should be considered preliminary. Miller et al. (2009) recently conducted a molecular genetic investigation of piping plovers, including mitochondrial DNA sequences and eight nuclear microsatellite loci, based on samples from 23 U.S. states and Canadian provinces. This included an analysis of samples from 17 individuals in the Great Lakes population. They found genetic evidence suggesting that interior birds have experienced genetic bottlenecks and that the Great Lakes region has also experienced a post-bottleneck population expansion. This finding may indicate a population growth following a previous bottleneck event (Miller et al. 2009). Miller et al. (2009) also reported genetic diversity measures for both mitochondrial and microsatellite data for Great Lakes piping plovers. Mitochondrial control region nucleotide diversity and gene diversity were somewhat lower for the Great Lakes population compared with the Atlantic Coast and Northern Great Plains populations in the U.S. and Canada (Miller et al. 2009). The average Great Lakes mitochondrial nucleotide diversity was also below the mean (but still within the range) observed at the same locus in a study of snowy plovers (Charadrius alexandrinus). The lower mitochondrial nucleotide diversity associated with Great Lakes birds may be attributed to historically low (or currently small) population sizes, founder events, or bottlenecks. For microsatellite markers, however, the average number of alleles per locus and heterozygosity in the Great Lakes samples were in the middle of the range observed for all piping plover populations. Although diversity measures observed by Miller et al. (2009) suggest that the current level of genetic diversity may not have a deleterious effect on Great Lakes piping plovers, further investigations are warranted. Furthermore, genetic drift could affect this small population over the long term (USFWS, 2017b).

Stressor: Wind power (USFWS, 2017b)
Exposure:
Response:
Consequence:
Narrative: Wind power has emerged as an alternative energy source in and around the Great Lakes. Wind turbines potentially impact local and migrating populations of birds due to collision-associated mortality. While the exact migration routes of piping plovers are unknown, individual observations along the Great Lakes coastline strongly suggest they use the shoreline as travel

corridors. Wind power facilities located along Great Lakes shorelines may pose a risk of injury to piping plovers, particularly during migration (USFWS, 2017b).

Stressor: Climate change (USFWS, 2017b; 2009)
Exposure:
Response:
Consequence:
Narrative: The potential impacts of climate change are increasingly evident in the Great Lakes region. Summer lake water temperatures are increasing, with Lake Superior's average summer surface water temperature increasing by 4.5° F since 1980 (Austin and Colman 2007). Ice forms later and melts earlier throughout the region. According to scenarios used in a national assessment, average temperatures in the Great Lakes region could increase 4° to 8° F by 2100, while precipitation could increase by 25% (Sousounis and Glick 2000). Despite projected increases in precipitation, increased air temperatures and reduced ice cover are expected to result in lake level decreases of 1.5 to as much as 8 feet (Sousounis and Glick 2000). These changes could have significant effects on both aquatic and terrestrial ecosystems. Expected changes due to climate change could have both positive and negative effects on piping plovers and their habitats. Reductions in lake levels could potentially increase the amount of available habitat by increasing the width and length of open beach, areas preferred by Great Lakes piping plovers. Conversely, a longer growing season, coupled with the loss of ice scour, may allow for vegetative encroachment, thus decreasing the amount of habitat available for piping plovers. Increases in regional temperatures may also alter the frequency and intensity of seasonal storms, which can inundate and wash out nests. Such changes could have a particularly significant impact in areas where nest densities are high. Overall, the magnitude of the threats of climate change on piping plover habitat remains unknown (USFWS, 2017b). Modeling for three sea-level rise scenarios (reflecting variable projections of global temperature rise) at five important U.S. shorebird staging and wintering sites predicted loss of 20-70% of current intertidal foraging habitat (Galbraith et al. 2002) (USFWS, 2009).

Stressor: Exotic/invasive vegetation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: A recently identified threat to piping plover habitat, not described in the listing rule or recovery plans, is the spread of coastal invasive plants into suitable piping plover habitat. Like most invasive species, coastal exotic plants reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plant species. If left uncontrolled, invasive plants cause a habitat shift from open or sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of piping plover roosting habitat, which is especially important during high tides and migration periods. Beach vitex (Vitex rotundifolia) is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Westbrooks and Madsen 2006). It currently occupies a very small percentage of its potential range in the U.S.; however, it is expected to grow well in coastal communities throughout the southeastern U.S. from Virginia to Florida, and west to Texas (Westbrooks and Madsen 2006). Unquantified amounts of crowfoot grass (Dactyloctenium aegyptium) grow invasively along portions of the Florida coastline. It forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat. The Australian pine (Casuarina equisetifolia) changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas. Shorebirds

prefer foraging in open areas where they are able to see potential predators, and tall trees provide good perches for avian predators. Australian pines potentially impact shorebirds, including the piping plover, by reducing attractiveness of foraging habitat and/or increasing avian predation (USFWS, 2009).

Stressor: Beach cleaning (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Man-made beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2009). These efforts remove accumulated wrack, topographic depressions, and sparse vegetation nodes used by roosting and foraging piping plovers. Removal of wrack also eliminates a beach's natural sand-trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Neal et al. 2007) (USFWS, 2009).

Stressor: Inadequacy of existing regulatory mechanisms (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Available regulatory mechanisms include local land use ordinances and state and federal regulations. However, implementation of these mechanisms is often constrained by practical limitations such as lack of staff and funding. Enforcement limitations and/or legal insufficiency of regulations to protect important habitat components result in continued degradation of a significant amount of wintering piping plover coastal habitat, including designated critical habitat units, resulting in a cumulative loss of habitat. At the current time, if the protections of the ESA were removed, existing local, state, and other federal regulatory provisions would provide insufficient protection to nonbreeding piping plover habitats used during migration and winter (USFWS, 2009).

Stressor: Military activities (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: To date, five bases have consulted with the USFWS under section 7 of the ESA, on military activities on beaches and baysides that may affect piping plovers or their habitat. Camp Lejeune in North Carolina consulted formally with USFWS in 2002 on troop activities, dune stabilization efforts, and recreational use of Onslow Beach. The permit conditions require twice-monthly piping plover surveys and use of buffer zones and work restrictions within buffer zones. Naval Station Mayport in Duval County, Florida, consulted with USFWS on Marine Corps training activities that included beach exercises and use of amphibious assault vehicles. The area of impact was not considered optimal for piping plovers, and the consultation was concluded informally. Similar informal consultations have occurred with Tyndall Air Force Base (Bay County) and Eglin Air Force Base (Okaloosa and Santa Rosa counties) in northwest Florida (USFWS, 2009).

Stressor: Contaminants and pesticides (USFWS, 2009)

Exposure:
Response:
Consequence:
Narrative: The Great Lakes plan states that concentration levels of polychlorinated biphenol (PCB) detected in Michigan piping plover eggs have the potential to cause reproductive harm. Contaminants have the potential to cause direct toxicity to individual birds or negatively impact their invertebrate prey base (Rattner and Ackerson 2008). Depending on the type and degree of contact, contaminants can have lethal and sub-lethal effects on birds, including behavioral impairment, deformities, and impaired reproduction (Rand and Petrocelli 1985, Gilbertson et al. 1991, Hoffman et al. 1996). Petroleum products are the contaminants of primary concern, as opportunities exist for petroleum to pollute intertidal habitats that provide foraging substrate. Impacts to piping plovers from oil spills have been documented throughout their life cycle (Chapman 1984; USFWS 1996; Burger 1997; Massachusetts Audubon 2003; Amirault-Langlais et al. 2007; A. Amos, University of Texas, pers. comm. 2009). This threat persists due to the high volume of shipping vessels (from which most documented spills have originated) traveling offshore and within connected bays along the Atlantic Coast and the Gulf of Mexico. Additional risks exist for leaks or spills from offshore oil rigs, associated undersea pipelines, and onshore facilities such as petroleum refineries and petrochemical plants. In 2000, mortality of large numbers of wading birds and shorebirds, including one piping plover, at Audubon's Rookery Bay Sanctuary on Marco Island, Florida, occurred following the county's aerial application of the organophosphate pesticide Fenthion for mosquito control purposes (Williams 2001). Subsequent to a lawsuit being filed against the Environmental Protection Agency (EPA) in 2002, the manufacturer withdrew Fenthion from the market, and EPA declared all uses were to end by November 30, 2004 (American Bird Conservancy 2007, which also states that all other counties in the U.S. now use less toxic chemicals for mosquito control). With one reported plover death from pesticide use, and with the causative pesticide now removed from use, this threat to piping plovers in the U.S. currently appears low. However, it is unknown whether pesticides are a threat for piping plovers wintering in the Bahamas, other Caribbean countries, or Mexico (USFWS, 2009).

Stressor: Storm events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: storms can create or enhance piping plover habitat while causing localized losses elsewhere in the wintering and migration range. Available information suggests that some birds may have resiliency to storms and move to unaffected areas without harm, while other reports suggest birds may perish from storm events. Significant concerns include disturbance to piping plovers and habitats during cleanup of debris, and post storm acceleration of shoreline stabilization activities, which can cause persistent habitat degradation and loss (USFWS, 2009).

Stressor: Vegetative encroachment (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Several coastal areas traditionally used by piping plovers in the past have gone unused in recent years (Stucker et al. 2003; Stucker and Cuthbert 2004; Westbrock et al. 2005; Cuthbert and Roche 2006, 2007a). These include several sites in northern Michigan, such as Wilderness

State Park. As recently as 2001, Wilderness State Park supported over 35% of the entire Great Lakes population. By 2008, the number of breeding pairs at the park was down to one. One possible explanation for this is that increases in vegetation have reduced the overall width of open beach. Piping plovers usually require approximately 30 m of open sandy beach for nesting (Lambert and Ratcliff 1981, Powell and Cuthbert 1992, Allan 1993 in USFWS 2003). In areas lacking natural disturbances (e.g., lake level fluctuations, storms, ice scour), vegetation can cover beaches and grow nearly to the water's edge, making the area unsuitable for nesting. The percentage of vegetative cover along the shoreline at Wilderness State Park, for example, has increased in the past six years and may have contributed to the reduction of breeding habitat (Stucker and Cuthbert 2005) (USFWS, 2009).

Stressor: Research (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Scientific investigations currently underway are conducted under the authority of permits issued under section 10 of the ESA, and are closely monitored. Current investigations include collection of feather samples for genetic analysis, close observation and monitoring of nest sites, and leg banding. Activities such as banding may result in short-term disturbances during capture, and have the potential for leg injury. Since 2003, a small number of individuals (<5) in the Great Lakes population have been reported with conditions that may have been related to leg bands. It should be noted, however, that some leg injuries may have been due to other causes. In 2004, banding protocols were modified, including a change in leg band position; since that time no observations of band-related injuries have been reported (USFWS, 2009).

Recovery

Reclassification Criteria:
The population will be considered for reclassification to threatened when the first four criteria are accomplished, and then considered for delisting when all five criteria are met (USFWS, 2009).

Delisting Criteria:
1. The population has increased to at least 150 pairs (300 individuals), for at least 5 consecutive years, with at least 100 breeding pairs (200 individuals) in Michigan and 50 breeding pairs (100 individuals) distributed among sites in other Great Lakes states (USFWS, 2017b).

2. Five-year average fecundity is within the range of 1.5-2.0 fledglings per pair, per year, across the breeding distribution, and ten-year population projections indicate the population is stable or continuing to grow above the recovery goal (USFWS, 2017b).

3. Ensure protection and long-term maintenance of essential breeding habitat in the Great Lakes and wintering habitat, sufficient in quantity, quality, and distribution to support the recovery goal of 150 pairs (300 individuals) (USFWS, 2017b).

4. Genetic diversity within the population is deemed adequate for population persistence and can be maintained over the long-term (USFWS, 2017b).

5. Agreements and funding mechanisms are in place for long-term protection and management activities in essential breeding and wintering habitat (USFWS, 2017b).

Recovery Actions:

- Protect the Great Lakes piping plover breeding population and manage breeding habitat to maximize survival and fecundity (USFWS, 2003).
- Protect wintering piping plovers and manage habitat to promote survival and recruitment (USFWS, 2003).
- Identify and protect migration habitat outside of wintering range (USFWS, 2003).
- Conduct scientific research to facilitate recovery efforts (USFWS, 2003).
- Develop and implement public education and outreach (USFWS, 2003).
- Develop partnerships and additional funding mechanisms (USFWS, 2003).
- Develop emergency methods to prevent extirpation (USFWS, 2003).
- Review progress toward recovery and revise recovery tasks as appropriate (USFWS, 2003).

Conservation Measures and Best Management Practices:

- Develop a comprehensive conservation plan for piping plovers in the U.S. portion of their migration and wintering range. a. Acquire funds to develop a concise, cohesive plan that will address the migration and wintering needs of the three breeding populations. This is most efficiently accomplished by a qualified contractor working in close coordination with USFWS biologists. b. Develop a state-by-state wintering and migration habitat use atlas. i. Quantify amount and distribution of currently existing habitat. ii. Determine the condition of each site, including the type and level of alteration, presence and threat level from invasive species, and whether natural coastal processes are impeded. Compare with historic habitat availability using aerial photography or other records. iii. Determine the temporal abundance and distribution of piping plover activity at sites with suitable habitat. Where appropriate data are currently lacking, conduct multiple surveys by qualified personnel across several migration and wintering seasons. Examples of reports summarizing methods and results of such surveys are available on request to the USFWS. iv. Evaluate likelihood of future actions, including human development and recreational uses, and natural events that could potentially affect habitat quantity and quality at each site. v. Evaluate factors at each site that will affect the response of habitat to accelerating sea-level rise and identify potential actions to minimize its adverse effects. c. Conduct a systematic review of recreational policies and beach management. Identify gaps in management and enforcement of regulatory mechanisms by state. Develop recommendations to improve management and enforcement of piping plover protections where warranted. d. Develop an education/outreach strategy to work with state, county, and municipal governments to develop and implement ordinances and other strategies reducing effects of habitat stabilization, beach cleaning practices, human uses, and pets in beach and bayside habitats. e. Develop an education/outreach strategy to work with private landowners with regard to habitat stabilization, beach-cleaning practices, human uses, and pets (USFWS, 2009).
- Develop, in coordination with land managers, management plans for critical habitat sites or other sites that support or could support nonbreeding piping plovers. This may be accomplished concurrently with development of the atlas described under action 1b above or as a follow-up task. a. Develop and implement a conservation plan tailored to the site's conditions. A range of management measures may include, as appropriate, leash laws and dog free zones, off-road vehicle management, and symbolic fencing of key habitats during periods of high plover use. b. Develop a recommended piping plover monitoring protocol for each site that includes suggested frequency

and intensity of monitoring. c. Monitor the effectiveness of management measures (2.a above) (USFWS, 2009).

- Improve consistency in the approach used, and recommendations generated for, piping plover conservation in ESA section 7 consultations and Coastal Barrier Resources Act review across all USFWS field offices throughout the species' U.S. coastal migration and wintering range. a. Regularly update USFWS field office staff regarding latest information on piping plovers and habitat use. b. Emphasize importance of maintaining natural coastal processes to perpetuate high quality piping plover migrating and wintering habitat (AC task 2.21). c. Discourage projects that will degrade or interfere with formation or maintenance of high quality piping plover habitat (GL task 2.22, AC task 2.21, NGP task 4.43). d. Encourage project features to minimize adverse effects on piping plovers and their habitat, including creation and enhancement of habitat in the vicinity of existing stabilization projects. . e. Develop a comprehensive monitoring and management plan template for shoreline stabilization projects on the wintering and migration grounds. f. Consider effects of climate change when determining long-term impacts. Include measures to conserve and enhance the capacity of piping plover habitats to adapt to sea-level rise (USFWS, 2009).
- Develop a website specifically for wintering and migrating piping plover issues (GL task 5.2 and AC tasks 4.1, 4.2). a. Develop a piping plover contact list of all individuals in each state and other countries (Canada, Mexico, Bahamas, etc.). b. Link to other plover websites. c. Upload all pertinent literature, including research and monitoring reports not protected by copyright, to the website. d. Upload summarized section 7 consultations, conservation measures, reasonable and prudent measures, and terms and conditions (USFWS, 2009).
- Focus the non-breeding portion of the International Census on enhancing understanding of piping plover abundance, distribution, and threat levels in seasonally emergent habitat (seagrass beds, oyster reefs, and mud flats) in Texas bays, and in Mexico and the Caribbean. Continue to encourage and improve International Census efforts at priority sites in Texas. b. USFWS regional coordinators for the International Census should establish contacts in Mexico, Bahamas, Cuba, and other appropriate Caribbean countries at least a year in advance of the 2011 International Census. i. Increase efforts to maximize survey coverage. ii. Encourage collection of information describing types and levels of threats at each International Census site in addition to physical and biological attributes of the site. iii. Provide information about color-banded birds and encourage surveyors to look for and report these marked piping plovers (USFWS, 2009).
- To further enhance understanding of spatial partitioning of the breeding populations (as well as the impacts of some threats) on the migration/winter grounds, USFWS should facilitate and encourage all efforts dedicated to (or incorporating) monitoring of color-banded piping plovers. There is urgency associated with this data collection since several large breeding grounds banding studies have recently ended or are slated for completion in the near future, and opportunities to glean information will decline as banded piping plovers die off (USFWS, 2009).
- Further investigate the partitioning of survival within the annual cycle, and determine whether winter habitat quality influences reproductive success and survival (GL task 4.1 and AC task 3.6). Explore opportunities for further comparison of survival rates among breeding populations to inform these issues (USFWS, 2009).
- Continue to refine characterization of optimal winter habitat and understanding of factors affecting piping plover use of different microhabitats (e.g., ocean intertidal zones, wrack, inlet shoreline, soundside flats). Research approaches should recognize that piping plovers may move among relatively nearby habitat patches. Plover habitat use patterns and needs may also vary geographically (across their nonbreeding range) and seasonally. a. Determine how habitat modification or complete loss of a site on migration and wintering grounds affects survival given

documented site fidelity. b. Develop design specifications for creating roosting and foraging habitat. c. Quantify the amount and distribution of habitat needed for recovery of each breeding population, giving due consideration to intra- and inter-species competition for use of similar habitats (USFWS, 2009).

- Develop strategies to reduce threats from accelerating sea-level rise. a. Identify human coastal stabilization practices that increase or decrease adverse effects of sea-level rise on coastal piping plover habitats. b. Identify sites most likely to maintain (or increase) characteristics of suitable piping plover breeding and/or migration habitat as sea-level rises. c. Evaluate projected effects of sea-level rise on the regional distribution of piping plover habitats over time. Facilitate use of LIDAR (a remote sensing system used to collect topographic data) mapping of coastal elevations, development of models, and timeframe analysis throughout the species wintering and migration range in the U.S. to generate projections regarding areas most likely to be inundated within given time frames (USFWS, 2009).
- Determine the extent that human and pet disturbance limits piping plover abundance and behavioral patterns in the wintering and migration habitats (USFWS, 2009).
- Determine the effect of human and pet disturbance on survival and reproductive fitness (USFWS, 2009).
- Support research to ascertain impacts of predation on wintering/migrating piping plovers, as well as to determine the effectiveness of predator control programs (USFWS, 2009).
- Identify and secure reliable funding for various recovery program partners aimed at continued coordination and management of threats from human disturbance and predation, as described in recovery plan tasks 1.22, 1.34, and 1.36 (USFWS, 2009).
- Continue to build partnerships and increase participation of non-governmental groups and volunteers in conservation efforts (recovery task 6.0) (USFWS, 2009).
- Closely monitor the population for disease outbreaks and prepare response plans to address disease outbreaks, with emphasis on Type E botulism (USFWS, 2009).
- Pursue development of agreements needed to assure long-term protection and management to maintain population targets and productivity (recovery task 1.18). Prototype agreements should be pursued at sites where there is a history of intensive and successful piping plover protection and a high degree of commitment to the piping plover protection program (USFWS, 2009).
- Continue efforts to purchase habitat and increase protection through conservation easements, deed restrictions, and other mechanisms (recovery task 1.362) (USFWS, 2009).
- Conduct further research on the genetic fitness and adequate effective size of the population through molecular genetic and pedigree analysis (recovery task 4.6) (USFWS, 2009).
- Update and refine population viability models to assess and potentially modify recovery goals for the population (recovery task 4.7) (USFWS, 2009).
- Develop strategies to reduce threats from the potential for water level decreases in the Great Lakes associated with climate change. Identify sites most likely to maintain (or increase) characteristics of suitable piping plover breeding and/or migration habitat (USFWS, 2009).
- Undertake studies addressing merlin foraging ecology and the relationship between merlins and piping plovers breeding areas in the Great Lakes (USFWS, 2009).
- Conduct studies to understand potential effects of wind turbine generators that may be located or proposed for the Great Lakes, nearshore, and within or between nesting or foraging habitats. Information needs include migration routes and altitude, flight patterns associated with breeding adults and post-fledged young of the year foraging at nearby sites that are not contiguous with nesting habitats, and avoidance rates under varying weather conditions (USFWS, 2009).

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SPECIES ACCOUNT: *Charadrius melodus circumcinctus* (Piping Plover - Northern Great Plains)

Species Taxonomic and Listing Information

Listing Status: Threatened; 12/11/1985; Midwest Region (R3) (USFWS, 2017)

Physical Description

The piping plover is a small [about 16.5 to 17.5 cm (6.5 to 7 inches long); 46 to 64 grams (1.5 to 2 ounces)] migratory shorebird with a short, stout bill, pale underparts and orange legs. During the breeding season, it also has a black band across the forehead, a single black neckband, and the bill is orange with a black tip. The piping plover was named for its melodic high-pitched call from which the scientific name is derived (USFWS 1988b). During the winter, the legs pale, the bill turns black, and the dark bands disappear. Chicks are speckled gray, buff, brown, and white down. Juveniles resemble adults in winter. Juveniles acquire adult plumage the spring after they fledge (Prater et al. 1977) (USFWS, 2015). Piping plover subspecies are phenotypically indistinguishable (USFWS, 2009).

Taxonomy

Miller et al. (2009) confirmed separate Atlantic and interior piping plover subspecies (C. m. melodus and C. m. circumcinctus, respectively). This study found that birds from the Great Lakes region were allied with the interior subspecies group and should be taxonomically referred to as C. m. circumcinctus. Currently available genetic information does not provide evidence that Great Lakes and Northern Great Plains piping plovers are genetically discrete (USFWS, 2009).

Historical Range

The Northern Great Plains population historically bred from Alberta to Ontario, Canada, south to Kansas and Colorado (USFWS, 2001).

Current Range

The breeding population of the Northern Great Plains piping plover extends from Nebraska north along the Missouri River through South Dakota, North Dakota, and eastern Montana, and on alkaline (salty) lakes along the Missouri River Coteau (a large plateau extending north and east of the Missouri River) in North Dakota, Montana, and extending into Canada. The majority of piping plovers from Prairie Canada winter along the south Texas coast, while breeding piping plovers from the U.S. are more widely distributed along the Gulf Coast from Florida to Texas (USFWS, 2015). Northern Great Plains piping plovers currently breed in eight states and three Canadian provinces (Elliott-Smith et al. 2009). Their range extends about 1,000 miles (1,600 km) from north to south and spans more than 800 miles (1,300 km) from west to east. Gratto-Trevor et al. (2009) found that Mississippi, Louisiana, and Texas coasts harbored 71% of observed wintering birds from the U.S. Northern Great Plains. Except at inland sites, piping plover migration routes and habitats overlap breeding and wintering habitats, and, unless banded, migrants passing through a site usually are indistinguishable from breeding or wintering piping plovers. Northern Great Plains populations were primarily seen farther west and south, especially on the Texas Gulf Coast in winter (Gratto-Trevor et al. 2009). Up to approximately 83% of the plovers in the U.S. Northern Great Plains nest on alkali lakes along the Missouri Coteau from central North Dakota to eastern Montana (Figure NGP10) (Brown and Jorgensen

2008, Peyton and Wilson 2008, USACE in litt. 2008a, USFWS in litt. 2008a) (USFWS, 2009a). Piping plovers winter in coastal areas of the United States from North Carolina to Texas. They also winter along the coast of eastern Mexico and on Caribbean islands from Barbados to Cuba and the Bahamas (Haig 1992) (USFWS, 2001).

Distinct Population Segments Defined

No; There are separate breeding populations in the Northern Great Plains and the Great Lakes areas (USFWS, 2009).

Critical Habitat Designated

Yes; 7/10/2001.

Legal Description

On May 19, 2009, the U.S. Fish and Wildlife Service (Service), designated revised critical habitat for the wintering population of the piping plover (Charadrius melodus) in 18 specific units in Texas under the Endangered Species Act of 1973, as amended (74 FR 23476 - 23600). In total, approximately 139,029 acres (56,263 hectares) fall within the boundaries of the revised critical habitat designation. Other previously designated critical habitat for the wintering piping plover in Texas or elsewhere in the United States remains unaffected.
On October 21, 2008, the U.S. Fish and Wildlife Service (Service), designated revised critical habitat for the wintering population of the piping plover (Charadrius melodus) in North Carolina under the Endangered Species Act of 1973, as amended (73 FR 62816 - 62841). In total, approximately 2,043 acres (ac) (827 hectares (ha)), in Dare and Hyde Counties, North Carolina, fall within the boundaries of the revised critical habitat designation.
On July 10, 2001, the Fish and Wildlife Service (Service), designated 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the piping plover (Charadrius melodus) (66 FR 36038 - 36143). This includes approximately 2,891.7 kilometers (km) (1,798.3 miles (mi)) of mapped shoreline and approximately 66,881 hectares (ha) (165,211 acres (ac)) of mapped area along the Gulf and Atlantic coasts and along margins of interior bays, inlets, and lagoons.
On September 11, 2002, the U.S. Fish and Wildlife Service (Service), designated critical habitat for the northern Great Plains breeding population of the piping plover (Charadrius melodus), pursuant to the Endangered Species Act of 1973, as amended (67 FR 57638 - 57717). The designation includes 19 critical habitat units containing prairie alkali wetlands, inland and reservoir lakes, totaling approximately 183,422 acres (ac) (74,228.4 hectares (ha)) and portions of 4 rivers totaling approximately 1,207.5 river miles (rm) (1,943.3 kilometers (km)) in the States of Minnesota, Montana, Nebraska, North Dakota, and South Dakota.
Critical habitat includes prairie alkali wetlands and surrounding shoreline, including 200 feet (ft) (61 meters (m)) of uplands above the high water mark; river channels and associated sandbars, and islands; reservoirs and their sparsely vegetated shorelines, peninsulas, and islands; and inland lakes and their sparsely vegetated shorelines and peninsulas. Section 7 of the Endangered Species Act requires Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to destroy or adversely modify critical habitat.

Critical Habitat Designation

18 units are designated as revised critical habitat in Texas for the wintering population of the piping plover. The units are divided into 24 areas: (1)Subunit TX–3A: South Padre Island – Gulf of Mexico Shoreline; (2)Subunit TX–3B: South Padre Island –Interior; (3)Subunit TX–3C: North Padre

Island – Interior; (4)Subunit TX–3D: North Padre Island – Gulf of Mexico; (5)Subunit TX–3E: Mesquite Rincon; (6)Unit TX–4: Lower Laguna Madre Mainland; (7)Unit TX–7: Newport Pass/Corpus Christi Pass Beach; (8)Unit TX–8: Mustang Island Beach; (9)Unit TX–9: Fish Pass Lagoons; (10)Subunit TX–10A: Shamrock Island; (11)Subunit TX–10B: Mustang Island – Unnamed sand flat; (12)Subunit TX–10C: Mustang Island – Lagoon Complex; (13)Unit TX–14: East Flats; (14)Unit TX–15: North Pass; (15)Unit TX–16: San Jose Beach; (16)Unit TX–18: Cedar Bayou/Vinson Slough; (17)Unit TX–19: Matagorda Island Beach; (18)Unit TX–22: Decros Point; (19)Unit TX–23: West Matagorda Peninsula Beach; (20)Unit TX–27: East Matagorda Bay/ Matagorda Peninsula Beach West; (21)Unit TX–28: East Matagorda Bay/ Matagorda Peninsula Beach East; (22)Unit TX–31: San Bernard NWR Beach; (23)Unit TX–32: Gulf Beach Between Brazos and San Bernard Rivers; and (24)Unit TX–33: Bryan Beach and Adjacent Beach.

Unit TX–3: Padre Island Subunit. TX–3A: South Padre Island – Gulf of Mexico Shoreline. This subunit consists of 2,891 ac (1170 ha) in Cameron and Willacy Counties, Texas. It is a beach 30.0 mi (48.2 km) in length on the gulfside of South Padre Island, which is a barrier island. The subunit is located within an area bounded on the south by the southern boundary of Andy Bowie County Park, and on the north by the south jetty of Mansfield Channel, which divides North and South Padre Islands. The jetty itself is outside the boundary of the subunit. The eastern boundary is the estimated MLLW of the Gulf of Mexico, and the western boundary is the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. The vegetated dune and Park Road 100, which runs northsouth along the western side of the dune, separates Subunits TX–3A and 3B. This subunit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately one quarter of the subunit is in Federal ownership and managed by the Service's Laguna Atascosa National Wildlife Refuge (NWR), and approximately 64 percent is in private ownership. The Service does not own the subsurface mineral rights. Ten percent is State land managed by the GLO, and a small portion at the southern end is County park land managed by Andy Bowie County Park. Subunit TX–3A is the southernmost unit of the revised critical habitat for the wintering population of the piping plover. It was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this subunit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1), surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. These threats are of greatest magnitude at the southern end of the subunit where housing developments are to the west of the subunit. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area. Subunit TX–3B: South Padre Island –Laguna Madre side. This bayside subunit consists of 44,137 ac (17,862 ha) in Cameron and Willacy Counties, Texas. Its southern boundary extends along the north side of an existing earthen, manmade dike running from the edge of dense dune vegetation to the Laguna Madre along latitude 26° 09' 19.00'' N. The dike is not within the boundary of the subunit. The western boundary is the western edge of the intertidal mudflats bordering the eastern shore of the lower Laguna Madre, and the northern boundary is Mansfield Channel. The eastern boundary is dense vegetation of the dunes or, if there is no dense vegetation or dune, the western boundary of Park Road 100. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. Approximately 42 percent of the land is federally owned and managed by the Service's Laguna Atascosa NWR, and approximately 38 percent is Stateowned and managed by the GLO. The remaining 20 percent is in private ownership along the western side of the subunit. The Service does not own the subsurface mineral rights beneath the refuge. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand and mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. These threats, particularly vehicle access, are of greatest magnitude at the southern portion of the subunit where roads are near or adjacent to PCE 1. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however, a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area. Subunit TX–3C: North Padre Island – Laguna Madre side. This bayside unit consists of 50,897 ac (20,597 ha) in Kenedy and Kleberg Counties, Texas. It is along and within the Laguna Madre and extends from the western boundary of Padre Island National Seashore (PAIS) to the Gulf Intracoastal Waterway (GIWW). The northern boundary of the subunit is a line extending westward from the PAIS (at latitude 27° 4' 29.9'' N), and its southern boundary is a line extending westward from the southern boundary of PAIS along the northern edge of the Mansfield Channel. The eastern boundary of this subunit is the western boundary of PAIS when the PCEs extend as far as PAIS or the eastern edge of the sand flats where the PCEs end. The portion of the western boundary north of longitude/latitude coordinate 26°48'38.2''N, 97°28'11.6''W is the eastern edge of the GIWW, and the portion of the western boundary south of the coordinate is the western edge of the intertidal mudflats bordering the eastern shore of the Laguna Madre. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. Most of the land is State-owned and managed by the GLO. A small portion is in private ownership. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This subunit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 8). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. At this time the Service is not aware of any management plans that address this species in this area. Subunit TX–3D: North Padre Island – Gulf of Mexico. This gulfside subunit consists of 270 ac (109 ha) of beach in Kleberg County, Texas. It extends along the gulf shore of North Padre Island from the northern boundary of PAIS northward 6.2 mi (10 km) to the Nueces County line. The southern boundary is the north boundary of the northeast section of the PAIS. The subunit extends eastward to the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This subunit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Most of the land is owned by the State and managed by the GLO. Approximately one-fifth is in private ownership. It was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this subunit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surfcast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. These threats are of greater magnitude at the north end of the subunit, where more roads provide easy access to the PCEs and the subunit is in close proximity to houses. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–3E: North Padre Island – Mesquite Rincon. This triangular bayside subunit of 9,6238 acres (3,894 hectares) lies on the western shore of the lower Laguna Madre in Kenedy County, Texas. The subunit is generally bounded by Rincon de la Soledad on the southwestern side, Mesquite Rincon on the north, and the GIWW and Rincon de San Jose on the east. The southwestern boundary is an irregular line along the PCEs between the latitude/longitude coordinate points: 26° 44’ 10.5’’ N, 97° 28’ 04.5’’ W at the southeastern point of Rincon de San Jose and 26° 50′ 58.1′′ N, 97° 34′ 19.5′′ W. The northern boundary is the line described between the latitude/longitude coordinate points: 26° 51′ 24.2′′ N, 97° 33′ 25.8′′ W and 26° 51′ 24.2′′ N, 97° 27′ 52.7′′ W. The northern portion of the eastern boundary is the western edge of the GIWW south to latitude/longitude coordinate point 26° 48′ 52.7′′ N, 97° 28′ 12.9′′ W. There the subunit curves westward and skirts a small horseshoeshaped inlet in the Laguna Madre to the northeastern point of Rincon de San Jose at latitude/longitude coordinate point 26° 48′ 43.9′′ N, 97° 29′ 4.7′′ W. There it continues south in an irregular line along the edge of the PCEs to the southeastern point of Rincon San Jose. Within that boundary (especially the southeastern portion of the subunit and northwestern-running edge), the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. Most of the land is in private ownership with a small portion that is State-owned and managed by the GLO. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This subunit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 7). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–4: Lower Laguna Madre Mainland. This bayside unit consists of 17,223 ac (6,970 ha) in Cameron and Willacy Counties, Texas, and lies along the western shoreline of the Lower Laguna Madre. The southern boundary is an east-west line at the northern tip of Barclay Island, approximately following latitude 26° 14′ 42.2′′ N. The northern boundary is an east-west line located near the northern tip of El Sauz Island, approximately 1.2 mi (1.9 km) south of the center of the city of Port Mansfield, Willacy County, Texas, and approximately following latitude 26° 32′ 7.8′′ N. The eastern boundary of the unit is the eastern edge of the line of dredge spoils that parallel the western side of the GIWW. The western boundary runs from southeast to northwest and is the western edge of sandy beach and mudflat habitat, approximately following the latitude/longitude coordinate points: latitude/longitude coordinate points: 26° 14′ 42.45′′ N, 97° 19′ 32.75′′ W; 26° 17′ 15.54′′ N, 97° 20′ 47.31′′ W; 26° 20′ 10.17′′ N, 97° 21′ 10.94′′ W; 26° 21′ 31.54′′ N, 97° 22′ 48.10′′ W; 26° 24′ 26.64′′ N, 97° 23′ 53.27′′ W; 26° 26′ 8.55′′ N, 97° 25′ 13.33′′ W; and 26° 32′ 5.44′′ N, 97° 27′ 6.91′′ W. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service has used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. Approximately one-third of this unit is within the Service's Laguna Atascosa NWR. Approximately half is Stateowned and managed by the GLO. The remainder is in private ownership. The Service does not own the subsurface mineral rights beneath the surface of the refuge. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand or mud flats above high tide for roosting (PCE 2). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This unit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 8). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however, a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–7: Newport Pass/Corpus Christi Pass Beach. This unit consists of 294 ac (119 ha) in Nueces County, Texas. It is a gulfside beach unit approximately 5.1-mi (8.2- km) long. The southern boundary is the gulfward extension of Saint Bartholomew Avenue, adjacent to the north end of the seawall. The northern boundary is the edge of the south jetty of the Fish Pass Structure at Mustang Island State Park. The eastern boundary is MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dune. Packery Channel cuts the beach approximately 0.3 mi (0.5 km) north of the south boundary. The seawall, jetty, bollards, and open water of Packery Channel are not within the boundaries of the unit. This unit is in State and private ownership; the State portion is managed by the Mustang Island State Park. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains PCEs in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. Due to its close proximity to Corpus Christi, this unit receives considerable recreational use and beach cleaning and nourishment. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–8: Mustang Island Beach. This unit consists of 623 ac (252 ha) in Nueces County, Texas. It is a gulfside beach unit approximately 12.5 mi (20.1 km) long. The southern boundary is the edge of the north jetty of the Fish Pass Structure at Mustang Island State Park. The northern boundary is the south side of the Horace Calder Pier in Port Aransas, Texas. The unit is bounded on the east by the MLLW of the Gulf of Mexico, and on the west by the dune line, where the habitat changes from lightly vegetated sandy beach to densely vegetated. The jetty and pier are not within the boundary of the unit. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The unit is in State and private ownership, with a small municipal park owned and managed by the City of Port Aransas. The State land is managed by the GLO. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. Due to its close proximity to Corpus Christi, this unit receives considerable recreational use and beach cleaning and nourishment. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–9: Fish Pass Lagoons. This bayside unit consists of 168 ac (68 ha) in Nueces County, Texas. This unit encompasses flats facing Corpus Christi Bay that extend 1.0 km (0.6 mi) on either side of Fish Pass. The inland boundary is a line of dense vegetation, and the bayside boundary is the northeast edge of the tidal sand flats that are a PCE. This unit includes all areas of habitat that contain PCEs 1, 2, 5, and 6 within the area described by a polygon with the following latitude/longitude coordinate points: 27° 42′ 14.63′′ N, 97° 10′ 44.70′′ W; 27° 41′ 56.97′′ N, 97° 10′ 8.13′′ W; 27° 41′ 24.35′′ N, 97° 10′ 36.89′′ W; 27° 41′ 18.98′′ N, 97° 11′ 16.79′′ W; 27° 41′ 23.51′′ N, 97° 11′ 31.32′′ W and 27° 42′ 14.63′′ N, 97° 10′ 44.70′′ W. Within that polygon, six moderate to large polygons from 5 to 64 ac (2 to 25 ha) each and two small polygons less than 1 ac (0.4 ha) each are PCEs and comprise the unit. Most of the unit is owned by the State and managed by the GLO. A few acres are in private ownership. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and/or mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–10: Shamrock Island and Adjacent Mustang Island Flats. Subunit TX–10A: Shamrock Island. This 12-ac (5-ha) island in Nueces County, Texas, was a peninsula extending off of Mustang Island in Corpus Christi Bay until erosion separated the island from the mainland. Five small polygons of sand flats from 1.1 to 6.8 ac (0.4 to 2.7 ha) comprise the subunit. Most of the land is State-owned and managed by the GLO; the remainder is privately owned. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–10B: Mustang Island: Unnamed sand flat. This 2-ac (1-ha) subunit in Nueces County, Texas, is a small, unnamed sand flat near the north edge of the mouth of Wilson's Cut in Corpus Christi Bay. The subunit is the western half of the island that is sand flats landward (easterly) to the western edge of tidal marsh. It is entirely Stateowned and managed by the GLO. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans and domestic animals; and increased predation due to recreational use. The location of the subunit, and the configuration of the polygons of PCEs that comprise this subunit, limit recreational access by vehicles to PCEs 1 and 2. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–10C: Mustang Island: Lagoon Complex. This 331-ac (134-ha) subunit in Nueces County, Texas, is an extensive lagoon complex that consists of 11 polygons within a larger polygon that extends 2.2 mi (3.5 km) south of Wilson's Cut in Corpus Christi Bay. The southern boundary of the larger polygon begins at the western end at latitude/ longitude coordinate point 27° 43' 2,4'' N, 97° 10' 19.4'' W at the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. It follows the dune line southeast approximately 830 ft (253 m) to a road, then follows the road approximately 945 ft (288 m) to the edge of the tidal sand flat PCE. It follows the southeastern edge of the sand flat northeast to the western edge of a northsouth road, where it follows the edge of the sand flat northward to the south edge of a road that runs east-west parallel to the southwestern edge of Wilson's Cut. The northern edge of the boundary is the south edge of the road or the northern extent of the sand flat when it does not reach the road. The western boundary follows the PCEs along their eastern edge at Corpus Christi Bay beginning 409 ft (125 m) southwest of the southwestern edge of Wilson's Cut to the coordinate point at the western edge of the southern boundary. A road transects the larger polygon described above, forming two polygons that exclude the road. The PCEs within the 11 polygons comprise the subunit. Within that boundaries of the 11 polygons, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the polygons that comprise the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundaries can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. The subunit consists of private and Stateowned lands. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to uncontrolled recreational access and beach cleaning and stabilization efforts. Road access to the PCEs is extensive. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–14: East Flats. This bayside unit consists of 591 ac (239 ha) in Nueces County, Texas. It is an irregularly shaped intertidal sand flat south of the Corpus Christi Ship Channel. The north boundary is the northern edge of the sand flat near or adjacent to dredge spoil areas bordering the south side of the Corpus Christi Ship Channel. The northwestern latitude/longitude coordinate is 27° 49’ 54.49’’ N, 97° 6’ 14.28’’ W, and the northeastern latitude/longitude coordinate is 27° 49’ 55.29’’ N, 97° 5’ 12.86’’ W. From there, the sand flat curves southward, and the southeastern edge of it forms a highly irregular line that ends in the southwest portion of the polygon at the eastern edge of a navigation channel from the Corpus Christi Ship Channel to Corpus Christi Bay at latitude/longitude coordinate 51.93’’ N, 97° 5’ 52.58’’ W. The sand flat continues on the western edge of the navigation channel in a northwesterly direction to latitude/longitude coordinate 27° 49’ 22.08’’ N, 97° 6’ 37.04’’ W. It then curves northeasterly and across the cut to the northern edge at the northwest coordinate. On the east, it abuts the City of Port Aransas. There is a small marshland within the sand flat that bisects the sand flat that is not a PCE and is not included in the unit. The unit is mostly in private ownership, with a small portion of State land managed by the GLO. This unit was occupied at the time of listing and is currently occupied. Current ocupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–15: North Pass. This bayside unit consists of 805 ac (326 ha) in Aransas County, Texas. The unit is bounded on the northeast by a line between latitude/longitude coordinates 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W and 27° 54′ 54.53′′ N, 97° 1′ 18.17′′ W, on the northwest and west by the edge of tidal sand flats in Aransas Bay, on the south by a line running east from coordinate 27° 53′ 16.96′′ N, 97° 2′ 22.44′′ W to unit TX–16, and on the southeast by the landward boundary of unit 16. The unit is all areas that contain the PCEs for the species within a larger area described by a polygon with the following sets of latitude/longitude coordinate points: 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W; 27° 53′ 10.68′′ N, 97° 1′ 21.36′′ W; 27° 53′ 16.96′′ N, 97° 2′ 22.44′′ W; 27° 53′ 33.08′′ N, 97° 2′ 33.05′′ W; 27° 54′ 42.68′′ N, 97° 2′ 4.83′′ W; 27° 54′ 47.59′′ N, 97° 1′ 51.73′′ W; 27° 54′ 54.53′′ N, 97° 1′ 18.17′′ W and 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale, so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. This unit is a remnant of a hurricane washover on San Jose Island. Approximately 18 percent is Stateowned and managed by the GLO; the remainder is in private ownership. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–16: San Jose Beach. This unit consists of 1,378 ac (558 ha) in Aransas County, Texas. It is a gulfside beach unit approximately 19.8 mi (31.9 km) long. The southern boundary is the edge of the north jetty of Aransas Pass. The jetty is not within the boundary of the unit. The south edge of Cedar Bayou Pass is the northern boundary. The eastern boundary is the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. A small section is in Federal ownership and managed by the Service's Matagorda Island NWR. The Service does not own the subsurface mineral rights. Approximately half of the unit is State-owned and managed by the GLO, and nearly as much is in private ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, the CCP is not yet available. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–18: Cedar Bayou/Vinson Slough. This bayside unit consists of 2,465 ac (998 ha) in Aransas County, Texas. It is a remnant of a hurricane washover area and includes the highly dynamic area of Cedar Bayou, the pass that separates San Jose Island and Matagorda Island. Beginning at the confluence of Vinson Slough and Cedar Bayou, the boundary follows the shore of Spalding Cove to Long Reef, then continues along a line extending 2.5 miles southwest of Long Reef to the shore of San Jose Island, then along the shore of the island to the landward boundary of Unit TX–16. Within that area, the unit consists of numerous polygons of PCEs; areas that are not PCEs within the described area are not within the boundaries of the unit. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. The southern and southeastern boundary of the unit is described by a line with the following sets of latitude/longitude coordinate points: 28° 1′ 21.76′′ N, 96° 57′ 51.24′′ W; 28° 1′ 12.77′′ N, 96° 57′ 31.18′′ W; 28° 2′ 3.07′′ N, 96° 56′ 45.84′′ W; 28° 2′ 15.92′′ N, 96° 56′ 25.10′′ W; 28° 2′ 30.32′′ N, 96° 56′ 11.97′′ W; 28° 3′ 15.62′′ N, 96° 54′ 20.01′′ W; 28° 3′ 58.58′′ N, 96° 53′ 24.65′′ W; 28° 4′ 1.15′′ N, 96° 52′ 14.65′′ W; 28° 3′ 31.74′′ N, 96° 51′ 38.29′′ W and 28° 3′ 17.69′′ N, 96° 51′ 38.47′′ W. The specific northern boundary is described by a line with the following sets of latitude/longitude coordinate points: 28° 5′ 44.24′′ N, 96° 54′ 8.16′′ W; 28° 5′ 13.23′′ N, 96° 52′ 44.85′′ W; 28° 4′ 33.99′′ N, 96° 50′ 46.55′′ W; 28° 4′ 38.92′′ N, 96° 50′ 40.79′′ W and 28° 4′ 22.98′′ N, 96° 50′ 22.94′′ W. The eastern boundary at the northeastern end of the unit is units TX–16 and TX–19 on the gulfside. The western boundary is the western edge of tidal sand flats in Aransas Bay. This area includes a small section of federally owned land managed by the Service's Matagorda Island NWR and a small section of State-owned land. The remaining area is privately owned. The Service does not own the subsurface mineral rights beneath the NWR. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use. Vehicle use of the unit may be limited somewhat by accessibility. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, the CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–19: Matagorda Island Beach. This unit consists of 2,413 ac (976 ha) in Calhoun County, Texas. It is a gulfside beach unit approximately 37.1 mi (59.7 km) long. The southern boundary is the northern edge of Cedar Bayou Pass, and the northern boundary is the southern edge of Pass Cavallo. At Pass Cavallo, the unit curves from the eastern gulfside passing between the south edge of the pass and the north edge of the dunes to a small area on the bayside. The eastern boundary is the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The federally owned land in this unit is managed by the Service's Matagorda Island NWR, which does not own the subsurface mineral rights. This unit also includes a small section of land in State ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and access by refuge staff and others for sea turtle monitoring efforts. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, a CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–22: Decros Point. This unit consists of 544 ac (220 ha) at the Matagorda/Calhoun County line, in Texas. It is a gulfside beach unit approximately 4.8 mi (7.7 km) long that wraps around to the bayside. This unit was originally the southern tip of the Matagorda Peninsula. It was made into an island by the dredging of the Matagorda Ship Channel, the edge of which is the northern boundary of the unit. The unit is horseshoe in shape with the east side along the Gulf of Mexico and the west side along Matagorda Bay; the two are connected at their southern boundary by habitat from the north edge of Pass Cavallo northward to the dune line. Densely vegetated sand dunes run north to south in the center of the horseshoe and are not within the boundary of the critical habitat because they are not a PCE. The eastern boundary is the MLLW of the Gulf of Mexico (see the Methods section for our derivation of MLLW), and the western boundary is the western edge of tidal sand flats on the east side of Matagorda Bay. Within the bayside of the boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately 60 percent of the unit is in State ownership managed by the GLO. The remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach (PCE 4) for roosting and sheltering. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. Due to a lack of road access, this unit does not receive much recreational vehicle use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–23: West Matagorda Peninsula Beach. This unit consists of 1,808 ac (732 ha) of shoreline in Matagorda County, Texas. It is a gulfside beach unit approximately 23.9 mi (38.5 km) long. The southern boundary is the northern jetty of the Matagorda Ship Channel. The northern boundary is the Old Colorado River channel. The MLLW of the Gulf of Mexico is the eastern boundary, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Just under half of the unit is Stateowned and managed by the GLO; the remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–27: East Matagorda Bay/ Matagorda Peninsula Beach West. This unit consists of 905 ac (366 ha) of shoreline in Matagorda County, Texas. It is a gulfside beach unit approximately 14.1 mi (22.8 km) long. The southwestern boundary is the northeastern edge of the Old Colorado River channel. The unit runs along the beach 14 mi (23 km) to the northeastern boundary opposite Eidelbach Flats described by a line between the latitude/longitude coordinate points: 28° 41’ 2.26’’ N, 95° 46’ 29.04’’W and 28° 41’ 6.74’’ N, 95° 46’ 32.46’’ W. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Just over half of the unit is Stateowned and managed by the GLO; the remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–28: East Matagorda Bay/ Matagorda Peninsula Beach East. This gulfside unit consists of 481 ac (194 ha) in Matagorda County, Texas. It extends along the Gulf beach southwest and northeast of Brown Cedar Cut. The cut is not within the boundary of the unit. This unit abuts portions of the southeastern edges of units TX–29 and TX–30, which are on the East Matagorda Bay side. The southwestern boundary is approximately 4 mi (6.5 km) southwest of Brown Cedar Cut at a line described by the following sets of latitude/ longitude coordinate points: 28° 43’ 11.91’’N, 95° 42’ 25.47’’W and 28° 43’ 17.09’’N, 95° 42’ 28.56’’W. The northeastern boundary is approximately 2.8 mi (4.5 km) northeast of Brown Cedar Cut to the point where Texas Farm to Market Road 457 intersects the beach. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat boundaries, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately onethird is in State ownership and managed by the GLO; the remaining two-thirds is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–31: San Bernard NWR Beach. This gulfside unit consists of 401 ac (162 ha) in Matagorda and Brazoria Counties, Texas. It is a 6.2-mi (10-km) segment of beach on the Gulf of Mexico near the mouth of the San Bernard River. The northeastern boundary is at the southwestern edge of the mouth of the San Bernard River. The southwestern boundary follows a line described by the following sets of latitude/longitude coordinate points: 28° 47’ 54.39’’ N, 95° 33’ 26.21’’ W, and 28° 47’ 57.69’’ N, 95° 33’ 27.75’’ W. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. There is a cut through the beach from the Gulf of Mexico to a lake 3.5 mi (5.6 km) southwest of the San Bernard River, which is not within the unit. Bollards also are not within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately 30 percent of this unit is in Federal ownership and managed by the Service's San Bernard NWR, which does not own the subsurface mineral rights. Approximately 48 percent is Stateowned and managed by the GLO with the remaining area in private ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. The federally owned portion has pedestrian recreational access, but no vehicle access. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, a CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–32: Gulf Beach Between Brazos and San Bernard Rivers. This gulfside unit consists of 556 ac (225 ha) of shoreline in Brazoria County, Texas. This unit is a 6.1-mi (9.8-km) segment of beach on the Gulf of Mexico between the mouths of the San Bernard and Brazos Rivers. The southwestern boundary is the northeastern edge of the mouth of the San Bernard River. The northeastern boundary is the western edge of the mouth of the Brazos River. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. It is entirely in State ownership and managed by the GLO. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–33: Bryan Beach and Adjacent Beach. This unit consists of 211 ac (85 ha) in Brazoria County, Texas. It is gulfside beach approximately 3.5 mi (5.7 km) in length on the Gulf of Mexico near the mouth of the Brazos River. The southwestern boundary is the northeastern edge of the Brazos River. The northeastern boundary is Farm-toMarket Road 1495 (Bryan Beach Rd). The southeastern boundary is the MLLW. The northwestern boundary follows along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The unit is entirely in State ownership and managed by the Texas Department of Parks and Wildlife. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Four units are designated as critical habitat for the wintering population of the piping plover in North Carolina. The four areas designated as critical habitat are: (1) Unit NC–1, Oregon Inlet; (2) Unit NC–2, Cape Hatteras Point; (3) Unit NC–4, Hatteras Inlet; and (4) Unit NC–5, Ocracoke Island.

Unit NC–1: Oregon Inlet. Unit NC–1 is approximately 8.0 km (5.0 mi) long, and consists of about 196 ha (485 ac) of sandy beach and inlet spit habitat on Bodie Island and Pea Island in Dare County, North Carolina. This is the northernmost critical habitat unit within the wintering range of the piping plover. Oregon Inlet is the northernmost inlet in coastal North Carolina, approximately 19.0 km (12.0 mi) southeast of the Town of Manteo, the county seat of Dare County. The unit is bounded by the Atlantic Ocean on the east and Pamlico Sound on the west and includes lands from the mean lower low water (MLLW) on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by piping plovers and where the PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The unit begins at Ramp 4 near the Oregon Inlet Fishing Center on Bodie Island and extends approximately 8.0 km (5.0 mi) south to the intersection of NC Highway 12 and Salt Flats Wildlife Trail (near Mile Marker 30, NC Highway 12), approximately 5.0 km (3.0 mi) from the groin, on Pea Island, and includes Green Island and any emergent sandbars south and west of Oregon Inlet, and the lands owned by the State of North Carolina, specifically islands DR–005–05 and DR– 005–06. However, this unit does not include the Oregon Inlet Fishing Center, NC Highway 12, the Bonner Bridge and its associated structures, the terminal groin, the historic Pea Island Life-Saving Station, or any of their ancillary facilities (e.g., parking lots, out buildings). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. Oregon Inlet has reported consistent use by wintering piping plovers dating from the mid-1960s. As many as 100 piping plovers have been reported from a single day survey during the fall migration (NCWRC unpublished data). Christmas bird counts regularly recorded 20 to 30 plovers using the area. Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). The overall number of piping plovers reported using the area has declined since the species was listed in 1986 (NCWRC unpublished data), which corresponds to increases in the number of human users (NPS 2005) and off-road vehicles (Davis and Truett 2000). Oregon Inlet is one of the first beach access points for off-road vehicles within Cape Hatteras National Seashore when traveling from the developed coastal communities of Nags Head, Kill Devil Hills, Kitty Hawk, and Manteo. As such, the inlet spit is a popular area for off-road vehicle users to congregate. The majority of the Cape Hatteras National Seashore users in this area are off-road vehicle owners and recreational fishermen. In fact, a recent visitor use study of Cape Hatteras National Seashore reported that Oregon Inlet is the second most popular off-road vehicle use area in the park (Vogelsong 2003). Furthermore, the adjacent islands are easily accessed by boat, which can be launched from the nearby Oregon Inlet Fishing Center. Pea Island National Wildlife Refuge (PINWR) does not allow off-road vehicle use; however, Pea Island regularly receives dredged sediments from the maintenance dredging of Oregon Inlet by the Corps. The disposal of dredged sediments on PINWR has the potential to disturb foraging and roosting plovers and their habitats. As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–2: Cape Hatteras Point. Unit NC–2 consists of 262 ha (646 ac) of sandy beach and sand and mud flat habitat in Dare County, North Carolina. Cape Hatteras Point (also known as Cape Point or Hatteras Cove) is located south of the Cape Hatteras Lighthouse. The unit extends south approximately 2.8 mi (4.5 km) from the ocean groin near the old location of the Cape Hatteras Lighthouse to the point of Cape Hatteras, and then extends west 4.7 mi (7.6 km) along Hatteras Cove shoreline (South Beach) to the edge of Ramp 49 near the Frisco Campground. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by piping plovers and where PCEs do not occur). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. This unit does not include the ocean groin. Consistent use by wintering piping plover has been reported at Cape Hatteras Point since the early 1980s, but the specific area of use was not consistently recorded in earlier reports. Often piping plovers found at Cape Hatteras Point, Cape Hatteras Cove, and Hatteras Inlet were reported as a collective group. However, more recent surveys report plover use at Cape Hatteras Point independently from Hatteras Inlet. These single day surveys have recorded as many as 13 piping plovers a day during migration (NCWRC unpublished data). Christmas bird counts regularly recorded 2 to 11 plovers using the area. Cape Hatteras Point is located near the Town of Buxton, the largest community on Hatteras Island. For that reason, Cape Hatteras Point is a popular area for ORV use and recreational fishing. A recent visitor use study of the park found that Cape Hatteras Point had the most ORV use within the park (Vogelsong 2003). As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–4: Hatteras Inlet. Unit NC–4 is approximately 8.0 km (5.0 mi) long, and consists of 166 ha (410 ac) of sandy beach and inlet spit habitat on the western end of Hatteras Island and the eastern end of Ocracoke Island in Dare and Hyde Counties, North Carolina. The unit begins at the first beach access point at Ramp 55 at the end of NC Highway 12 near the Graveyard of the Atlantic Museum on the western end of Hatteras Island and continues southwest to the beach access at the ocean-side parking lot near Ramp 59 on the northeastern end of Ocracoke Island. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which itself is not used by the piping plover and where PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The Hatteras Inlet unit includes all emergent sandbars within Hatteras Inlet including lands owned by the State of North Carolina, specifically Island DR–009–03/04. The unit is adjacent to, but does not include, the Graveyard of the Atlantic Museum, the ferry terminal, the groin on Ocracoke Island, NC Highway 12, or their ancillary facilities (e.g., parking lots, out buildings). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. Hatteras Inlet has reported consistent use by wintering piping plovers since the early 1980s, but the specific area of use was not consistently recorded in earlier reports. Often piping plovers found at Cape Hatteras Point, Cape Hatteras Cove, and Hatteras Inlet were reported as a collective group. However, more recent surveys report plover use at Hatteras Inlet independently from Cape Hatteras Point. These single-day surveys have recorded as many as 40 piping plovers a day during migration (NCWRC unpublished data). Christmas bird counts regularly recorded 2 to 11 plovers using the area. Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). The overall numbers of piping plovers reported using the area has declined in the last 10 years (NCWRC unpublished data), corresponding with increases in the number of human users (NPS 2005) and off-road vehicles (Davis and Truett 2000). Hatteras Inlet is located near the Village of Hatteras, Dare County, and is the southernmost point of Cape Hatteras National Seashore that can be reached without having to take a ferry. As such, the inlet is a popular off-road vehicle and recreational fishing area. In fact, a recent visitor use study of the park found Hatteras Inlet the fourth most used area by off-road vehicles in the park (Vogelsong 2003). Furthermore, the adjacent islands are easily accessed by boat, which can be launched from the nearby marinas of Hatteras Village. As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–5: Ocracoke Island. This unit consists of 203 ha (502 ac) of sandy beach and mud and sand flat habitat in Hyde County, North Carolina. The unit includes the western portion of Ocracoke Island beginning at the beach access point at the edge of Ramp 72 (South Point Road), extending west approximately 2.1 mi (3.4 km) to Ocracoke Inlet, and then back east on the Pamlico Sound side to a point where stable, densely vegetated dune habitat meets the water. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by the piping plover and where PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The unit includes all emergent sandbars within Ocracoke Inlet. This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. The unit is adjacent to but does not include NC Highway 12, any portion of the maintained South Point Road at Ramp 72, or any of their ancillary facilities. Ocracoke Island had inconsistent recorded use by wintering piping plovers in the early 1980s, and Christmas bird counts recorded only 1 to 6 plovers using the area throughout the early 1990s.

However, since the late 1990s when regular and consistent surveys of the area were conducted, as many as 72 piping plovers have been recorded during migration, and 4 to 18 plovers have been regularly recorded during the overwinter period (NCWRC unpublished data). Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). Ocracoke Inlet is located near the Village of Ocracoke, and is the southernmost point of the Cape Hatteras National Seashore. Ocracoke Island is only accessible by ferry. As such, the island is a popular destination for vacationers and locals interested in seclusion. The inlet is also a popular recreational fishing and ORV area. A recent visitor use study of the park reported Ocracoke Inlet was the third most popular ORV use area in the park (Vogelsong 2003). As a result, the primary threat to the wintering piping plover and its habitat within this unit is disturbance to and degradation of foraging and roosting areas by ORVs and by people and their pets. Therefore, sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

The lands designated as critical habitat were divided into 142 critical habitat conservation units that contain areas with the primary constituent elements for the piping plover in the wintering range of the species. These units are found in all eight States where piping plovers winter. See above for revised critical habitat in NC and TX (Units TX– 3, TX–4, TX–7, TX–8, TX–9, TX–10, TX–14, TX–15, TX–16, TX–18, TX–19, TX–22, TX–23, TX–27, TX–28, TX–31, TX–32, and TX–33).

Unit SC–1: Waites Island-North. 75 ha (186 ac) in Horry County. This unit includes the northern tip of Waites Island from the MLLW at Little River Inlet and runs west along the Atlantic Ocean shoreline 2.0 km (1.25 mi) and includes land from the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The unit continues north and west of Little River Inlet stopping at Sheephead Creek, including land from MLLW to dense vegetation line. The majority of the unit is privately owned.

Unit SC–2: Waites Island-South. 58 ha (142 ac) in Horry County.This unit includes the southern tip of Waites Island from the MLLW at Hog Inlet and runs east along the Atlantic Ocean shoreline 0.80 km (0.50 mi) and includes MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. It continues north and west of the Hog inlet, stopping at the first major tributary. Critical habitat includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Emerging sandbars within Hog Inlet and adjacent to the tip if eastern Cherry Grove Beach are also included from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begins and where the constituent elements no longer occur. The majority of this unit is privately owned.

Unit SC–3: Murrells Inlet/Huntington Beach. 135 ha (334 ac) in Georgetown County. The majority of the unit is within Huntington Beach State Park. This unit extends from the southern tip of Garden City Beach, just south of the groins (a rigid structure or structures built out from a shore to protect the shore from erosion or to trap sand) north of Murrells Inlet from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begins and where the constituent elements no longer occur stopping perpendicular with the southern end of Inlet Point Drive. It includes from MLLW south of Murrells Inlet to the northern edge of North Litchfield Beach approximately 4.5 km (3.0 mi). The unit includes the MLLW from the Atlantic Ocean up to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The lagoon at the north end of Huntington Beach State Park is also included.

Unit SC–4: Litchfield. 11 ha (28 ac) in Georgetown County. This unit includes the southern tip of Litchfield Beach beginning 0.50 km (0.30 mi) north of Midway Inlet and stopping at the MLLW at Midway Inlet. It includes from the MLLW on the Atlantic Ocean shoreline across and including land to the MLLW on the back bayside. This unit is mostly privately owned.

Unit SC–5: North Inlet. 99 ha (245 ac) in Georgetown County. The majority of the unit is within Tom Yawley Wildlife Center Heritage Preserve. This unit extends from MLLW to 1.0 km (.62 mi) north of North Inlet on Debidue Beach. It includes shoreline on the Atlantic Ocean from MLLW to the MLLW on the western side of the peninsula. This unit also includes from the MLLW south of North Inlet 1.6 km (1.0 mi). It includes the shoreline on the Atlantic Ocean from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. It includes shoreline running south and west of the inlet from the MLLW stopping at the MLLW at the first large tributary (no name).

Unit SC–6: North Santee Bay Inlet. 305 ha (753 ac) in Georgetown County. The majority of the unit is within the Tom Yawley Wildlife Center Heritage Preserve and the Santee-Delta Wildlife Management Area. This unit is at the North Santee Bay inlet and includes lands of South Island, Santee Point, Cedar Island, and all of North Santee Sandbar. This unit includes from MLLW at North Santee Bay Inlet running north along the Atlantic Ocean side of South Island 7.2 km (4.5 mi), stopping 0.60 km (0.4 mi) north of an unnamed inlet. It includes areas from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. This unit includes the eastern side of Cedar Island adjacent to the North Santee Bay Inlet from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of North Santee Sandbar to MLLW is included.

Unit SC–7: Cape Romain. 315 ha (777 ac) in Charleston County.The majority of the unit is within Cape Romain National Wildlife Refuge. This unit includes the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur on the southern and southeastern most 1.9 km (1.2 mi) portion of Cape Island, the southernmost portion of Lighthouse Island from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur, all of Lighthouse Island South to MLLW, and the southern side of the far eastern tip of Raccoon Key from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–8: Bull Island. 134 ha (332 ac) in Charleston County. The majority of the unit is within Cape Romain National Wildlife Refuge and land owned by the South Carolina Department of Natural Resources. This unit includes from Schooner Creek on north and south of the river to north of Price’s Inlet on the southern portion of Bull Island along the Atlantic Ocean 1.6 km (1.0 mi) and south of Price’s Inlet on the northeast tip of Capers Island Heritage Preserve 1.4 km (.86 mi) along the Atlantic Ocean. All areas begin at MLLW and extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–9: Stono Inlet. 495 ha (1223 ac) in Charleston County.Most of this unit is privately owned. It includes the eastern end of Kiawah Island (approximately 4.0 km (2.5 mi)) from MLLW on Atlantic Ocean running north to MLLW on first large tributary connecting east of Bass Creek running northeast into Stono River. It includes MLLW up to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur along Stono Inlet and River. All of Bird Key-Stono Heritage Preserve and all of Skimmer Flats to MLLW are included. The Golf course and densely vegetated areas are not included.

Unit SC–10: Seabrook Island. 117 ha (290 ac) in Charleston County.This unit runs from just 0.16 km (0.10 mi) north of Captain Sams Inlet to the southwest approximately 3.4 km (2.1 mi) along the Atlantic Ocean shoreline. It includes land areas from the MLLW on the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Most of this unit is privately owned.

Unit SC–11: Deveaux Bank. 130 ha (322 ac) in Charleston County. The entire unit is within Deveaux Bank Heritage Preserve. This unit includes all of Deveaux Island to the MLLW and is State-owned.

Unit SC–12: Otter Island. 68 ha (169 ac) in Colleton County.The majority of the unit is within St. Helena Sound Heritage Preserve. This unit includes the southern portion of Otter Island to the eastern mouth of Otter Creek. It includes the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The entire unit is State-owned.

Unit SC–13: Harbor Island. 50 ha (122 ac) in Beaufort County. The majority of the unit is State-owned. This unit extends from the northeastern tip of Harbor Island and includes all of Harbor Spit. It begins at the shoreline east of Cedar Reef Drive running south, stopping at the mouth of Johnson Creek. It includes the MLLW on the Atlantic Ocean and St. Helena Sound to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Harber Spit to MLLW is included.

Unit SC–14: Caper’s Island. 238 ha (589 ac) in Beaufort County. Most of this unit is privately owned. This unit includes the southern-most 4.5 km (2.8 mi) along the Atlantic Coast shoreline of Little Caper’s Island beginning at MLLW on south side of the inlet (un-named). It includes the MLLW on the Atlantic Ocean shoreline to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–15: Hilton Head. 43 ha (106 ac) in Beaufort County. The majority of this unit is State-owned. This unit includes the northeastern tip (Atlantic Ocean side) of Hilton Head Island and all of Joiner Bank. It begins at the shoreline east of northern Planters Row and ends at the shoreline east of Donax Road. It includes the MLLW of Port Royal Sound and the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Joiner Bank to MLLW is included.

Unit GA–1: Tybee Island. 37 ha (91 ac) in Chatham County. The majority of the unit is privately owned. This unit extends along the northern tip of Tybee Island starting from 0.8 km (0.5 mi) northeast from the intersection of Crab Creek and Highway 80 to 0.7 km (0.41 mi) northeast from the intersection of Highway 80 and Horse Pen Creek. The unit includes MLLW on Savannah River and Atlantic Ocean to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit GA–2: Little Tybee Island. 719 ha (1776 ac) in Chatham County. The majority of the unit is within Little Tybee Island State Heritage Preserve. This unit extends just south of the first inlet to Wassaw Sound along the Atlantic Ocean coastline, extending north along the sound 1.7 km (1.1 mi). It includes habitat from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–3: North Wassaw Island. 108 ha (267 ac) in Chatham County. The entire unit is within Wassaw National Wildlife Refuge. This unit includes the north-east tip of Wassaw Sound, 1.6 km (1.0 mi) along the inlet side and extending south along the Atlantic Ocean shoreline for 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–4: South Wassaw Island. 61 ha (151 ac) in Chatham County. The entire unit is within Wassaw National Wildlife Refuge. This unit extends from the last southern 1.6 km (1.0 mi.) on Atlantic Ocean side, around the southern tip of Wassaw Island, up to mouth of Odingsell River. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–5: Ossabaw Island. 434 ha (1072 ac) in Chatham County. entire unit is within Ossabaw Island State Heritage Preserve. This unit includes the northeastern tip from the mouth of the Bradley River east and 12 km (7.5 mi) south along the Atlantic Ocean shoreline to a point 0.4 km (0.25 mi) past the south-center inlet. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–6: St. Catherine’s Island Bar. 54 ha (135 ac) in Liberty County. The entire unit is State owned and located east-northeast of St. Catherine’s Island. This unit includes the entire St. Catherine’s Island Bar to MLLW.

Unit GA–7: McQueen’s Inlet. 215 ha (532 ac) in Liberty County. The majority of the unit is private land along the eastern-central coastline on St. Catherine’s Island. This unit extends from McQueen’s Inlet north approximately 3.5 km (2.2 mi) and south approximately 1.8 km (1.1 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–8: St. Catherine’s Island. 60 ha (147 ac) in Liberty County. The majority of the unit is private land on the southern tip of St. Catherine’s Island. This unit starts 1.2 km (0.75 mi) north of Sapelo Sound (along Atlantic Ocean shoreline) and stops inland at Brunsen Creek. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–9: Blackbeard Island. 129 ha (319 ac) in McIntosh County. The entire unit is within the Blackbeard Island National Wildlife Refuge. This unit includes the northeastern portion of the island beginning just east of the mouth of the confluence of McCloy Creek and Blackbeard Creek and continuing east and running south along the Atlantic Ocean shoreline for 1.4 km (.90 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–10: Sapelo Island. 85 ha (210 ac) in McIntosh County. The entire unit is State-owned and within Sapelo Island. The unit extends south of Cabretta Tip approximately 0.2 km (0.13 mi) and north of Cabretta Tip 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–11: Wolf Island. 238 ha (590 ac) in McIntosh County. The majority of the unit is within Wolf Island National Wildlife Refuge and private lands just north of the Refuge. This unit includes the southeastern tip of Queen's island adjacent to the Doboy Sound and includes the eastern shoreline of Wolf Island. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–12: Egg Island Bar. 61 ha (151 ac) in McIntosh County. This unit is State owned and includes all of Egg Island Bar to the MLLW.

Unit GA–13: Little St. Simon's Island. 609 ha (1505 ac) in Glynn County. The majority of the unit is private land on Little St. Simon's Island. This unit includes the entire eastern coastline along Little St. Simon's Island. It begins 1.1 km (.70 mi) west of the northeast tip of Little St. Simon's Island and runs east and then south along the Atlantic Ocean shoreline stopping at the minor tributary (no name) on the southeast tip of Little St. Simon's Island north of Hampton Creek. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Pelican Spit to MLLW is included when this sand bar is emergent.

Unit GA–14: Sea/St. Simon's Island. 191 ha (471 ac) in Glynn County. The majority of the unit is private land on the south tip of Sea Island and on the east beach of St. Simons Island. This unit extends north of Gould's Inlet (Sea Island) 2.5 km (1.54 mi) starting just south of the groin and extends south of Gould's Inlet (St. Simons Island) 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–15: Jekyll Island. 49 ha (121 ac) in Glynn County. The majority of the unit is within State lands on Jekyll Island. This unit includes the southern region of Jekyll Island beginning at the mouth of Beach Creek, running towards the tip of Jekyll Island and includes the shoreline running north along the Atlantic Ocean shoreline 1.9 km (1.20 mi) from the southern tip of Jekyll Island. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–16: Cumberland Island. 1454 ha (3591 ac) in Camden County. The majority of the unit is along Cumberland Island Wilderness Area and Cumberland Island National Seashore. This unit includes the majority of the eastern Atlantic Ocean shoreline of Cumberland Island. It begins .50 km (.31 mi) north of the inlet at Long Point, continues south along the Atlantic Ocean shoreline stopping 1.8 km (1.1 mi) west of the southern tip of Cumberland Island National Seashore. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Escambia County. The majority of the unit is within Big Lagoon State Recreation Area. This unit includes the peninsula and emerging sand and mudflats between 0.33 km (0.21 mi) west of the lookout tower along the shoreline and 0.24 km (0.15 mi) east of the lookout tower along the shoreline. Land along the shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All emerging sandbars to MLLW are included.

Unit FL–2: Big Sabine. 182 ha (450 ac) in Escambia County. The majority of the unit is owned by the University of West Florida. This unit includes areas adjacent to Santa Rosa Sound of Big Sabine Point and adjacent embayment between 8.0 km (5.0 mi) and 11.6 (7.2 mi) east of the Bob Sike's Bridge. It begins 0.10 km (.06 mi) north of SR 399 to MLLW on the Santa Rosa Sound.

Unit FL–3: Navarre Beach. 48 ha (118 ac) in Escambia and Santa Rosa Counties. The majority of the unit is owned by Eglin Air Force Base and Santa Rosa Island Authority. This unit includes lands on Santa Rosa Island Sound side, between 0.09 and 0.76 mi east of the eastern end of SR 399 to MLLW on Santa Rosa Sound side.

Unit FL–5: Shell/Crooked Islands. 1789 ha (4419 ac) in Bay County.The majority of the unit is within Tyndall Air Force Base and St. Andrews State Recreation Area. This unit includes all of Shell Island, Crooked Island West, and Crooked Island East from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–6: Upper St. Joe Peninsula. 182 ha (449 ac) in Gulf County.The majority of the unit is within St. Joseph State Park. This unit includes the northern portion of the peninsula from the tip to 8.0 km (5.0 mi) south along the Gulf of Mexico from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–7: Cape San Blas. 158 ha (390 ac) in Gulf County.The entire unit is within Eglin Air Force Base. This unit includes the area known as the Cape between the eastern boundary of Eglin and mile marker 2.1, including the peninsula and all emerging sandbars. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–8: St. Vincent Island. 146 ha (361 ac) in Franklin County.The majority of the unit is within St. Vincent National Wildlife Refuge. This unit includes the western tip of St. Vincent Island that is adjacent to Indian Pass (0.80 km (0.50 mi) east of tip along Indian Pass, and 1.9 km (1.2 mi) from tip southeast along Gulf of Mexico). The unit also includes St. Vincent Point from the inlet at Sheepshead Bayou east 1.6 km (1.0 mi) to include emerging oysters shoals and sand bars and extends south 0.21 km (0.13 mi) of St. Vincent Point. The unit includes the southeastern tip of St. Vincent Island extending north 1.4 km (0.90 mi) and south and west 2.1 km (1.3 mi). The western tip of Little St. George Island 0.80 km (0.50 mi) from West Pass is included (state owned lands). All sections of this unit include land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–9: East St. George Island. 1433 ha (3540 ac) in Franklin County. The majority of the unit is within St. George State Park. This unit begins 5.3 km (3.3 mi) east of the bridge and extends to East Pass. Shell Point, Rattlesnake Cove, Goose Island, East Cove, Gap Point, and Marsh Island are included. This unit includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur on the Gulf of Mexico, East Pass and St. George Sound.

Unit FL–10: Yent Bayou. 153 ha (378 ac) in Franklin County. The majority of the unit is State owned. This unit is adjacent to the area known as Royal Bluff. It includes the St. George Sound shoreline between 5.9 km (3.7 mi) and 9.5 km (5.9mi) east of SR 65. It includes from MLLW to where densely vegetated habitat or developed structures such as SR 65, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–11: Carabelle Beach. 56 ha (139 ac) in Franklin County. The area within this unit is privately owned. This unit is the peninsula created by Boggy Jordan Bayou. It includes St. George Sound shoreline (south of US 98) 1.6 km (1.0 mi) southwest along US 98 from the Carrabelle River Bridge and extends 1.9 km (1.2 mi) east along the St. George Sound shoreline. It includes from MLLW to where densely vegetated habitat or developed structures such as US 98, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–12: Lanark Reef. 260 ha (643 ac) in Franklin County. The entire unit is State owned. This unit includes the entire island and emerging sandbars to MLLW.

Unit FL–13: Phipps Preserve. 42 ha (104 ac) in Franklin County. This unit includes all of Phipps Preserve (owned by The Nature Conservancy) and any emerging sandbars from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–14: Hagens Cove. 486 ha (1200 ac) in Taylor County. The majority of the unit is within Big Bend Wildlife Management Area. This unit includes all of Hagens Cove and extends from MLLW on north side of Sponge Point to MLLW on south side of Piney Point. The eastern boundary of this unit ends (0.20 mi) west of SR 361. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–15: Anclote Key and North Anclote Bar. 146 ha (360 ac) in Pasco and Pinellas Counties. The majority of the unit is within Anclote Key State Preserve. This unit includes all of North Anclote Bar to the MLLW and the north, south and western sides of Anclote Key from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–16: Three Rooker Bar Island. 76 ha (188 ac) in Pinellas County. The majority of the unit is within Pinellas County Aquatic Preserve. This unit includes all the islands and emerging sandbars of this complex to MLLW.

Unit FL–17: North Honeymoon Island. 45 ha (112 ac) in Pinellas County. The majority of the unit is within Honeymoon Island State Recreation Area. This unit includes from Pelican Cove north to the far northern tip of Honeymoon Island. It includes the western shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur or the MLLW on the eastern shoreline.

Unit FL–18: South Honeymoon Island. 28 ha (70 ac) in Pinellas County.The majority of the unit is private land. This unit includes the southern end (southern-most 0.32 km (0.20 mi) on western side) of Honeymoon Island and encompasses the far southeastern tip and includes any emerging islands or sandbars to Hurricane Pass. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–19: Caladesi Island. 120 ha (296 ac) in Pinellas County.The majority of the unit is within Caladesi Island State Park. This unit extends from Hurricane Pass to Dunedin Pass on the Gulf of Mexico side. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–20: Shell Key and Mullet Key. 190 ha (470 ac) in Pinellas County. The majority of the unit is within Fort Desoto Park. This unit includes the Shell Key island complex. It also includes the northwest portion of Mullet Key including the western shorelines from Bunces Pass extending south, stopping 1.4 km (.86 mi) north of Ft. Desoto County Park pier. It includes from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–21: Egmont Key. 153 ha (377 ac) Hillsborough County. The majority of the unit is within Egmont Key National Wildlife Refuge. This unit includes the entire island to MLLW.

Unit FL–22: Cayo Costa. 175 ha (432 ac) in Lee County. The majority of the unit, including its northern and southern boundaries, is within Cayo Costa State Park, and nearly all of the remaining area is in the Cayo Costa Florida Conservation and Recreation Lands (CARL) acquisition project. This unit begins at the northern limit of sandy beaches at the northern end of the island, extends through Murdock Point, which at present has a sandbar and lagoon system, and ends at the former entrance to Murdock Bayou. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–23: North Captiva Island. 36 ha (88 ac) in Lee County.The unit is within the Cayo Costa CARL land purchase project. This unit includes the western shoreline extending from 0.80 km (0.50 mi) south of Captiva Pass to approximately Foster Bay. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–25: Bunche Beach. 187 ha (461 ac) in Lee County. This unit is mostly within a CARL Estero Bay acquisition project. Bunche Beach (also spelled Bunch) lies along San Carlos Bay, on the mainland between Sanibel Island and Estero Island (Fort Myers Beach), extending east from the Sanibel Causeway past the end of John Morris Road to a canal serving a residential subdivision. The unit also includes the western tip of Estero Island (Bodwitch Point, also spelled Bowditch Point), including Bowditch Regional Park, operated by Lee County and, on the southwest side of the island facing the Gulf, the beach south nearly to the northwesterly intersection of Estero Boulevard and Carlos Circle. It includes land from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur or, along the developed portion of Estero Island.

Unit FL–26: Estero Island. 86 ha (211 ac) in Lee County. The majority of the unit is privately owned. The unit consists of approximately the southern third of the island's Gulf-facing shoreline starting near Avenida Pescadora to near Redfish Road. The unit excludes south-facing shoreline at the south end of the island that faces Big Carlos Pass rather than the Gulf. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–27: Marco Island. 245 ha (606 ac) in Collier County. Most of the unit is at the Tigertail Beach County Park. The unit's northern border is on the north side of Big Marco Pass, including Coconut Island and all emerging sand bars. On the south side of Big Marco Pass, the boundary starts at the north boundary of Tigertail Beach County Park and extends to just south of the fourth condominium tower south of the County Park. The placement of the southern boundary assures that the unit includes all of Sand Dollar Island, the changeable sandbar off Tigertail Beach. The western boundary includes all the sand bars in Big Marco Pass but excludes Hideaway Beach. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–28: Marquesas Keys. 2,937 ha (7,256 ac) in Monroe County. The unit comprises the roughly circular atoll that encloses Mooney Harbor, including Gull Keys and Mooney Harbor Key. The entire unit is within Key West National Wildlife Refuge. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–29: Boca Grande/Woman/ Ballast Keys. 56 ha (138 ac) in Monroe County. These Keys are east of the Marquesas Keys and west of Key West. Boca Grande and Woman Keys are within Key West National Wildlife Refuge. Ballast Key is privately owned. This unit consists only of sandy beaches and flats between the MLLW and to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–30: Bahia Honda/Ohio Keys. 372 ha (918 ac) in Monroe County. This unit comprises Bahia Honda Key (including a small island off its southwest shore), which is almost entirely owned by Bahia Honda State Park, plus Ohio Key, which is privately owned. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–31: Lower Matecumbe Key. 19 ha (48 ac) in Monroe County. Part of the unit is at Anne's Beach park, an Islamorada village park. The remaining parts are at Sunset Drive (Lower Matecumbe Beach) and at Costa Bravo Drive (Port Antiqua Homeowners Beach) on the Florida Bay side of the island. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–32: Sandy Key/Carl Ross Key. 67 ha (165 ac) in Monroe County. This unit consists of two adjoining islands in Florida Bay, roughly south of Flamingo in Everglades National Park. The entire area is owned and managed by the National Park Service. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–33: St. Lucie Inlet. 114 ha (282 ac) in Martin County. The unit includes a small area south of the jetty on the north shore of St. Lucie Inlet, from the jetty west 0.42 km (0.26 mi). While the two sides of the inlet are privately owned, the great majority of the unit is on public land in the Saint Lucie Inlet State Preserve, administered by Jonathan Dickinson State Park. It begins on the sandy shoreline south of Saint Lucie Inlet and extends along the Atlantic Ocean shoreline 2.6 km (1.6 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur. The unit does not include sandbars within the inlet.

Unit FL–34: Ponce de Leon Inlet. 68 ha (168 ac) in Volusia County. The majority of the unit is within Smyrna Dunes Park and Lighthouse Point Park. This unit includes shoreline extending from the jetty north of Ponce de Leon Inlet west to the Halifax River and Inlet junction. It includes shoreline south of Ponce de Leon Inlet from the inlet and Halifax River junction, extending east and south along the Atlantic Ocean shoreline 1.2 km (.70 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–35: Nassau Sound-Huguenot. 950 ha (2347 ac) in Duval County. The majority of the unit is within Big Talbot Island State Park, Little Talbot Island State Park, and the Timucuan Ecological and Historical Preserve. This unit includes all emergent shoals and shoreline east of Nassau River bridge and extends to the inlet of the St. John's River. Amelia Island and the northern 2.7 km (1.7 mi) shoreline along Talbot Island are not included. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–36: Tiger Islands. 53 ha (130 ac) in Nassau County. This unit is privately owned. This unit extends from the mouth of Tiger Creek and runs north along Tiger Island 0.8 km (0.5 mi) and south along Little Tiger Island 1.4 km (0.9 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur. Emerging sandbars to MLLW are also included.

Unit AL–1: Isle Aux Herbes. 227 ha (561 ac) in Mobile County. This unit includes the entire Isle Aux Herbes island where primary constituent elements occur to MLLW and is Stateowned.

Unit AL–2: Dauphin, Little Dauphin, and Pelican Islands. 880 ha (2,174 ac) in Mobile County. This unit includes all of Dauphin Island where primary constituent elements occur from St. Stephens Street approximately 17.6 km (10.9 mi) west to the western tip of the island to MLLW and all of Little Dauphin and Pelican Islands to MLLW. The area is mostly privately owned but includes State and Federal lands.

Unit AL–3: Fort Morgan. 67 ha (166 ac) in Baldwin County. This area includes Mobile Bay and Gulf of Mexico shorelines within Bon Secour National Wildlife Refuge, Fort Morgan Unit. This unit extends from the west side of the pier on the northwest point of the peninsula, following the shoreline approximately 2.8 km (1.74 mi) southwest around the tip of the peninsula, then east to the terminus of the beach access road and is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The area is State-owned but is leased by the Federal Government.

Unit MS–1: Lakeshore through Bay St. Louis. 41 ha (101 ac) in Hancock County. This unit extends from the north side of Bryan Bayou outlet and includes the shore of the Mississippi Sound following the shoreline northeast approximately 15.0 km (9.3 mi) and ending at the southeast side of the Bay Waveland Yacht Club. The landward boundary of this unit follows the Gulf side of South and North Beach Boulevard and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–2: Henderson Point. 34 ha (84 ac) in Harrison County. This unit extends from 0.2 km (0.12 mi) west of the intersection of 3rd Avenue and Front Street and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.4 km (2.7 mi) to the west side of Pass Christian Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–3: Pass Christian. 77 ha (190 ac) in Harrison County. This unit extends from the east side of Pass Christian Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 10.5 km (6.5 mi) to the west side of Long Beach Pier and Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–4: Long Beach. 38 ha (94 ac) in Harrison County. This unit extends from the east side of Long Beach Pier and Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.4 km (2.7 mi) to the west side of Gulfport Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–5: Gulfport. 39 ha (96 ac) in Harrison County. This unit extends from the east side of Gulfport Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.8 km (3.0 mi) to the west side of the groin at the southern terminus of Courthouse Road, Mississippi City, MS. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–6: Mississippi City. 62 ha (153 ac) in Harrison County. This unit extends from the east side of the groin at the southern terminus of Courthouse Road, Mississippi City, MS, and includes the shore of the Mississippi Sound following the shoreline northeast approximately 7.9 km (4.9 mi) to the west side of President Casino. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–10: Ocean Springs West. 11 ha (27 ac) in Jackson County. This unit extends from U.S. 90 and includes the shore of Biloxi Bay following the shoreline southeast approximately 1.9 km (1.2 mi) to the Ocean Springs Harbor inlet. The landward boundary of this unit follows the Bay side of Front Beach Drive and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–11: Ocean Springs East. 7 ha (17 ac) in Jackson County. This unit extends from the east side of Weeks Bayou and includes the shore of Biloxi Bay following the shoreline southeast approximately 1.8 km (1.1 mi) to Halstead Bayou. The landward boundary of this unit follows the Bay side of East Beach Drive and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–12: Deer Island. 194 ha (479 ac) in Harrison County. This unit includes all of Deer Island, where primary constituent elements occur to the MLWW . Deer Island is privately owned.

Unit MS–13: Round Island. 27 ha (67 ac) in Jackson County. This unit includes all of Round Island to the MLWW and is privately owned.

Unit MS–14: Mississippi Barrier Islands. 3,168 ha (7,828 ac) in Harrison and Jackson Counties. This unit includes all of Cat, East and West Ship, Horn, Spoil, and Petit Bois Islands where primary constituent elements occur to MLLW. Cat Island is privately owned, and the remaining islands are part of the Gulf Islands National Seashore.

Unit MS–15: North and South Rigolets. 159 ha (393 ac) in Jackson County, MS, and 12 ha (30 ac) in Mobile County, AL. This unit extends from the southwestern tip of South Rigolets Island and includes the shore of Point Aux Chenes Bay, the Mississippi Sound, and Grand Bay following the shoreline east around the western tip, then north to the south side of South Rigolets Bayou; then from the north side of South Rigolets Bayou (the southeastern corner of North Rigolets Island) north to the northeastern most point of North Rigolets Island. This shoreline is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Approximately 4.4 km (2.7 mi) are in Mississippi and 2.9 km (1.8 mi) are in Alabama. Almost half the Mississippi shoreline length is in the Grand Bay National Wildlife Refuge.

Unit LA–1: Texas/Louisiana border to Cheniere au Tigre. 2,650 ha (6,548 ac) in Cameron and Vermilion Parishes. This unit extends from the east side of Sabine Pass (Texas/Louisiana border) and includes the shore of the Gulf of Mexico from the MLLW following the shoreline east 25.7 km (16.0 mi) to the west end of Constance Beach [approximately 2 km (1.2 mi) east of the intersection of Parish Road 528 and the beach]; it extends from the east end of the town of Holly Beach [0.25 km (0.16 mi) east of the intersection of Baritarick Boulevard and the beach] following the shoreline approximately 97 km (60.3 mi) east to the eastern boundary line of Rockefeller Wildlife Refuge [3.4 km (2.1 mi) east of Rollover Bayou]; and it extends from the east side of Freshwater Bayou Canal following the shoreline east for approximately 15 km (9.3 mi) to 1.3 km (0.81 mi) east of where the boundary of Paul J. Rainey Wildlife Sanctuary (National Audubon Society) meets the shoreline. All three sections of this unit include the land from the seaward boundary of MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The shoreline in this unit is both state and privately owned.

Unit LA–2: Atchafalaya River Delta. 921 ha (2,276 ac) in St. Mary Parish, LA. This unit is located in the eastern portion of the State-owned Atchafalaya Delta Wildlife Management Area (WMA) and includes all exposed land and islands where primary constituent elements occur east and southeast of the main navigation channel of the Atchafalaya River to the MLLW. The islands located south and southeast of the deltaic splay, Donna, T-Pat, and Skimmer Islands and the un-named bird island, are also included in this unit. This unit includes the entire islands where primary constituent elements occur to the MLLW.

Unit LA–3: Point Au Fer Island. 195 ha (482 ac) in Terrebonne Parish. This unit includes the entire small island at the northwest tip of Point Au Fer Island to MLLW, then extends from the northwest tip of Point Au Fer Island following the shoreline southeast approximately 7.7 km (4.8 mi) to the point where the un-named oil and gas canal extending southeast from Locust Bayou meets the shoreline [0.8 km (0.5 mi) southeast from Locust Bayou]. This shoreline is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. This entire unit is privately owned.

Unit LA–4: Isles Dernieres. 795 ha (1,964 ac) in Terrebonne Parish. This unit includes the State-owned Isles Dernieres chain, including Raccoon, Whiskey, Trinity and East Islands. This unit includes the entire islands where primary constituent elements occur to the MLLW.

Unit LA–5: Timbalier Island to East Grand Terre Island. 2,321 ha (5,735 ac) in Terrebonne, Lafourche, Jefferson, and Plaquemines Parishes. This unit includes: all of Timbalier Island where primary constituent elements occur to the MLLW, all of Belle Pass West [the ‘‘peninsula’’ extending north/northwest approximately 4.8 km (3.0 mi) from the west side of Belle Pass] where primary constituent elements occur to MLLW; the Gulf shoreline extending approximately 11 km (6.8 mi) east from the east side of Belle Pass bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur; all of Elmers Island peninsula where primary constituent elements occur to MLLW and the Gulf shoreline from Elmers Island to approximately 0.9 km (0.56 mi) west of Bayou Thunder Von Tranc bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur; the Gulf shoreline of Grand Isle from the Gulf side of the hurricane protection levee to MLLW; and all of East Grand Terre Island where primary constituent elements occur to the MLLW.

Unit LA–6: Mississippi River Delta. 105 ha (259 ac) in Plaquemines Parish, LA. This unit is part of the State-owned Pass a Loutre Wildlife Management Area and includes un-named sand (spoil) islands off South Pass of the Mississippi River near Port Eads. The entire islands to MLLW are included in this unit.

Unit LA–7: Breton Islands and Chandeleur Island Chain. 3,116 ha (7,700 ac) in Plaquemines and St. Bernard Parishes, LA. This unit includes Breton, Grand Gosier, and Curlew Islands and the Chandeleur Island chain. Those islands are part of the Breton National Wildlife Refuge or are state owned. The entire islands where primary constituent elements occur to MLLW are included in this unit.

Unit TX–1: South Bay and Boca Chica. 2,920 ha (7,217 ac) in Cameron County. The boundaries of the unit are: starting at the Loma Ochoa, following the Brownsville Ship Channel to the northeast out into the Gulf of Mexico to MLLW, then south along a line describing MLLW to the mouth of the Rio Grande, proceeding up the Rio Grande to Loma de Las Vacas, then from that point along a straight line north to Loma Ochoa. The unit does not include densely vegetated habitat within those boundaries. It includes wind tidal flats that are infrequently inundated by seasonal winds, and includes the tidal flats area known as South Bay. Beaches within the unit reach from the mouth of the Rio Grande northward to Brazos Santiago Pass, south of South Padre Island. The southern and western boundaries follow the change in habitat from wind tidal flat, preferred by the piping plover, to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include areas used for roosting by the piping plover. Portions of this unit are owned and managed by the Lower Rio Grande Valley National Wildlife Refuge, the South Bay Coastal Preserve, Boca Chica State Park, and private citizens.

Unit TX–2: Queen Isabella Causeway. 2 ha (6 ac) in Cameron County. The area extends along the Laguna Madre west of the city of South Padre Island. The southern boundary is the Queen Isabella State Fishing Pier, and the northern boundary is at the shoreline due west of the end of Sunny Isles Street. The Queen Isabella causeway bisects this shore but is not included within critical habitat. The eastern boundary is the where developed areas and/or dense vegetation begins, and the western boundary is MLLW. This unit contains lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–5: Upper Laguna Madre. 436 ha (1,076 ac) in Kleberg County. The southern boundary is the northern boundary of PAIS, and the northern boundary is the Kleberg/Nueces County line. The eastern boundary is the line where dense vegetation begins, and the western boundary is MLLW. This unit includes a series of small flats along the bayside of Padre Island in the Upper Laguna Madre. It includes wind tidal flats and sparsely-vegtated upland areas used for roosting by the piping plover. These boundaries receive heavy use by large numbers of shorebirds, including piping plovers. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur, and include upland areas used for roosting by the piping plover.

Unit TX–6: Mollie Beattie Coastal Habitat. 241 ha (596 ac) in Nueces County. This unit will be described as two subunits: (1) Subunit is bounded on the north by Beach Access Road 3, on the east by the inland boundary of critical habitat Unit TX–7, on the south by Zahn road, and on the west by Zahn Road. (2) The subunit is bounded on the north by Corpus Christi Pass, on the east by US 361, on the south by the north side of Packery Channel, and on the west by the Gulf Intercoastal Watersay. Some of the uplands are privately owned and the remaining are owned and managed by the TGLO. This unit includes two hurricane washover passes known as Newport and Corpus Christi Passes, and wind tidal flats that are infrequently inundated by seasonal winds. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include upland areas used for roosting by the piping plover.

Unit TX–11: Blind Oso. 2 ha (5 ac) in Nueces County. This unit is the flats of the Blind Oso, part of Oso Bay, from Hans and Pat Suter Wildlife Refuge (owned and managed by the City of Corpus Christi) northeast to Corpus Christi Bay and then southeast along the edge of Texas A&M University—Corpus Christi. The landward boundaries extend to where densely vegetated habitat, not used by the piping plover, begins, and extends out from the landward boundaries to MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–12: Adjacent to Naval Air Station-Corpus Christi. 2 ha (6 ac) in Nueces County. This unit is along the shore of Oso Bay on flats bordered by Naval Air Station-Corpus Christi and Texas Spur 3 to a point 2.5 km (1.5 mi) south of the bridge between Ward Island and the Naval Air Station. The landward boundary is the line where dense vegetation begins, and the boundary in the Bay is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–13: Sunset Lake. 176 ha (435 ac) in San Patricio County. This unit is triangle shaped, with State Highway 181 as the northwest boundary, and the limits of the City of Portland as the northeast boundary. The shore on Corpus Christi Bay is the third side of the triangle, with the actual boundary being MLLW off this shore. This unit is a large basin with a series of tidal ponds, sand spits and wind tidal flats. This unit is owned and managed by the City of Portland within a system of city parks. Some of the described area falls within the jurisdiction of the TGLO. It includes two city park units referred to as Indian Point and Sunset Lake. Much of the unit is a recent acquisition by the city, and management considerations for the park include the area's importance as a site for wintering and resident shorebirds. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–17: Allyn's Bight. 5 ha (14 ac) in Aransas County. This unit includes shoreline of San Jose Island on Aransas Bay from Allyn's Bight to Blind Pass, the channel between San Jose Island and Mud Island. The inland boundary is where the line of dense vegetation begins, and the bay-ward boundary is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–20: Ayers Point. 397 ha (982 ac) in Calhoun County. This unit is an unnamed lake on Matagorda Island between Shell Reef Bayou and Big Brundrett Lake, with San Antonio Bay to the north. The unit boundary extends landward from the lake to the line where dense vegetation begins and where the constituent elements no longer occur and includes upland areas used for roosting by the piping plover. This unit includes marsh and flats at Ayers Point on Matagorda Island National Wildlife Refuge. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–21: Panther Point to Pringle Lake. 863 ha (2,133 ac) in Calhoun County. This unit represents a narrow band of bayside habitats on Matagorda Island from Panther Point to the northeast end of Pringle Lake. The landward boundary is the line indicating where dense vegetation begins, and the bayward boundary is MLLW. The unit is entirely within Matagorda Island National Wildlife Refuge. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–24: West Matagorda Bay/ Western Peninsula Flats. 756 ha (1,868 ac) in Matagorda County. This unit extends along the bayside of Matagorda Peninsula from 7.5 southwest of Greens Bayou to 2.5 km (1.6 mi) northwest of Greens Bayou. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–25: West Matagorda Bay/ Eastern Peninsula Flats. 232 ha (575 ac) in Matagorda County. This unit follows the bayside of Matagorda Peninsula from Maverick Slough southwest for 5 km (3 mi). The unit begins at Maverick Slough to the northeast and extends 5 km (3 mi) to the southwest, enclosing a series of flats along Matagorda Bay. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–26: Colorado River Diversion Delta. 5 ha (13 ac) in Matagorda County. This unit consists follows the shore of the extreme eastern northeast corner of West Matagorda Bay from Culver Cut to Dog Island Reef. The southeastern tidally emergent portion of Dog Island Reef is included within the unit. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. The upland areas includes upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–29: Brown Cedar Cut. 119 ha (294 ac) in Matagorda County. This unit extends 2 km (1.2 m.) both southwest and northeast of the main channel of Brown Cedar Cut along the bayside of Matagorda Peninsula in East Matagorda Bay, and abuts unit TX–28 to the southeast. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. The eastern boundary of TX–29 follows the change in habitat from mud flats preferred by the piping plover, to slightly vegetated dune system adjacent to TX–28. This unit includes upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–30: Northeast Corner East Matagorda Bay. 120 ha (297 ac) in Matagorda County. This is a unit bounded on the north by the Gulf Intercoastal Waterway, on the east by the northeast limit of Matagorda bay up the line where dense vegetation begins, on the south by the boundary of Unit TX–28, and on the west by MLLW. It is a system of flats associated with tidal channels. This unit includes upland areas used for roosting by the piping plover and lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–34: San Luis Pass. 110 ha (272 ac) near the Brazoria/Galveston County line. This unit extends along the Gulf side of Galveston Island from San Luis Pass to the cite of the former town of Red Fish Cove (USGS 1:24,000 map, San Luis Pass, Texas; 1963, photorevision 1974). The landward boundary is the line indicating the beginning of dense vegetation, and the gulfside boundary is MLLW. Approximately 57 percent of the unit includes flats in the floodtide delta that are State-owned and managed by the TGLO. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–35: Big Reef. 47 ha (117 ac) in Galveston County. This unit consists of beach and sand flats on the north, west, and east shore of Big Reef, down to MLLW. South Jetty is not included.

The area is currently managed by the City of Galveston. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–36: Bolivar Flats. 160 ha (395 ac) in Galveston County. This unit extends from the jetties on the southwest end of the Bolivar Peninsula to a point on the Gulf beach 1 km (0.6 mi) north of Beacon Bayou. It includes 5.0 km (3 mi) of Gulf shoreline. The landward boundary is the line indicating the beginning of dense vegetation, and the gulfside boundary is MLLW. The area is leased from TGLO by Houston Audubon Society and managed for its important avian resources. The upland areas are used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–37: Rollover Pass. 6 ha (16 ac) in Galveston County. This unit consists of Rollover Bay on the bayside of Bolivar Peninsula. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. It includes flats on State-owned land managed by the TGLO. This unit captures the intertidal complex of the bay, and is bounded by the towns of Gilchrist to the east and the Gulf beach of the Bolivar Peninsula to the south. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

The critical habitat designation for the northern Great Plains breeding population of Charadrius melodus circumcinctus includes 19 units totaling approximately 183,422 ac (74,228.4 ha) of habitat in Minnesota, Montana, and North Dakota, and approximately 1,207.5 mi (1,943.3 km) of river in Montana, North Dakota, South Dakota, and Nebraska (67 FR 57638 - 57717).

Minnesota: Unit MN–1, Rocky Point, Pine and Curry Island, and Morris Point—This unit includes approximately 235.2 ac (95.1 ha) of unique habitat, including sparsely vegetated windswept islands, peninsulas, and sandy points or spits that interface with Lake of the Woods in Lake of the Woods County. Although this unit is small in size, there have been up to 50 plovers found during the breeding season. Numbers have declined since the mid-1980s and there is a continued need for habitat and predator management. This unit represents the most eastern portion of the northern Great Plains population of breeding piping plovers and may be an important link between the Great Lakes and northern Great Plains breeding populations. It is the only remaining breeding site for piping plovers in Minnesota. Approximately 100.4 ac (40.6 ha) are designated within the 697- ac (282.3-hectare) Rocky Point Wildlife Management Area, which is in public ownership, managed by the Minnesota Department of Natural Resources. Rocky Point is located just east of Arneson on Lake of the Woods. Unit 1 also includes approximately 134.8 ac (54.5 ha) within the Pine and Curry Island Scientific and Natural Area which is in public ownership, managed by the Minnesota Department of Natural Resources. Pine and Curry Island Scientific and Natural Area includes approximately 112.6 ac (45.6 ha) of a sandy barrier island (Pine and Curry Island) and 22.2 ac (8.9 ha) of an adjacent peninsula (Morris Point) located at the mouth of the Rainy River on Lake of the Woods.

Montana: Unit MT–1, Sheridan County—This unit includes approximately 19,222.9 ac (7,779.4 ha) of 20 alkali lakes and wetlands in Sheridan County, located in the extreme northeast corner of Montana. These alkali lakes and wetlands are characterized as follows— shallow, seasonally to permanently flooded; mixosaline to hypersaline chemistry; sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; 200 ft (61 m) of uplands above the wetlands' high water mark including springs and fens, which provide foraging and protective habitat for piping plovers. Sites included in this unit are occupied by piping plovers. This unit requires special management including increasing reproductive success through predator exclusion devices, such as nest cages and electric fences, and reducing vegetation encroachment on nesting beaches through prescribed burning or grazing. Essential breeding habitat is dispersed throughout this unit which represents the largest portion (approximately 66 percent) of the plovers surveyed in Montana. This unit also links similar habitat in Canada and North Dakota. Approximately 5,571 ac (2,254.5 ha) are in private ownership and 13,651.9 ac (5,524.8 ha) are in public ownership. Of the lands in public ownership, 13,356.8 ac (5,405.4 ha) are in Federal ownership and 295.1 ac (119.4 ha) are in State ownership. Federal lands designated include piping plover populations on Medicine Lake National Wildlife Refuge and several Waterfowl Production Areas, both owned and managed by the Service. State lands designated include land owned and managed by the Montana Department of Natural Resources and Conservation. Unit MT–4, Bowdoin National Wildlife Refuge—This unit encompasses approximately 3,294.5 ac (1,333.2 ha) on Bowdoin National Wildlife Refuge with sparsely vegetated shoreline beaches, peninsulas, and islands composed of sand gravel, or shale that interface with these water bodies. The site is located in east-central Phillips County, approximately 170.8 mi (275 km) west of the North Dakota border and 37.3 mi (60 km) south of Canada. This unit represents the western edge of the northern Great Plains breeding population of the piping plover and requires special management including water level and predator management. Bowdoin National Wildlife Refuge is in public ownership (Federal) and managed by the Service. Lake Bowdoin is an off stream facility receiving water from the Milk River.

Nebraska: Unit NE–1, Platte, Loup, and Niobrara Rivers—This unit encompasses approximately 440 mi (707.9 km) of river. The river habitat includes sparsely vegetated channel sandbars, sand and gravel beaches on islands within the high bank for nesting, temporary pools on sandbars and islands, and the interface of sand and river where plovers forage. All three of these rivers are occupied by and provide essential habitat for the piping plover. Niobrara River—The Niobrara River is a tributary of the Missouri River, originating in Wyoming and flowing through the northern part of the Nebraska Sandhills region. The portion of the Niobrara included in as Critical Habitat starts at the bridge south of Norton, Nebraska, and extends downstream 120 mi (193 km) to its confluence with the Missouri River. The Niobrara River is one of the most undeveloped rivers in the northern Great Plains and represents one of the last rivers with largely untouched piping plover habitats. The source of water for this river is largely groundwater discharge which helps to provide a year-round base flow with few flood events which are essential to successful plover nesting. Essential nesting habitat is dispersed throughout this unit and this unit represents about 36 percent of Nebraska’s plover population. Five miles of the Niobrara are within the Ponca Tribe reservation boundary. In 1991, Congress designated 76 mi (122.3 km) of the Niobrara River as a ‘‘National Scenic River,’’ 50 mi (80.5 km) of which are included in the Critical Habitat designation. The National Scenic River reach ends where Highway 137 crosses the river. The Nature Conservancy owns and manages 9.5 mi (15.3 km) along the Niobrara River that falls within both the National Scenic River reach and the piping plover Critical Habitat. Other ownership and interests are principally private. The primary land use along the Niobrara River is farming (east along the river) and ranching (west along the river). Loup River—The Loup River flows 68 mi (109.4 km) to its confluence with the Platte River near Columbus. Ownership interests within this reach of Critical Habitat are primarily private. Habitat on the Loup River designation is part of the larger Platte River watershed and provides productive habitat for piping plovers. The Loup River is one of the Platte River’s principal tributaries. Platte River—The North and Middle Platte Rivers each originate in the Rocky Mountains of Colorado with snow melt, and flow east into Nebraska where they join forming the Platte River near the town of North Platte.

The reach included in the piping plover Critical Habitat begins at the Lexington bridge and extends to the Platte's confluence with the Missouri River 252 mi (405.5 km) downstream. About one-fourth of this part of the Platte is already designated as critical habitat for the whooping crane (Grus americana), including a 3-mi wide (4.8-km) northsouth buffer starting at a western boundary south of Lexington east to south of Shelton. Ownership is primarily private, including 28.5 mi (45.9 km) which is managed as conservation land by The Nature Conservancy, Platte River Whooping Crane Habitat Maintenance Trust, Central Nebraska Public Power and Irrigation District, Nebraska Public Power District, and the National Audubon Society's Lillian Annette Rowe Sanctuary. The State of Nebraska owns 8 mi (12.9 km) along the Platte River, which is primarily under the jurisdiction of the Nebraska Game and Parks Commission. Essential nesting habitat is dispersed throughout this unit.

North Dakota: Units 1–10 in North Dakota (described below) include prairie alkali lakes and wetlands. These alkali lakes and wetlands are characterized as follows— shallow; seasonally to permanently flooded; mixosaline to hypersaline chemistry; sandy to gravelly, sparsely vegetated beaches, salt-encrusted mudflats, and/or gravelly salt flats; 200 ft (61 m) of uplands above the wetlands' high water mark, including springs and fens which provide foraging and protective habitat for piping plovers. Sites included in this unit are occupied (determined to have nesting piping plovers in more than 1 year) by piping plovers. This unit requires special management including increasing reproductive success through predator exclusion devices, such as nest cages and electric fences, and reducing vegetation encroachment on nesting beaches through prescribed burning or grazing. These essential breeding habitats in North Dakota can support more than 50 percent of the current known population of the northern Great Plains Piping Plover. The proximity of Units 1–10 to the Missouri River provides an important ecological link that may allow birds extra protection from a severe drought that results in dry wetlands basins. As birds experience drought in these units biologists believe birds move to the river. Conversely, birds may move to these units when Missouri River flows are high. Unit ND–1—This unit encompasses approximately 7,456.9 ac (3,017.7 ha) of 13 alkali lakes and wetlands in Divide and Williams Counties, located in the extreme northwestern corner of North Dakota. Approximately 1,765.2 ac (714.3 ha) are in public ownership and 5,691.7 ac (2,303.4 ha) are in private ownership. Of the lands in public ownership 1,337.9 ac (541.4 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 427.2 ac (172.9 ha) are in State ownership. State lands designated include 3.1 ac (1.2 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 424.1 ac (171.6 ha) of school lands owned and managed by the North Dakota Land Department. Unit ND–2—This unit encompasses approximately 20,683.8 ac (8,370.6 ha) of 14 alkali lakes and wetlands in Burke, Renville, and Mountrail Counties, in northwestern North Dakota. Approximately 13,986.5 ac (5,660.2 ha) are in public ownership and 6,697.3 ac (2,710.3 ha) are in private ownership. Of the lands in public ownership, 13,251.8 ac (5,362.9 ha) are in Federal ownership and 734.6 ac (297.3 ha) are in State ownership. Federal lands designated include Lostwood and Upper Souris National Wildlife Refuges and Waterfowl Productions Areas, both owned and managed by the Service. State lands designated include 320.1 ac (129.5 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 414.4 ac (167.7 ha) of school lands owned and managed by the North Dakota Land Department. Unit ND–3—This unit encompasses approximately 2,524.5 ac (1,021.6 ha) of 11 alkali lakes and wetlands in Mountrail and Ward Counties in northwestern North Dakota. Approximately 615.9 ac (249.2 ha) are in public ownership and 1,908.5 ac (772.3 ha) are in private ownership. Of the lands in public ownership, 615.7 ac (249.2 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 0.2 ac (0.08 ha) are in State ownership. State lands designated are owned and managed by the North Dakota Game and Fish Department as a Wildlife Management Area. Unit ND–4—This unit encompasses approximately 5,150.7 ac (2,084.4 ha) of eight alkali lakes and wetlands in McLean County in north-central North Dakota. Approximately 1,292.6 ac (523.1 ha) are in public ownership and 3,858 ac (1,561.3 ha) are in private ownership. Of the lands in public ownership, 752.1 ac (304.3 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 540.5 ac (218.7 ha) are in State ownership. State lands designated include 435.5 ac (176.2 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 104.9 ac (42.4 ha) of school lands owned and managed by the North Dakota Land Department. The John E. Williams Preserve, owned and managed by The Nature Conservancy (private), also is included in this unit. Unit ND–5—This unit encompasses approximately 3,925.6 ac (1,588.7 ha) of 10 alkali lakes and wetlands in McHenry and Sheridan Counties in north-central and central North Dakota. Approximately 406.8 ac (164.6 ha) are in public ownership and 3,518.8 ac (1,424 ha) are in private ownership. All public lands are in Federal ownership with 34.4 ac (13.9 ha) owned and managed by the Service as Waterfowl Production Areas and 372.4 ac (150.7 ha) owned by the BOR and managed by the North Dakota Game and Fish Department as a Wildlife Management Area. Unit ND–6—This unit encompasses approximately 6,075.2 ac (2,458.6 ha) of 11 alkali lakes and wetlands in Benson and Pierce Counties, in northeastern North Dakota. Approximately 767.3 ac (310.5 ha) are in public ownership and 5,307.9 ac (2,148 ha) are in private ownership. Of the lands in public ownership, 724.8 ac (293.3 ha) are in Federal ownership and 42.5 ac (17.2 ha) are in State ownership. State lands designated include 20.7 ac (8.4 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 21.7 ac (8.79 ha) of school lands owned and managed by the North Dakota Land Department. Unit ND–7—This unit encompasses approximately 30,125.7 ac (12,191.7 ha) of nine alkali lakes and wetlands in Burleigh and Kidder Counties, in southcentral North Dakota. Approximately 20,012.1 ac (8,089.8 ha) are in public ownership and 10,113.5 ac (4,092.9 ha) are in private ownership. Of the lands in public ownership, 18,113.1 ac (7,330.3 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 1,898.9 ac (768.5 ha) are in State ownership. State lands designated include 1,247.9 ac (505 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department and 650.9 ac (263.4 ha) of school lands owned and managed by the North Dakota Land Department. Federal lands designated include Long Lake National Wildlife Refuge and Waterfowl Production Areas owned and managed by the Service. Unit ND–8—This unit encompasses approximately 4,056.7 ac (1,641.7 ha) of three alkali lakes and wetlands in Stutsman County, in south-central North Dakota. Approximately 3,593.6 ac (1,454.3 ha) are in public ownership and 463.1 ac (187.4 ha) are in private ownership. Of the lands in public ownership, 3,583.8 ac (1,450.3 ha) are in Federal ownership and 9.7 ac (3.9 ha) are in State ownership. Federal lands designated include Chase Lake and Arrowwood National Wildlife Refuges and Waterfowl Production Areas owned and managed by the Service. State lands designated include 7.9 ac (3.2 ha) of school lands owned and managed by the North Dakota Land Department and 1.8 ac (0.7 ha) of Wildlife Management Areas owned and managed by the North Dakota Game and Fish Department. Unit ND–9—This unit encompasses approximately 2,658 ac (1,075.6 ha) of six alkali lakes and wetlands in Logan and McIntosh Counties in south-central North Dakota. Approximately 732.5 ac (296.4 ha) are in public ownership and 1,925.5 ac (779.2 ha) are in private ownership. Of the lands in public ownership, 497.7 ac (201.4 ha) are in Federal ownership (Waterfowl Production Areas managed by the Service) and 234.7 ac (95 ha) are in State ownership (Wildlife Management Areas managed by the North Dakota Game and Fish Department. Unit ND–10—This unit encompasses approximately 641.6 ac (259.6 ha) of one alkali lake in Eddy County in northeastern North Dakota. Approximately 6.8 ac (2.7 ha) are in public ownership as a Waterfowl Production Area managed by the Service and 634.7 ac (256.8 ha) are in private ownership.

Missouri River Units: Missouri River Units—Missouri River units consist of riverine and reservoir (Fort Peck Lake, Lake Sakakawea and Lake Audubon, Lake Oahe, and Lewis and Clark Lake) reaches. All reservoirs except Lake Audubon are mainstem impoundments, constructed by dams, and regulated by the Corps. Lake Audubon is a sub-impoundment of Lake Sakakawea and is regulated by the BOR through operation of the Snake Creek Pumping Plant. Overall the Missouri River has accounted for up to 31 percent of the northern Great Plains population of piping plovers. All of the units are occupied. Piping plover habitat within reservoir reaches is composed of shorelines, peninsulas, and islands, below the top of the maximum operating pool and is owned by the Federal government. These reservoir habitats include sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, grave, or shale, and their interface with the water. These reservoir reaches provide habitat for about 42 percent of the piping plovers on the Missouri River. Piping plover habitat within riverine reaches consists of inter-channel islands and sandbars including their temporary pools and interface with the river. These habitats are sparsely vegetated and consist of sand and gravel substrates. Riverine reaches provide habitat for about 58 percent of the piping plovers on the Missouri River. Ownership of these sites varies by State. In Montana, islands and sandbars are recognized as owned by the State except along the reservation boundaries of the Assiniboine and Sioux Tribes of Fort Peck. The Assiniboine and Sioux Tribes of Fort Peck own land to the midchannel of the Missouri River adjacent to the Reservation boundary. In North Dakota and South Dakota, islands and sandbars are recognized as owned by the State. Four Tribes along the Missouri River in North Dakota and South Dakota have critical habitat designated within the boundary of their reservation including the Standing Rock Sioux Tribe, and the Three Affiliated Tribes (Mandan, Hidatsa, and Arikara Tribes) of the Ft. Berthold Reservation, the Cheyenne River Sioux Tribe, and the Yankton Sioux Tribe. Additionally, these Tribes have land or Tribal trust land on submerged sites or sandbars/ islands within the critical habitat designation of the Missouri River in North and South Dakota. In Nebraska, islands and sandbars are owned by the adjacent landowner including the Santee Sioux Tribe.

Montana: Unit MT–2—This unit encompasses approximately 125.4 mi (201.8 km) from just west of Wolf Point, McCone County, Montana, at RM 1712.0 downstream to the Montana/North Dakota border, Richland County, Montana, and McKenzie County, North Dakota, at RM 1586.6. The Missouri River in this unit flows through reservation land of the Assiniboine and Sioux Tribes of Fort Peck (81.7 mi (131.5 km)), State land, and privately owned land. Unit MT–3, Fort Peck Reservoir—This unit encompasses approximately 77,370 ac (31,311 ha) of Fort Peck Reservoir, located entirely within the Charles M. Russell National Wildlife Refuge which is in Federal ownership, managed by the Service.

North Dakota: Unit ND–11, Missouri River— Approximately 354.6 mi (570.6 km) from the Montana/North Dakota border just west of Williston, McKenzie County, North Dakota, at RM 1586.6 downstream to the North Dakota/South Dakota border in Sioux and Emmons Counties, North Dakota, and Corson and Campbell Counties, South Dakota, at RM 1232.0. Lake Sakakawea, Lake Audubon, and Lake Oahe are included in this unit, along with a free-flowing stretch of the Missouri River from RM 1389 to 1302 (Garrison Reach). The North Dakota Game and Fish Department manages the north half of Audubon Reservoir and the Service manages the south half of Audubon Reservoir. The Missouri River and associated reservoirs in this unit include 6.83

mi (11 km) of shoreline (right and left bank) of trust land and 77 liner rm (123.9 km) within the reservation boundary of the Three Affiliated Tribes of Fort Berthold and 23.22 mi (37.37 km) of shoreline on trust land and 38 linear rm (61.16 km) within the reservation boundary of Standing Rock Sioux Tribe and 20 mi (32.19 km) of shoreline on trust land. A mix of State and privately owned lands also are included in this unit.

South Dakota Unit SD–1 Missouri River— Approximately 159.7 mi (257 km) from the North Dakota/South Dakota border northeast of McLaughlin, Corson County, South Dakota, at RM 1232.0 downstream to RM 1072.3, just north of Oahe Dam (Oahe Reservoir). The Missouri River and associated reservoirs in this unit include 3.22 mi (5.18 km) of shoreline (right bank) on trust land and 41 linear mi (65.98 km) within the reservation boundary of the Standing Rock Sioux and 23.44 mi (37.72 km) of shoreline (right bank) on trust land and 77 linear mi (123.92 km) within the reservation boundary of Cheyenne River Sioux Tribe. A mix of State and privately owned lands also are included in this unit. Unit SD–2, Missouri River— Approximately 127.8 mi (204.4 km) from RM 880.0, at Fort Randall Dam, Bon Homme and Charles Mix Counties, South Dakota, downstream to RM 752.2 near Ponca, Dixon County, Nebraska. One mainstem Missouri River reservoir, Lewis and Clark Lake, and two riverine reaches (Fort Randall and Gavins Point) are included in this unit. In addition to the 127.8 mi (204.4 km) that border South Dakota on the left bank there are approximately 7.8 mi (12.4 km) of river bordering South Dakota on the right bank. All islands and sandbars in South Dakota are in State ownership with the exception of 60.36 mi (97.14 km) of shoreline (left bank) on trust land and 34 linear miles (54.72 km) within the reservation boundary of the Yankton Sioux Tribe. Approximately 120 mi (192 km) (right bank) of river border Nebraska. Sandbars and islands in Nebraska (State line extends to midchannel) belong to the adjacent landowner. Approximately 16 linear mi (25.75 km) (right bank) of river below Ft. Randall Dam are within the boundary of the Santee Sioux Reservation, including 0.05 mi (0.08 km) of shoreline on trust land.

Primary Constituent Elements/Physical or Biological Features

Wintering piping plover’s PCEs are the habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. The primary constituent elements are:

(1) Intertidal sand beaches (including sand flats) or mud flats (between the MLLW and annual high tide) with no, or very sparse, emergent vegetation for feeding. In some cases, these flats may be covered or partially covered by a mat of blue-green algae.

(2) Unvegetated or sparsely vegetated sand, mud, or algal flats above annual high tide for roosting. Such sites may have debris or detritus and may have micro-topographic relief (less than 20 in (50 cm) above substrate surface) offering refuge from high winds and cold weather.

(3) Surf-cast algae for feeding.

(4) Sparsely vegetated backbeach, which is the beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road. Backbeach is used by plovers for roosting and refuge during storms.

(5) Spits, especially sand, running into water used for foraging and roosting.

(6) Salterns, or bare sand flats in the center of mangrove ecosystems that are found above mean high water and are only irregularly flushed with sea water.

(7) Unvegetated washover areas with little or no topographic relief for feeding and roosting. Washover areas are formed and maintained by the action of hurricanes, storm surges, or other extreme wave actions.

(8) Natural conditions of sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites).

See above.

See above.

The one overriding primary constituent element (biological) required to sustain the northern Great Plains breeding population of piping plovers that must be present at all sites is the dynamic ecological processes that create and maintain piping plover habitat. Without this biological process the physical component of the primary constituent elements would not be able to develop. These processes develop a mosaic of habitats on the landscape that provide the essential combination of prey, forage, nesting, brooding and chick-rearing areas. The annual, seasonal, daily, and even hourly availability of the habitat patches is dependent on local weather, hydrological conditions and cycles, and geological processes. The biological primary constituent element, i.e., dynamic ecological processes, creates different physical primary constituent elements on the landscape. These physical primary constituent elements exist on different habitat types found in the northern Great Plains, including mixosaline to hypersaline wetlands (Cowardin et al. 1979), rivers, reservoirs, and inland lakes. These habitat types or physical primary constituent elements that sustain the northern Great Plains breeding population of piping plovers are described as follows:

i. On prairie alkali lakes and wetlands, the physical primary constituent elements include—(1) shallow, seasonally to permanently flooded, mixosaline to hypersaline wetlands with sandy to gravelly, sparsely vegetated beaches, salt-encrusted mud flats, and/or gravelly salt flats; (2) springs and fens along edges of alkali lakes and wetlands; and (3) adjacent uplands 200 ft (61 m) above the high water mark of the alkali lake or wetland.

ii. On rivers the physical primary constituent elements include—sparsely vegetated channel sandbars, sand and gravel beaches on islands, temporary pools on sandbars and islands, and the interface with the river.

iii. On reservoirs the physical primary constituent elements include—sparsely vegetated shoreline beaches, peninsulas, islands composed of sand, gravel, or shale, and their interface with the water bodies.

iv. On inland lakes (Lake of the Woods) the physical primary constituent elements include—sparsely vegetated and windswept sandy to gravelly islands, beaches, and peninsulas, and their interface with the water body.

Special Management Considerations or Protections

Activities that may destroy or adversely modify critical habitat are those for which the affected critical habitat would not remain functional to serve its intended conservation role for the species. More specifically, such activities could eliminate or reduce the habitat necessary for foraging by eliminating or reducing the piping plovers' food base; destroying or removing available upland habitats necessary for protection of the birds during storms or other harsh environmental conditions; increasing the amount of vegetation to levels that make foraging or roosting habitats unsuitable; and/or increasing recreational activities to such an extent that the amount of available undisturbed foraging or roosting habitat is reduced, with direct or cumulative adverse effects to individuals and completion of their life cycles. Examples of actions that have effects on wintering piping plover habitats include, but are not limited to: (1) Disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; (2) Predation, especially by falcons, hawks, coyotes, bobcats and feral cats; (3) Beach maintenance (e.g., nourishment (adding sand) and cleaning) and stabilization efforts (e.g., construction of jetties and other hard structures). (4) Oil and other hazardous materials spills and cleanup; (5) Discharge of freshwater from oil and gas activities; (6) Construction of dwellings, roads, marinas, and other structures, and associated activities including staging of materials and equipment; and/or (7) Dredging and dredge spoil placement, and associated activities including staging of equipment and materials.

See above.

See above.

Critical habitat does not include existing developed areas such as mainstem dam structures, buildings, marinas, boat ramps, bank stabilization and breakwater structures, row cropped or plowed agricultural areas, roads and other lands (e.g., high bank bluffs along Missouri River) unlikely to contain primary constituent elements essential for northern Great Plains piping plover conservation.

Life History

Feeding Narrative

Juvenile: The chicks learn to feed themselves and eat smaller versions adult food items (Hull 1981). (NatureServe, 2015)

Adult: Piping plovers forage by gleaning invertebrates from the substrate or running and pecking on the substrate with short runs between pecks (Elliott-Smith and Haig 2004). Sandy mud flats, ephemeral pools, seasonally emergent seagrass beds, mud/sand flats with scattered oysters, and overwash fans are considered primary foraging habitats (Nicholls and Baldassarre 1990b; Cohen et al. 2008). Intertidal areas provide key foraging habitats. Zonick (2000) found dietary differences across the range of piping plovers in Texas, with plovers along the northern Texas coast feeding predominantly on polychaetes while those observed further south largely fed on insects and other arthropods. Wrack also contains invertebrate organisms consumed by piping plovers and other shorebirds (USFWS, 2015). As observed in Texas studies, Lott et al. (2009) identified bay beaches (bay shorelines as opposed to ocean-facing beaches) as the most common landform used by foraging piping plovers in southwest Florida. There is some very limited evidence that plover forage on the alkali lakes may be produced on the nearby prairie (Nordstrom 1990) (USFWS, 2009). Primary prey for wintering plovers includes polychaete marine worms, various crustaceans, insects, and occasionally bivalve mollusks (Zonick and Ryan 1996, p. 26), which they peck from on top or just beneath the surface of moist or wet sand, mud, or fine shell (USFWS, 2009b).

Reproduction Narrative

Adult: Piping plovers breed on bare sandy or gravelly beaches, sandbars, or islands in several different types of habitat across the broad landscape of the NGP. Piping plovers begin to arrive on the breeding grounds in the first half of April, with courtship, followed by nesting, beginning in mid-to-late April (Catlin and Fraser 2006a; Catlin and Fraser 2007; Felio et al. 2009; Felio et al. 2010a; Felio et al. 2010b; Shaffer et al. 2013). Both adults share incubation duties (Wilcox 1959, Cairns 1982) which last 25 to 28 days (Elliott-Smith and Haig 2004). Hatching begins in late May to early June, generally peaking in June and early July (Catlin 2009). The young leave the nest within hours of hatch and begin to forage almost immediately (Wilcox 1959, Haig 1992). Chicks may be brooded for up to 21 days post-hatch, although the female sometimes deserts the brood after 5 to 10 days (Haig and Oring 1988; Haig 1992; Maxson 2000). Chicks fledge 25 to 35 days after hatching, and are capable of sustained flight soon after fledging (Knetter et al. 2001; Catlin et al. 2013). Piping plovers readily renest if earlier nests fail (Whyte 1985; Haig 1987). They generally only raise one brood a season, although they have been documented to raise two broods on rare occasions (Bottitta et al. 1997). Piping plovers begin to leave the breeding grounds as early as mid-July, with adults leaving first and juveniles last (Elliott-Smith and Haig 2004). Although piping plovers have been documented to live as long as 11 years, the Service estimates that with a 78 to 80 percent adult survival rate, the average lifespan is approximately 5-6 years (USFWS, 2015). In the Northern Great Plains, most piping plovers nest on the unvegetated shorelines of alkali lakes, reservoirs, or river sandbars, as described in the 1988 recovery plan. On occasion, however, they will select non-typical sites for nesting (USFWS, 2009).

Tolerance Ranges/Thresholds

Adult: Low (USFWS, 2009)

Site Fidelity

Adult: High (USFWS, 2009)

Habitat Narrative

Adult: On the wintering grounds, piping plovers forage and roost along barrier and mainland beaches, sand, mud, and algal flats, washover passes, salt marshes, and coastal lagoons. New information confirms inter- and intra-annual fidelity of piping plovers to migration and wintering sites. Several studies identified wrack (organic material including seaweed, seashells, driftwood, and other materials deposited on beaches by tidal action) as an important component of roosting habitat for nonbreeding piping plovers. Recent geographic analysis of piping plover distribution on the upper Texas coast noted major concentration areas at the mouths of rivers and washover passes (low, sparsely vegetated barrier island habitats created and maintained by temporary, storm-driven water channels) into major bay systems (Arvin 2008). Piping plovers in the Northern Great Plains population inhabit unvegetated shorelines of alkali lakes, reservoirs, or river sandbars (USFWS, 2009). Wintering plovers are dependent on a mosaic of habitat patches, and move among these patches, depending on local weather and tidal conditions (Drake et al. 2001, pp. 262– 263) (USFWS, 2009b).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2009)

Migratory vs Non-migratory vs Seasonal Movements

Juvenile: Migratory/spring and summer (NatureServe, 2015)

Adult: Migratory (USFWS, 2009)

Dispersal

Adult: High (USFWS, 2009)

Dispersal/Migration Narrative

Juvenile: The juveniles may remain in wintering areas later but are generally gone by mid- to late August (Cuthbert and Wiens 1982). (NatureServe, 2015)

Adult: Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean (USFWS, 2009). Piping plovers spend three to five months on the breeding grounds annually, and the rest of the year on the wintering or in migration. Piping plovers spend up to 10 months of their annual cycle on their migration and winter grounds, typically from 15 July through 15 May (Elliott-Smith and Haig 2004; Noel et al. 2007; Stucker et al. 2010). Southward migration from the breeding grounds primarily occurs from July to September, with the majority of birds initiating migration by the end of August (USFWS 1996; USFWS 2003). Piping plovers depart the wintering grounds as early as mid-February and as late as mid-May, with peak migration in March (Haig 1992) (USFWS, 2015).

Additional Life History Information

Adult: Migrates to breeding grounds July - September (USFWS, 2015)

Population Information and Trends

Population Trends:

Decline from 1991 through 2001, increase from 2001 through 2006 (USFWS, 2009)

Resiliency:

High (inferred from current range/distribution)

Population Size:

2,959 adults; 1,212 breeding pairs (USFWS, 2009)

Minimum Viable Population Size:

1,300 breeding paris (see recovery criterion 1); 1.24 fledglings/pair (USFWS, 2009)

Additional Population-level Information:

Populations are sensitive to adult and juvenile survival rates (USFWS, 2009)

Population Narrative:

The most consistent finding in the various population viability analyses (PVAs) conducted for piping plovers (Ryan et al. 1993, Melvin and Gibbs 1996, Plissner and Haig 2000, Wemmer et al. 2001, Larson et al. 2002, Calvert et al. 2006, Brault 2007) is the sensitivity of extinction risk to even small declines in adult and/or juvenile survival rates. The International Piping Plover Census, conducted every five years, also estimates the number of piping plover pairs in the Northern Great Plains; the 2006 estimate was 2,959 adults and 1,212 breeding pairs. The most recent model examining population viability suggested that a region-wide fledge ratio of 1.24 would be required for stability (Larson et al. 2002). Plover adult numbers seem to be roughly correlated with the amount of suitable habitat available on the Missouri River system. The International Piping Plover Census numbers indicate that the Northern Great Plains population (including Canada) declined from 1991 through 2001 then increased dramatically from 2001 through 2006 (USFWS, 2009).

Threats and Stressors

Stressor: Sand placement projects (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: In the wake of episodic storm events, managers of lands under public, private, and county ownership often protect coastal structures using emergency storm berms; this is frequently followed by beach nourishment or renourishment activities (nourishment projects are considered “soft” stabilization versus “hard” stabilization such as seawalls). Berm placement and beach nourishment deposit substantial amounts of sand along Gulf of Mexico and Atlantic beaches to protect local property in anticipation of preventing erosion and what otherwise would be considered natural processes of overwash and island migration (Schmitt and Haines 2003). Past and ongoing stabilization projects fundamentally alter the naturally dynamic coastal processes that create and maintain beach strand and bayside habitats, including those habitat components that piping plovers rely upon. Although impacts may vary depending on a range of factors, stabilization projects may directly degrade or destroy piping plover roosting and foraging habitat in several ways. Front beach habitat may be used to construct an artificial berm that is densely planted in grass, which can directly reduce the availability of roosting habitat. Over time, if the beach narrows due to erosion, additional roosting habitat between the berm and the water can be lost. Berms can also prevent or reduce the natural overwash that creates roosting habitats by converting vegetated areas to open sand areas (see summary of studies documenting importance of bay beach habitats for piping plover foraging, section WM 2.2.1.4). The vegetation growth caused by impeding natural overwash can also reduce the maintenance and creation of bayside intertidal feeding habitats. In addition, stabilization projects may indirectly encourage further development of coastal areas and increase the threat of disturbance (see WM 2.2.2.5) (USFWS, 2009).

Stressor: Inlet stabilization/relocation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Many navigable mainland or barrier island tidal inlets along the Atlantic and Gulf of Mexico coasts are stabilized with jetties, groins, or by seawalls and/or adjacent industrial or residential development. Jetties are structures built perpendicular to the shoreline that extend

through the entire nearshore zone and past the breaker zone (Hayes and Michel 2008) to prevent or decrease sand deposition in the channel. Inlet stabilization with rock jetties and associated channel dredging for navigation alter the dynamics of longshore sediment transport and affect the location and movement rate of barrier islands (Camfield and Holmes 1995), typically causing downdrift erosion. Sediment is then dredged and added back to islands which subsequently widen. Once the island becomes stabilized, vegetation encroaches on the bayside habitat, thereby diminishing and eventually destroying its value to piping plovers. Accelerated erosion may compound future habitat loss, depending on the degree of sea-level rise. Unstabilized inlets naturally migrate, re-forming important habitat components, whereas jetties often trap sand and cause significant erosion of the downdrift shoreline. These combined actions affect the availability of piping plover habitat (Cohen et al. 2008). Tidal inlet relocation can cause loss and/or degradation of piping plover habitat; although less permanent than construction of hard structures, effects can persist for years (USFWS, 2009).

Stressor: Sand mining/dredging (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Sand mining, the practice of extracting (dredging) sand from sand bars, shoals, and inlets in the nearshore zone, is a less expensive source of sand than obtaining sand from offshore shoals for beach nourishment. Sand bars and shoals are sand sources that move onshore over time and act as natural breakwaters. Inlet dredging reduces the formation of exposed ebb and flood tidal shoals considered to be primary or optimal piping plover roosting and foraging habitat. Removing these sand sources can alter depth contours and change wave refraction as well as cause localized erosion (Hayes and Michel 2008). Exposed shoals and sandbars are also valuable to piping plovers, as they tend to receive less human recreational use (because they are only accessible by boat) and therefore provide relatively less disturbed habitats for birds. We do not have a good estimate of the amount of sand mining that occurs across the piping plover wintering range, nor do we have a good estimate of the number of inlet dredging projects that occur. This number is likely greater than the number of total jettied inlets shown in Table WM3, since most jettied inlets need maintenance dredging, but non-hardened inlets are often dredged as well (USFWS, 2009).

Stressor: Groins (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Groins (structures made of concrete, rip rap, wood, or metal built perpendicular to the beach in order to trap sand) are typically found on developed beaches with severe erosion. Although groins can be individual structures, they are often clustered along the shoreline. Groins act as barriers to longshore sand transport and cause downdrift erosion, which prevents piping plover habitat creation by limiting sediment deposition and accretion (Hayes and Michel 2008). These structures are found throughout the southeastern Atlantic Coast, and although most were in place prior to the piping plover's 1986 ESA listing, installation of new groins continues to occur (USFWS, 2009).

Stressor: Seawalls and revetments (USFWS, 2009)
Exposure:

Response:
Consequence:
Narrative: Seawalls and revetments are vertical hard structures built parallel to the beach in front of buildings, roads, and other facilities to protect them from erosion. However, these structures often accelerate erosion by causing scouring in front of and downdrift from the structure (Hayes and Michel 2008), which can eliminate intertidal foraging habitat and adjacent roosting habitat. Physical characteristics that determine microhabitats and biological communities can be altered after installation of a seawall or revetment, thereby depleting or changing composition of benthic communities that serve as the prey base for piping plovers. At four California study sites, each comprised of an unarmored segment and a segment seaward of a seawall, Dugan and Hubbard (2006) found that armored segments had narrower intertidal zones, smaller standing crops of macrophyte wrack, and lower shorebird abundance and species richness. Geotubes (long cylindrical bags made of high-strength permeable fabric and filled with sand) are softer alternatives, but act as barriers by preventing overwash. We did not find any sources that summarize the linear extent of seawall, revetment, and geotube installation projects that have occurred across the piping plover's wintering and migration habitat (USFWS, 2009).

Stressor: Exotic/invasive vegetation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Beach vitex (Vitex rotundifolia) is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Westbrooks and Madsen 2006). It currently occupies a very small percentage of its potential range in the U.S.; however, it is expected to grow well in coastal communities throughout the southeastern U.S. from Virginia to Florida, and west to Texas (Westbrooks and Madsen 2006). In 2003, the plant was documented in New Hanover, Pender, and Onslow counties in North Carolina, and at 125 sites in Horry, Georgetown, and Charleston counties in South Carolina. One Chesapeake Bay site in Virginia was eradicated, and another site on Jekyll Island, Georgia, is about 95% controlled (D. Suiter, USFWS, pers. comm. 2009). Beach vitex has been documented from two locations in northwest Florida, but one site disappeared after erosional storm events. The landowner of the other site has indicated an intention to eradicate the plant, but follow through is unknown (R. Farley, PBS&J, Inc., pers. comm. 2009). Task forces formed in North and South Carolina in 2004-05 have made great strides to remove this plant from their coasts. To date, about 200 sites in North Carolina have been treated, with 200 additional sites in need of treatment. Similar efforts are underway in South Carolina. Unquantified amounts of crowfootgrass (Dactyloctenium aegyptium) grow invasively along portions of the Florida coastline. It forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat. The Australian pine (Casuarina equisetifolia) changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas. Shorebirds prefer foraging in open areas where they are able to see potential predators, and tall trees provide good perches for avian predators. Australian pines potentially impact shorebirds, including the piping plover, by reducing attractiveness of foraging habitat and/or increasing avian predation. The propensity of these exotic species to spread, and their tenacity once established, make them a persistent threat, partially countered by increasing landowner awareness and willingness to undertake eradication activities. Piping plover habitat is by nature ephemeral, with fluctuating water levels periodically clearing vegetation, which then grows back over time during dry periods. However, invasive exotics, particularly salt cedar, which is tolerant of flooding, are a growing problem on plover

habitat (USACE 2007a). On the Missouri River reservoirs, changing water conditions provide prime habitat for noxious weeds to become established, with up to 200,000 acres of potential habitat exposed on Lake Oahe alone in dry conditions (USACE 2008c). Salt cedar, leafy spurge (Euphorbia esula), Canada thistle (Cirsium arvense), and absinth wormwood (Artemisia absinthium) have been identified as noxious weeds on Missouri River reservoir shorelines (USACE 2007b). Other invasive species, such as kochia (Kochia scoparia) and clover (Trifolium spp.) can also rapidly take over plover habitat, precluding nesting (USACE 2007a) (USFWS, 2009).

Stressor: Wrack removal and beach cleaning (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Wrack on beaches and baysides provides important foraging and roosting habitat for piping plovers (Drake 1999, Smith 2007, Maddock et al. 2009, Lott et al. 2009) and many other shorebirds on their winter, breeding, and migration grounds. Man-made beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2009). These efforts remove accumulated wrack, topographic depressions, and sparse vegetation nodes used by roosting and foraging piping plovers. Removal of wrack also eliminates a beach's natural sand-trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Neal et al. 2007). Tilling beaches to reduce soil compaction, as sometimes required by the USFWS for sea turtle protection after beach nourishment activities, has similar impacts (USFWS, 2009).

Stressor: Disease (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Although researchers increased vigilance following detection of several cases of West Nile virus in breeding Northern Great Plains piping plovers and Type E botulism in the Great Lakes breeding population, the USFWS is not aware of instances of disease in nonbreeding piping plovers. Bird species testing positive for low pathogenic avian influenza consist of Pacific golden-plover (1), bar-tailed godwit (3), dunlin (8), marsh sandpiper (1), red knot (1), sanderling (1), sharp-tailed sandpiper (1), and western sandpiper (1) (Acker, pers. comm. 2009). Based on information available to date, the Service concludes that West Nile virus and avian influenza remain a minor threat to shorebirds, including the piping plover, on their wintering and migration grounds (USFWS, 2009).

Stressor: Predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The 2003 Great Lakes recovery plan expressed concern about the increase in predators (fox, coyotes, dogs, and cats) that are present year-round on the wintering grounds. The impact of predation on migrating or wintering piping plovers remains largely undocumented. Except for one incident involving a cat in Texas (NY Times 2007), no depredation of piping plovers

during winter or migration has been noted, although it would be difficult to document. Avian and mammalian predators are common throughout the species' wintering range. Predatory birds are relatively common during fall and spring migration, and it is possible that raptors occasionally take piping plovers (Drake et al. 2001). Regarding predation, the magnitude of this threat to nonbreeding piping plovers remains unknown, but given the pervasive, persistent, and serious impacts of predation on other coastal reliant species, it remains a potential threat. Focused research to confirm impacts as well as to ascertain effectiveness of predator control programs may be warranted, especially in areas frequented by Great Lakes birds during migration and wintering months. The Service considers predator control on their wintering and migration grounds to be a low priority at this time (USFWS, 2009).

Stressor: Recreational disturbance (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Intense human disturbance in shorebird winter habitat can be functionally equivalent to habitat loss if the disturbance prevents birds from using an area (Goss-Custard et al. 1996), which can lead to roost abandonment and local population declines (Burton et al. 1996). Pfister et al. (1992) implicate anthropogenic disturbance as a factor in the longterm decline of migrating shorebirds at staging areas. Disturbance, i.e., human and pet presence that alters bird behavior, disrupts piping plovers as well as other shorebird species. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from the disturbances (Johnson and Baldassarre 1988; Burger 1991; Burger 1994; Elliott and Teas 1996; Lafferty 2001a, 2001b; Thomas et al. 2002), which limits the local abundance of piping plovers (Zonick and Ryan 1995, Zonick 2000). Shorebirds that are repeatedly flushed in response to disturbance expend energy on costly short flights (Nudds and Bryant 2000). Shorebirds are more likely to flush from the presence of dogs than people, and birds react to dogs from farther distances than people (Lafferty 2001a, 2001b; Thomas et al. 2002). Dogs off leash are more likely to flush piping plovers from farther distances than are dogs on leash; nonetheless, dogs both on and off leashes disturb piping plovers (Hoopes 1993). Pedestrians walking with dogs often go through flocks of foraging and roosting shorebirds; some even encourage their dogs to chase birds. Off-road vehicles can significantly degrade piping plover habitat (Wheeler 1979) or disrupt the birds' normal behavior patterns (Zonick 2000). The 1996 Atlantic Coast recovery plan cites tire ruts crushing wrack into the sand, making it unavailable as cover or as foraging substrate (Hoopes 1993, Goldin 1993). The plan also notes that the magnitude of the threat from off-road vehicles is particularly significant, because vehicles extend impacts to remote stretches of beach where human disturbance would otherwise be very slight. Godfrey et al. (1980 as cited in Lamont et al. 1997) postulated that vehicular traffic along the beach may compact the substrate and kill marine invertebrates that are food for the piping plover. Zonick (2000) found that the density of off-road vehicles negatively correlated with abundance of roosting piping plovers on the ocean beach (USFWS, 2009).

Stressor: Military actions (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Military actions are not listed as threats in either the listing rule or recovery plans. Twelve coastal military bases are located in the Southeast. To date, five bases have consulted

with the USFWS under section 7 of the ESA, on military activities on beaches and baysides that may affect piping plovers or their habitat. Camp Lejeune in North Carolina consulted formally with USFWS in 2002 on troop activities, dune stabilization efforts, and recreational use of Onslow Beach. The permit conditions require twice-monthly piping plover surveys and use of buffer zones and work restrictions within buffer zones. Naval Station Mayport in Duval County, Florida, consulted with USFWS on Marine Corps training activities that included beach exercises and use of amphibious assault vehicles. The area of impact was not considered optimal for piping plovers, and the consultation was concluded informally. Similar informal consultations have occurred with Tyndall Air Force Base (Bay County) and Eglin Air Force Base (Okaloosa and Santa Rosa counties) in northwest Florida. Both consultations dealt occasional use of motorized equipment on the beaches and associated baysides. Tyndall Air Force Base has minimal on-the-ground use, and activities, when conducted, occur on the Gulf of Mexico beach, which is not considered the optimal area for piping plovers within this region. Eglin Air Force Base conducts twice-monthly surveys for piping plovers, and habitats consistently documented with piping plover use are posted with avoidance requirements to minimize direct disturbance from troop activities (USFWS, 2009).

Stressor: Contaminants (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The various piping plover recovery plans identify contaminants, particularly oil spills, as a threat. The Great Lakes plan also states that concentration levels of polychlorinated biphenol (PCB) detected in Michigan piping plover eggs have the potential to cause reproductive harm. Contaminants have the potential to cause direct toxicity to individual birds or negatively impact their invertebrate prey base (Rattner and Ackerson 2008). Depending on the type and degree of contact, contaminants can have lethal and sub-lethal effects on birds, including behavioral impairment, deformities, and impaired reproduction (Rand and Petrocelli 1985, Gilbertson et al. 1991, Hoffman et al. 1996).Beach-stranded 55-gallon barrels and smaller containers, which may fall from moving cargo ships or offshore rigs and are not uncommon on the Texas coast, contain primarily oil products (gasoline or diesel), as well as other chemicals such as methanol, paint, organochlorine pesticides, and detergents (C. Lee, USFWS, pers. comm. 2009). Federal and state land managers have protective provisions in place to secure and remove the barrels, thus reducing the likelihood of contamination. The extent to which contaminant levels in piping plovers can be attributed to wintering and migratory stopover sites is unknown. Research focused on known winter and migration habitats of the Great Lakes birds may be necessary should any breeding issues arise with regard to PCB levels. Petroleum products are the contaminants of primary concern, as opportunities exist for petroleum to pollute intertidal habitats that provide foraging substrate. Impacts to piping plovers from oil spills have been documented throughout their life cycle (Chapman 1984; USFWS 1996; Burger 1997; Massachusetts Audubon 2003; Amirault-Langlais et al. 2007; A. Amos, University of Texas, pers. comm. 2009). This threat persists due to the high volume of shipping vessels (from which most documented spills have originated) traveling offshore and within connected bays along the Atlantic Coast and the Gulf of Mexico. Additional risks exist for leaks or spills from offshore oil rigs, associated undersea pipelines, and onshore facilities such as petroleum refineries and petrochemical plants (USFWS, 2009).

Stressor: Pesticides (USFWS, 2009)

Exposure:
Response:
Consequence:
Narrative: Neither the final listing rule nor the recovery plans identified pesticides as a threat to piping plovers on the wintering grounds. In 2000, mortality of large numbers of wading birds and shorebirds, including one piping plover, at Audubon's Rookery Bay Sanctuary on Marco Island, Florida, occurred following the county's aerial application of the organophosphate pesticide Fenthion for mosquito control purposes (Williams 2001). Fenthion, a known toxin to birds, was registered for use as an avicide by Bayer chemical manufacturer. With one reported plover death from pesticide use, and with the causative pesticide now removed from use, this threat to piping plovers in the U.S. currently appears low. However, it is unknown whether pesticides are a threat for piping plovers wintering in the Bahamas, other Caribbean countries, or Mexico (USFWS, 2009). Although unknown, given the widespread use of neonicotinoids and the tendency to accumulate in wetlands, persistence in the soil, and potential adverse effects on the quantity and composition of the insect community, neonicotinoids may have a negative effect on the piping plover population, particularly breeding areas in alkaline lakes (USFWS, 2015).

Stressor: Accelerating sea-level rise (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Over the past 100 years, the globally-averaged sea level has risen approximately 10-25 centimeters (Rahmstorf et al. 2007), a rate that is an order of magnitude greater than that seen in the past several thousand years (Douglas et al. 2001 as cited in Hopkinson et al. 2008). The IPCC suggests that by 2080 sea-level rise could convert as much as 33% of the world's coastal wetlands to open water (IPCC 2007). Although rapid changes in sea level are predicted, estimated time frames and resulting water levels vary due to the uncertainty about global temperature projections and the rate of ice sheets melting and slipping into the ocean (IPCC 2007, CCSP 2008). Inundation of piping plover habitat by rising seas could lead to permanent loss of habitat that lies immediately seaward of numerous structures or roads, especially if those shorelines are also armored with hardened structures. Without development or armoring, low undeveloped islands can migrate toward the mainland, pushed by the overwashing of sand eroding from the seaward side and being re-deposited in the bay (Scavia et al. 2002). Overwash and sand migration are impeded on developed portions of islands. Instead, as sea-level increases, the ocean-facing beach erodes and the resulting sand is deposited offshore. The buildings and the sand dunes then prevent sand from washing back toward the lagoons, and the lagoon side becomes increasingly submerged during extreme high tides (Scavia et al. 2002), diminishing both barrier beach shorebird habitat and protection for mainland developments (USFWS, 2009).

Stressor: Storm events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Storms are a component of the natural processes that form coastal habitats used by migrating and wintering piping plovers, and positive effects of storm-induced overwashand vegetation removal have been noted in portions of the wintering range. The adverse effects on piping plovers attributed to storms are sometimes due to a combination of storms and other

environmental changes or human use patterns. Other storm-induced adverse effects include post-storm acceleration of human activities such as beach nourishment, sand scraping, and berm and seawall construction. As discussed in more detail in WM 2.2.2.1, such stabilization activities can result in the loss and degradation of feeding and resting habitats. Storms also can cause widespread deposition of debris along beaches. Removal of debris often requires large machinery, which can cause extensive disturbance and adversely affect habitat elements such as wrack. Recent climate change studies indicate a trend toward increasing hurricane numbers and intensity (Emanuel 2005, Webster et al. 2005). When combined with predicted effects of sea-level rise, there may be increased cumulative impacts from future storms. In sum, storms can create or enhance piping plover habitat while causing localized losses elsewhere in the wintering and migration range (USFWS, 2009).

Stressor: Inadequacy of existing regulatory mechanisms (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Protections for piping plovers migrating and wintering outside the U.S. include the 2005 designation of 1.5 million acres of the Laguna Madre de Tamaulipas region in Mexico as a Federal Natural Protected Area. Any land-use alterations to piping plover habitats within this area are now subject to review under a federal permitting process that encourages avoidance and minimization of impacts; however, it does not preclude alterations. This is similar to the ESA in allowing some adverse effects to designated critical habitat. Regulatory protections for piping plovers in the Caribbean and Cuba are currently unknown. Enforcement limitations and/or legal insufficiency of regulations to protect important habitat components result in continued degradation of a significant amount of wintering piping plover coastal habitat, including designated critical habitat units, resulting in a cumulative loss of habitat. At the current time, if the protections of the ESA were removed, existing local, state, and other federal regulatory provisions would provide insufficient protection to nonbreeding piping plover habitats used during migration and winter (USFWS, 2009).

Stressor: Reservoirs, channelization of rivers, and modification of river flows (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Prior to colonization, river systems in the Northern Great Plains generally had large rises in the spring as water melted off of the prairie and then the mountains. These spring rises carried sediment down the system, creating sandbar islands as the water slowed and deposited the material. The water levels would then drop throughout the summer, exposing more acres of sandbar as the season progressed (USFWS 2003). After European settlement, attempts were made to make the rivers more predictable and suitable for navigation, and to minimize seasonal flooding. River channels were straightened and channelized, and a number of dams were constructed. These dams greatly reduced sediment inflow into the system, reducing the amount of sand available for sandbar creation (National Research Council 2002). Additionally, the hydrology of the rivers has been drastically altered. On the Missouri river, flows used to generally decline over the summer as tributary flows decreased. Today, they generally increase during the nesting season to provide for downstream needs (USFWS 2003). This means that less sandbar habitat is available over the course of the summer, rather than more, as would have been the case prior to dam construction. By contrast, due to the large number of users on the Platte River,

flows are variable and the river often runs dry in the summer, also leading to a reduction in piping plovers on the river (National Research Council 2004). The lack of sufficient suitable habitat due to modification of river flows continues to be a major threat to the piping plover (USFWS, 2009).

Stressor: Sand and gravel mining (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Mining is ongoing in Nebraska in the lower and central Platte River systems. Mine operators inadvertently create piping plover habitat by depositing waste sand alongside pit lakes. Plovers nest on spoil piles of sparsely or non-vegetated sand and associated lakes at sand and gravel mines. Generally, when production is finished, the mines are turned into housing developments. Some lakes have been constructed for housing developments without first mining the area. As the 1988 plan states, these activities can be problematic because of construction activities in the areas where plovers nest, potentially directly impacting nesting birds or indirectly disturbing nesting or brood rearing activities (Brown and Jorgensen 2008). The 1988 plan also identifies predation as a problem on these mine sites (USFWS, 2009)

Stressor: Oil and gas development (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Oil development on the breeding grounds has increased dramatically since 1988 and remains a threat today. Although USFWS personnel work with oil producers to avoid impacts to plovers, unless a federal permit is required, the USFWS is not necessarily informed about oil activity, and many wells are put in without any input regarding potential impacts on plovers. In North Dakota and Montana, oil production near plover nesting habitat has increased substantially since 1988, and many oil wells are near known plover nesting areas. The impacts from oil development are largely unknown but potentially substantial. Prior to production, seismic surveys are performed over an extensive area to determine the likely location of oil reserves. This requires large equipment that can leave permanent tracks in plover nesting areas, even under frozen conditions in winter. Plover chicks can have difficulty getting out of vehicle tracks, which may contribute to mortality (Eddings 1991, Howard et al. 1993). The extensive road system built to access oil wells may cause direct mortality of adult plovers. Plovers were documented to be hit by cars on a road between Lake Audubon and Lake Sakakawea (a Missouri River reservoir) in North Dakota (USFWS 2004; M. Shriner, Western Area Power Administration, in litt. 2007). Plover mortality has also been documented from powerline strikes (M. Shriner in litt. 2007). Drilling activity is extremely loud and would likely be disruptive to nesting plovers if it is done during the nesting season. Contamination from the reserve pit, either while the well is active or over time after the extraction is complete, may permanently impact piping plover habitat (USFWS, 2009).

Stressor: Wind power (USFWS, 2009)
Exposure:
Response:
Consequence:

Narrative: The number of wind farms in the Northern Great Plains is increasing rapidly (American Wind Energy Association 2008). North Dakota has been identified as the top state in the nation for wind energy potential, and Montana is the fifth highest (American Wind Energy Association 2009). The potential impacts of wind farms on piping plovers are unknown but may be significant. Impacts may occur through direct collision with turbines, or indirectly if plovers avoid previously used areas that now contain wind farms (USFWS, 2009).

Stressor: Intraspecific aggression (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: There is some information suggesting that in situations where density may be leading to insufficient forage for chicks, piping plover adults will attack nonrelated young (D. Catlin in litt. 2009). In the Northern Great Plains, this agonistic behavior is likely related to limited available habitat, as birds are forced to nest in dense concentrations and compete for forage (D. Catlin in litt. 2009). Intraspecific aggression seems to be a symptom of birds nesting too densely resulting in competition for resources. The reduction in suitable nesting habitat due to a number of factors is a major threat to the species, likely limiting reproductive success and thus future recruitment into the population (USFWS, 2009).

Stressor: Power lines (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Overhead power lines have been documented to kill a large number of birds, including plovers (USFWS 2004, M. Shriner in litt. 2007). Overall, power lines are known to kill piping plovers when located between feeding and nesting areas, but it is unknown whether the increasing number of powerlines across the migration routes impacts plovers (USFWS, 2009).

Stressor: Agricultural development (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Alkaline wetlands of the prairie pothole region lie within an agricultural landscape and are subject to siltation, pre-mature filling and other impacts (Gleason and Euliss 1998). Wetlands in agricultural fields receive more sediment from upland areas than wetlands in grassland landscapes. Cultivation of the wetland catchment areas, where surface water runs off to the wetland basin, has greatly altered the dynamics of surface runoff and hydrologic inputs to groundwater. Excessive sediment input can potentially alter the aquatic food web and other basic wetland functions. Retaining grasslands or restoring grassland buffers around plover nesting basins may reduce siltation and other contaminant impacts (USFWS, 2015).

Recovery

Reclassification Criteria:
Not available.

Delisting Criteria:

1. Using the most current estimates of region-specific breeding population and population growth (?), the NGP plover population model indicates that the upper 95 percent confidence limit on the probability of a regional population going extinct within the next 50 years is < 0.05. This criterion is satisfied for all four regions (description of the areas is under number '2' below). In addition, the following are met: 1. for every region, population growth is stable or increasing (= 1.0) over a 10-year average, and is projected to remain steady or increasing over the next 50 years, and 2. the population will be distributed so that at least 15 percent of the population is in each of the following regions: a. Southern Rivers (Missouri River system from Fort Randall Dam, South Dakota to Ponca, Nebraska, the Niobrara River, the Loup River system and the Platte River system) b. Northern Rivers (Missouri River system from Fort Peck Lake, Montana to Pierre, South Dakota) c. U.S. Alkaline Lakes d. Prairie Canada (USFWS, 2015).

2. A minimum amount of suitable nesting and foraging habitat is available on a regional basis, as described below. a. 1,630 ha (4,030 ac) in Southern Rivers (Missouri River system from Fort Randall Dam, South Dakota to Ponca, Nebraska, the Niobrara River, the Loup River system and the Platte River system) b. 1,320 ha (3,270 ac) in Northern Rivers (Missouri River system on Fort Peck Lake, Montana to Pierre, South Dakota) c. 1,460 ha (3,600 ac) in the U.S. Alkaline Lakes d. 1,460 ha (3,610 ac) in Prairie Canada. This criterion should be met for a minimum of 12 years prior to initiating delisting (USFWS, 2015).

3. Sufficient habitat is available on the coastal migration and wintering grounds in quantity and quality to support conservation of the species at recovery levels as defined by Criterion 1. This will include designated Critical Habitat, and additional habitat that was not designated but is regularly used by wintering piping plovers. Piping plovers should be spatially distributed in the following locations. a. Western Gulf Coast - from the Galveston Bay area, west-southwest along the coast of Texas and Mexico b. Central Gulf Coast - east-northeast of Galveston Bay through Jefferson County in NW Florida c. Eastern Gulf Coast - Florida's west coast-Taylor County, Florida south to Monroe County d. Atlantic Coast Florida's east coast, including the Florida Keys up through northeastern North Carolina, Caribbean Islands, and the Bahamas Islands (USFWS, 2015).

4. Ensure commitments are in place and functioning as anticipated to provide longterm funding, protection, and conservation management activities in essential breeding and wintering grounds. a. Southern Rivers (Missouri River system from Fort Randall Dam, South Dakota to Ponca, Nebraska, the Niobrara River, the Loup River system and the Platte River system) b. Northern Rivers (Missouri River system from Fort Peck Lake, Montana to Pierre, South Dakota) c. U.S. Alkaline Lakes d. U.S. Wintering Grounds (USFWS, 2015).

Recovery Actions:
- Protect habitat on the breeding grounds to support piping plovers at recovery level goals (USFWS, 2015).
- River system management: Ensure that river management mimics the natural system to the extent possible and furnishes sufficient high-quality nesting habitat to be available at a level to support piping plovers at recovery goals (USFWS, 2015).
- Alkaline Lakes: Identify and reduce threats in landscape ecology of the alkaline lakes basins such that the basins will provide quality self-sustaining habitat (USFWS, 2015).
- Work with commercial aggregate (also known as sand and gravel) mining companies to operate mines to avoid adversely affecting piping plovers during operations (USFWS, 2015).

- Implement steps to reduce unsustainable levels of predation risk over the long- term through ecosystem restoration (USFWS, 2015).
- Protect breeding plovers and their habitats from impacts of energy development (USFWS, 2015).
- Identify and control plant species, with an emphasis on invasives, that may make habitat unsuitable (USFWS, 2015).
- Develop and implement comprehensive plans, reflective of local conditions, to manage and avoid conflicts and to address the social and public relations challenges resulting from restrictions placed on human activities and interests such as recreation, residency, economic development and commerce. Actions should be focused on areas where management actions intended to protect piping plovers may interfere with human activities (USFWS, 2015).
- Coordinate among state, federal, and tribal agencies as well as private landowners to ensure that plover protection is incorporated into development plans on or near plover habitat in order to avert negative impacts to plovers (USFWS, 2015).
- Develop a Conservation Strategy for the long-term management of piping plovers and their habitat, including a post de-listing plan (USFWS, 2015).
- Work internally in the USFWS, and with federal and state agencies on projects so that there are no net negative impacts to plover habitat by assisting with design, implementation, permits, or mitigation measures (USFWS, 2015).
- Ensure that conservation measures designed to offset the adverse effects of human activities, developments and management decisions are monitored for effectiveness (USFWS, 2015).
- Ensure that incidental take that may be authorized pursuant to the ESA is consistent with recovery (USFWS, 2015).
- Continue monitoring efforts on the breeding grounds to track population trends and reproductive success. Monitoring efforts should be coordinated throughout the Northern Great Plains breeding grounds so that overall trends can be tracked across the range (See appendix 3B for a matrix on how this might be done across the range). Input monitoring results into the NGP plover model (see Appendix 2B) to assess progress towards recovery (USFWS, 2015).
- Work with biologists in Canada to identify and find solutions to international problems that may be impacting survival (USFWS, 2015).
- Coordinate between research and monitoring programs across the NGP to determine demographic parameters across time as local and regional conditions change (USFWS, 2015).
- Monitor status of State Wildlife Action Plan revisions and leverage opportunities to provide input on this species (USFWS, 2015).
- Evaluate impacts to the breeding population from projected climate change modeling and analysis (USFWS, 2015).

Conservation Measures and Best Management Practices:

- Develop a comprehensive conservation plan for piping plovers in the U.S. portion of their migration and wintering range. a. Acquire funds to develop a concise, cohesive plan that will address the migration and wintering needs of the three breeding populations. This is most efficiently accomplished by a qualified contractor working in close coordination with USFWS biologists. b. Develop a state-by-state wintering and migration habitat use atlas (GL tasks 2.12, 2.13, 2.16; AC task

2.1; NGP task 1.13). i. Quantify amount and distribution of currently existing habitat. ii. Determine the condition of each site, including the type and level of alteration, presence and threat level from invasive species, and whether natural coastal processes are impeded. Compare with historic habitat availability using aerial photography or other records. iii. Determine the temporal abundance and distribution of piping plover activity at sites with suitable habitat. Where appropriate data are currently lacking, conduct multiple surveys by qualified personnel across several migration and wintering seasons. Examples of reports summarizing methods and results of such surveys are available on request to the USFWS. iv. Evaluate likelihood of future actions, including human development and recreational uses, and natural events that could potentially affect habitat quantity and quality at each site. v. Evaluate factors at each site that will affect the response of habitat to accelerating sea-level rise and identify potential actions to minimize its adverse effects. c. Conduct a systematic review of recreational policies and beach management. Identify gaps in management and enforcement of regulatory mechanisms by state. Develop recommendations to improve management and enforcement of piping plover protections where warranted (AC task 2.24). d. Develop an education/outreach strategy to work with state, county, and municipal governments to develop and implement ordinances and other strategies reducing effects of habitat stabilization, beach cleaning practices, human uses, and pets in beach and bayside habitats (GL task 5.2, AC task 2.24, NGP task 5.2). e. Develop an education/outreach strategy to work with private landowners with regard to habitat stabilization, beach-cleaning practices, human uses, and pets (USFWS, 2009).

- Develop, in coordination with land managers, management plans for critical habitat sites or other sites that support or could support nonbreeding piping plovers. This may be accomplished concurrently with development of the atlas described under action 1b above or as a follow-up task (GL tasks 2.14, 2.22; AC tasks 2.13, 2.2; NGP tasks 4.42, 4.43). a. Develop and implement a conservation plan tailored to the site's conditions. A range of management measures may include, as appropriate, leash laws and dogfree zones, off-road vehicle management, and symbolic fencing of key habitats during periods of high plover use. b. Develop a recommended piping plover monitoring protocol for each site that includes suggested frequency and intensity of monitoring. c. Monitor the effectiveness of management measures (2.a above) (USFWS, 2009).
- Improve consistency in the approach used, and recommendations generated for, piping plover conservation in ESA section 7 consultations and Coastal Barrier Resources Act review across all USFWS field offices throughout the species' U.S. coastal migration and wintering range. a. Regularly update USFWS field office staff regarding latest information on piping plovers and habitat use. b. Emphasize importance of maintaining natural coastal processes to perpetuate high quality piping plover migrating and wintering habitat (AC task 2.21). c. Discourage projects that will degrade or interfere with formation or maintenance of high quality piping plover habitat (GL task 2.22, AC task 2.21, NGP task 4.43). d. Encourage project features to minimize adverse effects on piping plovers and their habitat, including creation and enhancement of habitat in the vicinity of existing stabilization projects. . e. Develop a comprehensive monitoring and management plan template for shoreline stabilization projects on the wintering and migration grounds. f. Consider effects of climate change when determining long-term impacts. Include measures to conserve and enhance the capacity of piping plover habitats to adapt to sea-level rise (USFWS, 2009).
- Develop a website specifically for wintering and migrating piping plover issues (GL task 5.2 and AC tasks 4.1, 4.2). a. Develop a piping plover contact list of all individuals in each state and other countries (Canada, Mexico, Bahamas, etc.). b. Link to other plover websites. c. Upload all pertinent literature, including research and monitoring reports not protected by copyright, to the website. d. Upload summarized section 7 consultations, conservation measures, reasonable and prudent measures, and terms and conditions (USFWS, 2009).

- Focus the non-breeding portion of the International Census on enhancing understanding of piping plover abundance, distribution, and threat levels in seasonally emergent habitat (seagrass beds, oyster reefs, and mud flats) in Texas bays, and in Mexico and the Caribbean (GL task 2.13 and NGP task 1.13). a. Continue to encourage and improve International Census efforts at priority sites in Texas. b. USFWS regional coordinators for the International Census should establish contacts in Mexico, Bahamas, Cuba, and other appropriate Caribbean countries at least a year in advance of the 2011 International Census. i. Increase efforts to maximize survey coverage. ii. Encourage collection of information describing types and levels of threats at each International Census site in addition to physical and biological attributes of the site. iii. Provide information about color-banded birds and encourage surveyors to look for and report these marked piping plovers (USFWS, 2009).
- To further enhance understanding of spatial partitioning of the breeding populations (as well as the impacts of some threats) on the migration/winter grounds, USFWS should facilitate and encourage all efforts dedicated to (or incorporating) monitoring of color-banded piping plovers. There is urgency associated with this data collection since several large breeding grounds banding studies have recently ended or are slated for completion in the near future, and opportunities to glean information will decline as banded piping plovers die off (GL task 2.12, NGP task 1.133) (USFWS, 2009).
- Further investigate the partitioning of survival within the annual cycle, and determine whether winter habitat quality influences reproductive success and survival (GL task 4.1 and AC task 3.6). Explore opportunities for further comparison of survival rates among breeding populations to inform these issues (USFWS, 2009).
- Continue to refine characterization of optimal winter habitat and understanding of factors affecting piping plover use of different microhabitats (e.g., ocean intertidal zones, wrack, inlet shoreline, soundside flats) (GL task 4.4; AC tasks 3.11, 3.12, 3.13; NGP tasks 2.22, 2.23). Research approaches should recognize that piping plovers may move among relatively nearby habitat patches. Plover habitat use patterns and needs may also vary geographically (across their nonbreeding range) and seasonally. a. Determine how habitat modification or complete loss of a site on migration and wintering grounds affects survival given documented site fidelity. b. Develop design specifications for creating roosting and foraging habitat. c. Quantify the amount and distribution of habitat needed for recovery of each breeding population, giving due consideration to intra- and inter-species competition for use of similar habitats (USFWS, 2009).
- Develop strategies to reduce threats from accelerating sea-level rise. a. Identify human coastal stabilization practices that increase or decrease adverse effects of sea-level rise on coastal piping plover habitats. b. Identify sites most likely to maintain (or increase) characteristics of suitable piping plover breeding and/or migration habitat as sea-level rises. c. Evaluate projected effects of sea-level rise on the regional distribution of piping plover habitats over time. Facilitate use of LIDAR (a remote sensing system used to collect topographic data) mapping of coastal elevations, development of models, and timeframe analysis throughout the species wintering and migration range in the U.S. to generate projections regarding areas most likely to be inundated within given time frames (USFWS, 2009).
- Determine the extent that human and pet disturbance limits piping plover abundance and behavioral patterns in the wintering and migration habitats (GL task 2.14, AC task 3.14, NGP task 3.221) (USFWS, 2009).
- Determine the effect of human and pet disturbance on survival and reproductive fitness (GL task 4.1, AC task 3.14, NGP task 3.221) (USFWS, 2009).
- Support research to ascertain impacts of predation on wintering/migrating piping plovers, as well as to determine the effectiveness of predator control programs (USFWS, 2009).

- A draft and final revised recovery plan (or, alternatively, an interim conservation strategy) for the Northern Great Plains piping plover population should be developed (USFWS, 2009).
- Continue to construct habitat on the Missouri River system while exploring ways that flows could be altered to provide additional habitat for piping plover nesting and brood rearing (USFWS, 2009).
- Actively explore ways that the Missouri River reservoirs and shorelines can be manipulated to provide breeding habitat under a variety of water conditions (USFWS, 2009).
- Ensure habitat availability. Identify how much habitat is needed over time on river systems to provide for a secure Northern Great Plains piping plover population. The Missouri and Platte rivers in particular are highly altered systems, leading to flooding of breeding habitat and suppressed reproduction. To date, sandbar creation efforts on the Missouri River have not kept pace with habitat loss. See recovery plan tasks 4.416 and 4.417 (USFWS, 2009).
- Continue to perform monitoring and recovery actions annually throughout the U.S. Northern Great Plains population (USFWS, 2009).
- Identify and secure consistent funding for management, monitoring, and recovery efforts for the U.S. alkali lakes population (USFWS, 2009).
- Public outreach: a. Increase public outreach and education in areas where there is the potential for human/plover interactions. See recovery plan tasks 5.51 and 5.52. b. Increase law enforcement activities in areas where human disturbance may be impacting reproductive success (USFWS, 2009).
- Habitat protection: a. Continue to work with landowners on the alkali lakes to ensure protection of piping plover alkali lakes and surrounding uplands. Where possible, obtain longterm agreements with landowners to protect these habitats. Increase efforts to remove trees, rockpiles, etc., that may harbor predators. See recovery plan tasks 4.417 and 4.418. b. On the river systems, obtain easements or fee-title on undeveloped land to reduce current and future pressure from human activities on nearby piping plover habitat. Keep as much of the river bank as possible from being stabilized, since this increases flow velocity and thus sandbar erosion rates and encourages development. See recovery plan task 4.416. c. Restrict public use of sandbar and shoreline areas as needed to provide for piping plover nesting and brood-rearing needs (USFWS, 2009).
- Explore the movement of birds within the Northern Great Plains. It has been postulated that if there is not much habitat on the Missouri River system, birds will nest on the alkali lakes and vice versa. Sightings of banded birds have established that birds do move among the Missouri River, Nebraska, and the alkali lakes. There have been some sightings of birds hatched in Saskatchewan that apparently breed on the alkali lakes in Montana. However, it is not known if there are large-scale movements of piping plovers from one habitat type to another, in particular between the alkali lakes in the U.S. and Canada and the Missouri River system. A study of large-scale piping plover movements over time would help to identify where to focus management actions to ensure that there is habitat available in areas where birds may go if habitat in one area is not suitable in a given year (USFWS, 2009).
- Predation control efforts are ongoing on the Missouri River system and the U.S. alkali lakes. However, predation control may not always have the intended effect. For example, caging nests may increase adult mortality if predators learn to key in on cages. Increasing the number of chicks hatched may not lead to a higher fledging success, since predators may key in on densely occupied areas. Research is needed to determine if predation control is actually improving reproductive success in all areas where it is taking place. See recovery plan tasks 3111 and 3112 (USFWS, 2009).
- The International Census is an extremely useful tool in the Northern Great Plains. Therefore, we recommend continuing the International Census for this population (recovery plan tasks 111 and 112). It may also be worth exploring additional sampling techniques between International Censuses to better track piping plover population trends on the Northern Great Plains. A well-designed

sampling approach in which a subset of sites is surveyed more frequently may supplement the International Census by providing information on population trends and bird movements. Therefore, sub-sampling is unlikely to completely replace efforts to periodically survey the entire region. However, a combination of attempting to survey the entire area coupled with more frequent sub-sampling may provide more accurate and timely information about population trends (USFWS, 2009).

- Wind power is rapidly expanding in the Northern Great Plains. Research is needed to assess the threat this poses to piping plovers at breeding sites and in migration corridors. Special focus should be placed on the impact of associated power transmission lines (USFWS, 2009).
- . Oil and gas exploration and production is rapidly expanding throughout Northern Great Plains breeding grounds. Work is needed to determine the short and long-term impacts of oil exploration and production, including short-term impacts such as seismic work or drilling, ongoing impacts of extraction, potential impacts of spills or leakage, and long-term, cumulative changes as more habitat is disturbed for well pads and roads (USFWS, 2009).
- Piping plover adult numbers appear to fluctuate in response to the quantity of water in the river system (see Figure NGP13 in this review). A historical analysis of system storage and flows compared with adults surveyed and reproductive success may help in future river management. See recovery plan tasks 4161 and 4162 (USFWS, 2009).
- There is very limited evidence suggesting that forage on alkali lakes may be generated from nearby prairies. Changes in surrounding habitat may impact plovers in other ways as well. Examining forage on alkali lakes in relation to surrounding land use may help to focus alkali lake management priorities over the long term. See recovery plan task 211 (USFWS, 2009).
- Clarify the piping plover ESA listing to recognize the subspecies Charadrius melodus melodus and C. m. circumcinctus, and, within C. m. circumcinctus, two DPSs (USFWS, 2009).
- The International Piping Plover Census has fostered widespread involvement in survey efforts and provided extensive data. However, as piping plover conservation efforts mature, it may be beneficial to shift the Census effort to address specific questions that are not answered by other ongoing efforts. Given ongoing recovery programs on the breeding grounds, the most important future International Census contribution to ESA recovery implementation and monitoring for all piping plovers is the abundance estimate for the Northern Great Plains breeding population (including Prairie Canada). The highest benefit can be realized by emphasizing completeness and quality control of this portion of the census and by expediting synthesis and reporting, so that managers can make timely use of this information (see recommendation 11 for the Northern Great Plains breeding range). The most valuable potential contribution from future winter censuses is improved understanding of the species' range in the Caribbean, Mexico, and other areas that may not have been fully covered in the past (e.g., seasonally emergent habitats within bays lying between the mainland and barrier islands in Texas) (USFWS, 2009).

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SPECIES ACCOUNT: *Charadrius melodus melodus* (Piping Plover - Atlantic)

Species Taxonomic and Listing Information

Listing Status: Threatened; 12/11/1985; Northeast Region (R5) (USFWS, 2017)

Physical Description

Piping plover subspecies are phenotypically indistinguishable (USFWS, 2009). The piping plover is a small Nearctic (i.e., North American) shorebird approximately 17 centimeters (7 inches) long with a wingspread of about 38 cm (15 in) (Palmer 1967). Wilcox (1959) found that breeding females were slightly heavier than males (55.6 grams vs. 54.9 g), had slightly shortertail lengths (50.5 millimeters vs. 51.3 mm), but had similar wing lengths. Breeding birds have white underparts, light beige back and crown, white rump, and black upper tail with a white edge. In flight, each wing shows a single, white wing stripe with black highlights at the wrist joints and along the trailing edges. Breeding plumage characteristics are a single black breastband, which is often incomplete, and a blackbar across the forehead. The black breastband and brow bar are generally more pronounced in breeding males than females (Wilcox 1939). The legs and bill are orange in summer, with a black tip on the bill. In winter, the birds lose the blackbands, the legs fade from orange to pale yellow, and the bill becomes mostly black (USFWS, 1996).

Taxonomy

Miller et al. (2009) confirmed separate Atlantic and interior piping plover subspecies (C. m. melodus and C. m. circumcinctus, respectively). This study found that birds from the Great Lakes region were allied with the interior subspecies group and should be taxonomically referred to as C. m. circumcinctus. Very rare (perhaps completely absent) reproductive interchange between the Great Lakes and the Northern Great Plains populations constitutes a marked separation of breeding ranges, albeit insufficient or too recent to result in substantial genetic differences demonstrated by available studies (USFWS, 2009).

Historical Range

See current range/disitrbution.

Current Range

Migrating breeders from eastern Canada have been observed in Massachusetts, New Jersey, New York, and North Carolina (Amirault et al. 2005). Information gaps include the wintering locations of the U.S. Atlantic Coast breeding population. Although there is no exclusive partitioning of the wintering range, piping plovers from the Atlantic Coast (i.e., eastern Canada) and the Great Lakes are most prevalent during migration and winter along the southern Atlantic Coast. Wintering ranges of all three breeding populations overlap on the Gulf Coast of Florida. The latitudinal extent of the breeding population did not change between 1986 and 2006, as piping plovers nested annually from southern North Carolina north to the western coast of Newfoundland. Breeding piping plovers were present each year in all Atlantic Coast states from North Carolina to Maine, except for New Hampshire, where they were reported in 1997 for the first time since ESA listing. One to three pairs were reported nesting in South Carolina in 1986, 1990, 1991, and 1993 (Hecht and Melvin 2009a) (USFWS, 2009). The Atlantic Coastpiping plover(Charadrius melodus) population breeds on coastal beachesfrom Newfoundland to North

Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast from North Carolina south, along the GulfCoast, and in the Caribbean. Piping plovers continue to breed successfully at or near the extremes of their historic range. While the extent of the current range does not appear to be substantially different from the historic range, piping plovers are absent from many former nesting beaches on the Atlantic Coast (Cairns and McLaren 1980, Litwin etal. 1993, CWS 1994, Virginia Department of Game and Inland Fisheries 1994) (USFWS, 1996).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 7/10/2001.

Legal Description

On May 19, 2009, the U.S. Fish and Wildlife Service (Service), designated revised critical habitat for the wintering population of the piping plover (Charadrius melodus) in 18 specific units in Texas under the Endangered Species Act of 1973, as amended (Act). In total, approximately 139,029 acres (56,263 hectares) fall within the boundaries of the revised critical habitat designation. The revised critical habitat is located in Cameron, Willacy, Kenedy, Kleberg, Nueces, Aransas, Calhoun, Matagorda, and Brazoria Counties, Texas. Other previously designated critical habitat for the wintering piping plover in Texas or elsewhere in the United States remains unaffected.
On October 21, 2008, the U.S. Fish and Wildlife Service (Service), designated revised critical habitat for the wintering population of the piping plover (Charadrius melodus) in North Carolina under the Endangered Species Act of 1973, as amended (Act) (73 FR 62816 - 62841). In total, approximately 2,043 acres (ac) (827 hectares (ha)), in Dare and Hyde Counties, North Carolina, fall within the boundaries of the revised critical habitat designation.
July 10, 2001, the Fish and Wildlife Service (Service), designate 137 areas along the coasts of North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, and Texas as critical habitat for the wintering population of the piping plover (Charadrius melodus). This includes approximately 2,891.7 kilometers (km) (1,798.3 miles (mi)) of mapped shoreline and approximately 66,881 hectares (ha) (165,211 acres (ac)) of mapped area along the Gulf and Atlantic coasts and along margins of interior bays, inlets, and lagoons.

Critical Habitat Designation

18 units are designated as revised critical habitat in Texas for the wintering population of the piping plover. The 18 revised critical habitat units are divided into 24 areas: (1)Subunit TX–3A: South Padre Island – Gulf of Mexico Shoreline; (2)Subunit TX–3B: South Padre Island –Interior; (3)Subunit TX–3C: North Padre Island – Interior; (4)Subunit TX–3D: North Padre Island – Gulf of Mexico; (5)Subunit TX–3E: Mesquite Rincon; (6)Unit TX–4: Lower Laguna Madre Mainland; (7)Unit TX–7: Newport Pass/Corpus Christi Pass Beach; (8)Unit TX–8: Mustang Island Beach; (9)Unit TX–9: Fish Pass Lagoons; (10)Subunit TX–10A: Shamrock Island; (11)Subunit TX–10B: Mustang Island – Unnamed sand flat; (12)Subunit TX–10C: Mustang Island – Lagoon Complex; (13)Unit TX–14: East Flats; (14)Unit TX–15: North Pass; (15)Unit TX–16: San Jose Beach; (16)Unit TX–18: Cedar Bayou/Vinson Slough; (17)Unit TX–19: Matagorda Island Beach; (18)Unit TX–22: Decros Point; (19)Unit TX–23: West Matagorda Peninsula Beach; (20)Unit TX–27: East Matagorda Bay/ Matagorda Peninsula Beach West; (21)Unit TX–28: East Matagorda Bay/ Matagorda

Peninsula Beach East; (22)Unit TX–31: San Bernard NWR Beach; (23)Unit TX–32: Gulf Beach Between Brazos and San Bernard Rivers; and (24)Unit TX–33: Bryan Beach and Adjacent Beach.

Unit TX–3: Padre Island. Subunit TX–3A: South Padre Island – Gulf of Mexico Shoreline. This subunit consists of 2,891 ac (1170 ha) in Cameron and Willacy Counties, Texas. It is a beach 30.0 mi (48.2 km) in length on the gulfside of South Padre Island, which is a barrier island. The subunit is located within an area bounded on the south by the southern boundary of Andy Bowie County Park, and on the north by the south jetty of Mansfield Channel, which divides North and South Padre Islands. The jetty itself is outside the boundary of the subunit. The eastern boundary is the estimated MLLW of the Gulf of Mexico, and the western boundary is the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. The vegetated dune and Park Road 100, which runs northsouth along the western side of the dune, separates Subunits TX–3A and 3B. This subunit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately one quarter of the subunit is in Federal ownership and managed by the Service's Laguna Atascosa National Wildlife Refuge (NWR), and approximately 64 percent is in private ownership. The Service does not own the subsurface mineral rights. Ten percent is State land managed by the GLO, and a small portion at the southern end is County park land managed by Andy Bowie County Park. Subunit TX–3A is the southernmost unit of the revised critical habitat for the wintering population of the piping plover. It was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this subunit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1), surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. These threats are of greatest magnitude at the southern end of the subunit where housing developments are to the west of the subunit. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area. Subunit TX–3B: South Padre Island –Laguna Madre side. This bayside subunit consists of 44,137 ac (17,862 ha) in Cameron and Willacy Counties, Texas. Its southern boundary extends along the north side of an existing earthen, manmade dike running from the edge of dense dune vegetation to the Laguna Madre along latitude 26° 09' 19.00'' N. The dike is not within the boundary of the subunit. The western boundary is the western edge of the intertidal mudflats bordering the eastern shore of the lower Laguna Madre, and the northern boundary is Mansfield Channel. The eastern boundary is dense vegetation of the dunes or, if there is no dense vegetation or dune, the western boundary of Park Road 100. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them.

However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. Approximately 42 percent of the land is federally owned and managed by the Service's Laguna Atascosa NWR, and approximately 38 percent is Stateowned and managed by the GLO. The remaining 20 percent is in private ownership along the western side of the subunit. The Service does not own the subsurface mineral rights beneath the refuge. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand and mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. These threats, particularly vehicle access, are of greatest magnitude at the southern portion of the subunit where roads are near or adjacent to PCE 1. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however, a draft CCP is not yet available. At this time, The Service is not aware of any additional management plans that address this species in this area. Subunit TX–3C: North Padre Island – Laguna Madre side. This bayside unit consists of 50,897 ac (20,597 ha) in Kenedy and Kleberg Counties, Texas. It is along and within the Laguna Madre and extends from the western boundary of Padre Island National Seashore (PAIS) to the Gulf Intracoastal Waterway (GIWW). The northern boundary of the subunit is a line extending westward from the PAIS (at latitude 27° 4' 29.9'' N), and its southern boundary is a line extending westward from the southern boundary of PAIS along the northern edge of the Mansfield Channel. The eastern boundary of this subunit is the western boundary of PAIS when the PCEs extend as far as PAIS or the eastern edge of the sand flats where the PCEs end. The portion of the western boundary north of longitude/latitude coordinate 26°48'38.2''N, 97°28'11.6''W is the eastern edge of the GIWW, and the portion of the western boundary south of the coordinate is the western edge of the intertidal mudflats bordering the eastern shore of the Laguna Madre. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that we used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. Most of the land is State-owned and managed by the GLO. A small portion is in private ownership. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5).

This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This subunit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 8). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. At this time the Service is not aware of any management plans that address this species in this area. Subunit TX–3D: North Padre Island – Gulf of Mexico. This gulfside subunit consists of 270 ac (109 ha) of beach in Kleberg County, Texas. It extends along the gulf shore of North Padre Island from the northern boundary of PAIS northward 6.2 mi (10 km) to the Nueces County line. The southern boundary is the north boundary of the northeast section of the PAIS. The subunit extends eastward to the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This subunit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Most of the land is owned by the State and managed by the GLO. Approximately one-fifth is in private ownership. It was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this subunit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surfcast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. These threats are of greater magnitude at the north end of the subunit, where more roads provide easy access to the PCEs and the subunit is in close proximity to houses. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–3E: North Padre Island – Mesquite Rincon. This triangular bayside subunit of 9,6238 acres (3,894 hectares) lies on the western shore of the lower Laguna Madre in Kenedy County, Texas. The subunit is generally bounded by Rincon de la Soledad on the southwestern side, Mesquite Rincon on the north, and the GIWW and Rincon de San Jose on the east. The southwestern boundary is an irregular line along the PCEs between the latitude/longitude coordinate points: 26° 44’ 10.5’’ N, 97° 28’ 04.5’’ W at the southeastern point of Rincon de San Jose and 26° 50’ 58.1’’ N, 97° 34’ 19.5’’ W. The northern boundary is the line described between the latitude/longitude coordinate points: 26° 51’ 24.2’’ N, 97° 33’ 25.8’’ W and 26° 51’ 24.2’’ N, 97° 27’ 52.7’’ W. The northern portion of the eastern boundary is the western edge of the GIWW south to latitude/longitude coordinate point 26° 48’ 52.7’’ N, 97° 28’ 12.9’’ W. There the subunit curves westward and skirts a small horseshoeshaped inlet in the Laguna Madre to the northeastern point of Rincon de San Jose at latitude/longitude coordinate point 26° 48’ 43.9’’ N, 97° 29’ 4.7’’ W. There it continues south in an irregular line along the edge of the PCEs to the southeastern point of Rincon San Jose. Within that boundary (especially the southeastern portion of the subunit and northwestern-running edge), the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that we used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. Most of the land is in private ownership with a small portion that is State-owned and managed by the GLO. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the Laguna for foraging and roosting (PCE 5). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This subunit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 7). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–4: Lower Laguna Madre Mainland. This bayside unit consists of 17,223 ac (6,970 ha) in Cameron and Willacy Counties, Texas, and lies along the western shoreline of the Lower Laguna Madre. The southern boundary is an east-west line at the northern tip of Barclay Island, approximately following latitude 26° 14′ 42.2′′ N. The northern boundary is an east-west line located near the northern tip of El Sauz Island, approximately 1.2 mi (1.9 km) south of the center of the city of Port Mansfield, Willacy County, Texas, and approximately following latitude 26° 32′ 7.8′′ N. The eastern boundary of the unit is the eastern edge of the line of dredge spoils that parallel the western side of the GIWW. The western boundary runs from southeast to northwest and is the western edge of sandy beach and mudflat habitat, approximately following the latitude/longitude coordinate points: latitude/longitude coordinate points: 26° 14′ 42.45′′ N, 97° 19′ 32.75′′ W; 26° 17′ 15.54′′ N, 97° 20′ 47.31′′ W; 26° 20′ 10.17′′ N, 97° 21′ 10.94′′ W; 26° 21′ 31.54′′ N, 97° 22′ 48.10′′ W; 26° 24′ 26.64′′ N, 97° 23′ 53.27′′ W; 26° 26′ 8.55′′ N, 97° 25′ 13.33′′ W; and 26° 32′ 5.44′′ N, 97° 27′ 6.91′′ W. Within that boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. Approximately one-third of this unit is within the Service's Laguna Atascosa NWR. Approximately half is Stateowned and managed by the GLO. The remainder is in private ownership. The Service does not own the subsurface mineral rights beneath the surface of the refuge. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand or mud flats above high tide for roosting (PCE 2). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). This unit also contains sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites) for feeding (PCE 8). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. Laguna Atascosa NWR is preparing a Comprehensive Conservation Plan (CCP) that should address the wintering population of the piping plover as well as other listed species; however, a draft CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–7: Newport Pass/Corpus Christi Pass Beach. This unit consists of 294 ac (119 ha) in Nueces County, Texas. It is a gulfside beach unit approximately 5.1-mi (8.2- km) long. The southern boundary is the gulfward extension of Saint Bartholomew Avenue, adjacent to the north end of the seawall. The northern boundary is the edge of the south jetty of the Fish Pass Structure at Mustang Island State Park. The eastern boundary is MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dune. Packery Channel cuts the beach approximately 0.3 mi (0.5 km) north of the south boundary. The seawall, jetty, bollards, and open water of Packery Channel are not within the boundaries of the unit. This unit is in State and private ownership; the State portion is managed by the Mustang Island State Park. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains PCEs in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. Due to its close proximity to Corpus Christi, this unit receives considerable recreational use and beach cleaning and nourishment. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–8: Mustang Island Beach. This unit consists of 623 ac (252 ha) in Nueces County, Texas. It is a gulfside beach unit approximately 12.5 mi (20.1 km) long. The southern boundary is the edge of the north jetty of the Fish Pass Structure at Mustang Island State Park. The northern boundary is the south side of the Horace Calder Pier in Port Aransas, Texas. The unit is bounded on the east by the MLLW of the Gulf of Mexico, and on the west by the dune line, where the habitat changes from lightly vegetated sandy beach to densely vegetated. The jetty and pier are not within the boundary of the unit. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The unit is in State and private ownership, with a small municipal park owned and managed by the City of Port Aransas. The State land is managed by the GLO. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to beach cleaning and nourishment for recreational use. Due to its close proximity to Corpus Christi, this unit receives considerable recreational use and beach cleaning and nourishment. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–9: Fish Pass Lagoons. This bayside unit consists of 168 ac (68 ha) in Nueces County, Texas. This unit encompasses flats facing Corpus Christi Bay that extend 1.0 km (0.6 mi) on either side of Fish Pass. The inland boundary is a line of dense vegetation, and the bayside boundary is the northeast edge of the tidal sand flats that are a PCE. This unit includes all areas of habitat that contain PCEs 1, 2, 5, and 6 within the area described by a polygon with the following latitude/longitude coordinate points: 27° 42′ 14.63′′ N, 97° 10′ 44.70′′ W; 27° 41′ 56.97′′ N, 97° 10′ 8.13′′ W; 27° 41′ 24.35′′ N, 97° 10′ 36.89′′ W; 27° 41′ 18.98′′ N, 97° 11′ 16.79′′ W; 27° 41′ 23.51′′ N, 97° 11′ 31.32′′ W and 27° 42′ 14.63′′ N, 97° 10′ 44.70′′ W. Within that polygon, six moderate to large polygons from 5 to 64 ac (2 to 25 ha) each and two small polygons less than 1 ac (0.4 ha) each are PCEs and comprise the unit. Most of the unit is owned by the State and managed by the GLO. A few acres are in private ownership. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and/or mud flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand, or mud flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–10: Shamrock Island and Adjacent Mustang Island Flats. Subunit TX–10A: Shamrock Island. This 12-ac (5-ha) island in Nueces County, Texas, was a peninsula extending off of Mustang Island in Corpus Christi Bay until erosion separated the island from the mainland. Five small polygons of sand flats from 1.1 to 6.8 ac (0.4 to 2.7 ha) comprise the subunit. Most of the land is State-owned and managed by the GLO; the remainder is privately owned. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–10B: Mustang Island: Unnamed sand flat. This 2-ac (1-ha) subunit in Nueces County, Texas, is a small, unnamed sand flat near the north edge of the mouth of Wilson's Cut in Corpus Christi Bay. The subunit is the western half of the island that is sand flats landward (easterly) to the western edge of tidal marsh. It is entirely Stateowned and managed by the GLO. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans and domestic animals; and increased predation due to recreational use. The location of the subunit, and the configuration of the polygons of PCEs that comprise this subunit, limit recreational access by vehicles to PCEs 1 and 2. At this time, the Service is not aware of any management plans that address this species in this area. Subunit TX–10C: Mustang Island: Lagoon Complex. This 331-ac (134-ha) subunit in Nueces County, Texas, is an extensive lagoon complex that consists of 11 polygons within a larger polygon that extends 2.2 mi (3.5 km) south of Wilson's Cut in Corpus Christi Bay. The southern boundary of the larger polygon begins at the western end at latitude/ longitude coordinate point 27° 43' 2,4'' N, 97° 10' 19.4'' W at the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. It follows the dune line southeast approximately 830 ft (253 m) to a road, then follows the road approximately 945 ft (288 m) to the edge of the tidal sand flat PCE. It follows the southeastern edge of the sand flat northeast to the western edge of a northsouth road, where it follows the edge of the sand flat northward to the south edge of a road that runs east-west parallel to the southwestern edge of Wilson's Cut. The northern edge of the boundary is the south edge of the road or the northern extent of the sand flat when it does not reach the road. The western boundary follows the PCEs along their eastern edge at Corpus Christi Bay beginning 409 ft (125 m) southwest of the southwestern edge of Wilson's Cut to the coordinate point at the western edge of the southern boundary. A road transects the larger polygon described above, forming two polygons that exclude the road. The PCEs within the 11 polygons comprise the subunit. Within that boundaries of the 11 polygons, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the polygons that comprise the subunit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the subunit boundaries can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. The subunit consists of private and Stateowned lands. This subunit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This subunit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this subunit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and modification and loss of habitat due to uncontrolled recreational access and beach cleaning and stabilization efforts. Road access to the PCEs is extensive. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–14: East Flats. This bayside unit consists of 591 ac (239 ha) in Nueces County, Texas. It is an irregularly shaped intertidal sand flat south of the Corpus Christi Ship Channel. The north boundary is the northern edge of the sand flat near or adjacent to dredge spoil areas bordering the south side of the Corpus Christi Ship Channel. The northwestern latitude/longitude coordinate is 27° 49′ 54.49′′ N, 97° 6′ 14.28′′ W, and the northeastern latitude/longitude coordinate is 27° 49′ 55.29′′ N, 97° 5′ 12.86′′ W. From there, the sand flat curves southward, and the southeastern edge of it forms a highly irregular line that ends in the southwest portion of the polygon at the eastern edge of a navigation channel from the Corpus Christi Ship Channel to Corpus Christi Bay at latitude/longitude coordinate 51.93′′ N, 97° 5′ 52.58′′ W. The sand flat continues on the western edge of the navigation channel in a northwesterly direction to latitude/longitude coordinate 27° 49′ 22.08′′ N, 97° 6′ 37.04′′ W. It then curves northeasterly and across the cut to the northern edge at the northwest coordinate. On the east, it abuts the City of Port Aransas. There is a small marshland within the sand flat that bisects the sand flat that is not a PCE and is not included in the unit. The unit is mostly in private ownership, with a small portion of State land managed by the GLO. This unit was occupied at the time of listing and is currently occupied. Current ocupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand and mud flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–15: North Pass. This bayside unit consists of 805 ac (326 ha) in Aransas County, Texas. The unit is bounded on the northeast by a line between latitude/longitude coordinates 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W and 27° 54′ 54.53′′ N, 97° 1′ 18.17′′ W, on the northwest and west by the edge of tidal sand flats in Aransas Bay, on the south by a line running east from coordinate 27° 53′ 16.96′′ N, 97° 2′ 22.44′′ W to unit TX–16, and on the southeast by the landward boundary of unit 16. The unit is all areas that contain the PCEs for the species within a larger area described by a polygon with the following sets of latitude/longitude coordinate points: 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W; 27° 53′ 10.68′′ N, 97° 1′ 21.36′′ W; 27° 53′ 16.96′′ N, 97° 2′ 22.44′′ W; 27° 53′ 33.08′′ N, 97° 2′ 33.05′′ W; 27° 54′ 42.68′′ N, 97° 2′ 4.83′′ W; 27° 54′ 47.59′′ N, 97° 1′ 51.73′′ W; 27° 54′ 54.53′′ N, 97° 1′ 18.17′′ W and 27° 54′ 8.70′′ N, 97° 0′ 36.97′′ W. Within that boundary, the

Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale, so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. This unit is a remnant of a hurricane washover on San Jose Island. Approximately 18 percent is Stateowned and managed by the GLO; the remainder is in private ownership. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover, including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1) and unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2). This subunit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats of activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–16: San Jose Beach. This unit consists of 1,378 ac (558 ha) in Aransas County, Texas. It is a gulfside beach unit approximately 19.8 mi (31.9 km) long. The southern boundary is the edge of the north jetty of Aransas Pass. The jetty is not within the boundary of the unit. The south edge of Cedar Bayou Pass is the northern boundary. The eastern boundary is the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. A small section is in Federal ownership and managed by the Service's Matagorda Island NWR. The Service does not own the subsurface mineral rights. Approximately half of the unit is State-owned and managed by the GLO, and nearly as much is in private ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, the CCP is not yet available. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–18: Cedar Bayou/Vinson Slough. This bayside unit consists of 2,465 ac (998 ha) in Aransas County, Texas. It is a remnant of a hurricane washover area and includes the highly dynamic area of Cedar Bayou, the pass that separates San Jose Island and Matagorda Island. Beginning at the confluence of Vinson Slough and Cedar Bayou, the boundary follows the shore of Spalding Cove to Long Reef, then continues along a line extending 2.5 miles southwest of Long Reef to the shore of San Jose Island, then along the shore of the island to the landward boundary of Unit TX–16. Within that area, the unit consists of numerous polygons of PCEs; areas that are not PCEs within the described area are not within the boundaries of the unit. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http:// criticalhabitat.fws.gov. The southern and southeastern boundary of the unit is described by a line with the following sets of latitude/longitude coordinate points: 28° 1′ 21.76′′ N, 96° 57′ 51.24′′ W; 28° 1′ 12.77′′ N, 96° 57′ 31.18′′ W; 28° 2′ 3.07′′ N, 96° 56′ 45.84′′ W; 28° 2′ 15.92′′ N, 96° 56′ 25.10′′ W; 28° 2′ 30.32′′ N, 96° 56′ 11.97′′ W; 28° 3′ 15.62′′ N, 96° 54′ 20.01′′ W; 28° 3′ 58.58′′ N, 96° 53′ 24.65′′ W; 28° 4′ 1.15′′ N, 96° 52′ 14.65′′ W; 28° 3′ 31.74′′ N, 96° 51′ 38.29′′ W and 28° 3′ 17.69′′ N, 96° 51′ 38.47′′ W. The specific northern boundary is described by a line with the following sets of latitude/longitude coordinate points: 28° 5′ 44.24′′ N, 96° 54′ 8.16′′ W; 28° 5′ 13.23′′ N, 96° 52′ 44.85′′ W; 28° 4′ 33.99′′ N, 96° 50′ 46.55′′ W; 28° 4′ 38.92′′ N, 96° 50′ 40.79′′ W and 28° 4′ 22.98′′ N, 96° 50′ 22.94′′ W. The eastern boundary at the northeastern end of the unit is units TX–16 and TX–19 on the gulfside. The western boundary is the western edge of tidal sand flats in Aransas Bay. This area includes a small section of federally owned land managed by the Service's Matagorda Island NWR and a small section of State-owned land. The remaining area is privately owned. The Service does not own the subsurface mineral rights beneath the NWR. This unit was occupied at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. This unit contains PCEs in the appropriate spatial arrangement essential to the conservation of the piping plover including intertidal sand flats with no or very sparse emergent vegetation for feeding (PCE 1), unvegetated or sparsely vegetated sand flats above high tide for roosting (PCE 2), and sand spits running into the bay for foraging and roosting (PCE 5). This unit also includes unvegetated washover areas with little or no topographic relief for feeding and roosting (PCE 7). The PCEs in this unit may require special management considerations or protections to ameliorate the threats oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use. Vehicle use of the unit may be limited somewhat by accessibility. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, the CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–19: Matagorda Island Beach. This unit consists of 2,413 ac (976 ha) in Calhoun County, Texas. It is a gulfside beach unit approximately 37.1 mi (59.7 km) long. The southern boundary is the northern edge of Cedar Bayou Pass, and the northern boundary is the southern edge of Pass Cavallo. At Pass Cavallo, the unit curves from the eastern gulfside passing between the south edge of the pass and the north edge of the dunes to a small area on the bayside. The eastern boundary is the MLLW of the Gulf of Mexico, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The federally owned land in this unit is managed by the Service's Matagorda

Island NWR, which does not own the subsurface mineral rights. This unit also includes a small section of land in State ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; increased predation due to recreational use; and access by refuge staff and others for sea turtle monitoring efforts. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, a CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–22: Decros Point. This unit consists of 544 ac (220 ha) at the Matagorda/Calhoun County line, in Texas. It is a gulfside beach unit approximately 4.8 mi (7.7 km) long that wraps around to the bayside. This unit was originally the southern tip of the Matagorda Peninsula. It was made into an island by the dredging of the Matagorda Ship Channel, the edge of which is the northern boundary of the unit. The unit is horseshoe in shape with the east side along the Gulf of Mexico and the west side along Matagorda Bay; the two are connected at their southern boundary by habitat from the north edge of Pass Cavallo northward to the dune line. Densely vegetated sand dunes run north to south in the center of the horseshoe and are not within the boundary of the critical habitat because they are not a PCE. The eastern boundary is the MLLW of the Gulf of Mexico and the western boundary is the western edge of tidal sand flats on the east side of Matagorda Bay. Within the bayside of the boundary, the Service has excluded from critical habitat designation areas that do not contain PCEs. Those areas appear as holes in the unit. The map that is included in this rule is at such a large scale that the holes where critical habitat is not designated do not appear in them. However, the GIS coverages that the Service used to generate the map can be viewed at a finer scale so that the holes where critical habitat is not designated within the unit boundary can be seen. Those GIS coverages can be accessed at http://criticalhabitat.fws.gov. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately 60 percent of the unit is in State ownership managed by the GLO. The remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach (PCE 4) for roosting and sheltering. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development activities; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. Due to a lack of road access, this unit does not receive much recreational vehicle use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–23: West Matagorda Peninsula Beach. This unit consists of 1,808 ac (732 ha) of shoreline in Matagorda County, Texas. It is a gulfside beach unit approximately 23.9 mi (38.5 km) long. The southern boundary is the northern jetty of the Matagorda Ship Channel. The northern boundary is the Old Colorado River channel. The MLLW of the Gulf of Mexico is the eastern boundary, and the western boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Just under half of the unit is Stateowned and managed by the GLO; the remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–27: East Matagorda Bay/ Matagorda Peninsula Beach West. This unit consists of 905 ac (366 ha) of shoreline in Matagorda County, Texas. It is a gulfside beach unit approximately 14.1 mi (22.8 km) long. The southwestern boundary is the northeastern edge of the Old Colorado River channel. The unit runs along the beach 14 mi (23 km) to the northeastern boundary opposite Eidelbach Flats described by a line between the latitude/longitude coordinate points: 28° 41’ 2.26’’ N, 95° 46’ 29.04’’W and 28° 41’ 6.74’’ N, 95° 46’ 32.46’’ W. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Just over half of the unit is Stateowned and managed by the GLO; the remainder is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–28: East Matagorda Bay/ Matagorda Peninsula Beach East. This gulfside unit consists of 481 ac (194 ha) in Matagorda County, Texas. It extends along the Gulf beach southwest and northeast of Brown Cedar Cut. The cut is not within the boundary of the unit. This unit abuts portions of the southeastern edges of units TX–29 and TX–30, which are on the East Matagorda Bay side. The southwestern boundary is approximately 4 mi (6.5 km) southwest of Brown Cedar Cut at a line described by the following sets of latitude/ longitude coordinate points: 28° 43’ 11.91’’N, 95° 42’ 25.47’’W and 28° 43’ 17.09’’N, 95° 42’ 28.56’’W. The northeastern boundary is approximately 2.8 mi (4.5 km) northeast of Brown Cedar Cut to the point where Texas Farm to Market Road 457 intersects the beach. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat boundaries, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately onethird is in State ownership and managed by the GLO; the remaining two-thirds is privately owned. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–31: San Bernard NWR Beach. This gulfside unit consists of 401 ac (162 ha) in Matagorda and Brazoria Counties, Texas. It is a 6.2-mi (10-km) segment of beach on the Gulf of Mexico near the mouth of the San Bernard River. The northeastern boundary is at the southwestern edge of the mouth of the San Bernard River. The southwestern boundary follows a line described by the following sets of latitude/longitude coordinate points: 28° 47’ 54.39’’ N, 95° 33’ 26.21’’ W, and 28° 47’ 57.69’’ N, 95° 33’ 27.75’’ W. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. There is a cut through the beach from the Gulf of Mexico to a lake 3.5 mi (5.6 km) southwest of the San Bernard River, which is not within the unit. Bollards also are not within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. Approximately 30 percent of this unit is in Federal ownership and managed by the Service’s San Bernard NWR, which does not own the subsurface mineral rights. Approximately 48 percent is Stateowned and managed by the GLO with the remaining area in private ownership. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of oil and gas exploration and development, including stockpiling materials on sand flats or disposing of dredged material on them, and discharging fresh water across unvegetated tidal flats; activities associated with residential and commercial development; recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. The federally owned portion has pedestrian recreational access, but no vehicle access. The refuge is preparing a CCP that should address the wintering population of the piping plover as well as other listed species; however, a CCP is not yet available. At this time, the Service is not aware of any additional management plans that address this species in this area.

Unit TX–32: Gulf Beach Between Brazos and San Bernard Rivers. This gulfside unit consists of 556 ac (225 ha) of shoreline in Brazoria County, Texas. This unit is a 6.1-mi (9.8-km) segment of beach on the Gulf of Mexico between the mouths of the San Bernard and Brazos Rivers. The southwestern boundary is the northeastern edge of the mouth of the San Bernard River. The northeastern boundary is the western edge of the mouth of the Brazos River. The southeastern boundary is the MLLW of the Gulf of Mexico. The northwestern boundary runs along the dune line, where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. It is entirely in State ownership and managed by the GLO. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Unit TX–33: Bryan Beach and Adjacent Beach. This unit consists of 211 ac (85 ha) in Brazoria County, Texas. It is gulfside beach approximately 3.5 mi (5.7 km) in length on the Gulf of Mexico near the mouth of the Brazos River. The southwestern boundary is the northeastern edge of the Brazos River. The northeastern boundary is Farm-toMarket Road 1495 (Bryan Beach Rd). The southeastern boundary is the MLLW. The northwestern boundary follows along the dune line where the habitat changes from lightly vegetated, sandy beach to densely vegetated dunes. This unit does not include bollards within the critical habitat designation, although they may be present within the described area because they are too small to be detected with the mapping methodology used. The unit is entirely in State ownership and managed by the Texas Department of Parks and Wildlife. The unit was occupied by piping plovers at the time of listing and is currently occupied. Current occupancy has been confirmed by species experts at least 2 years out of the last 10 years. Habitat in this unit contains features in the appropriate spatial arrangement that are essential to the conservation of the wintering population of the piping plover, including sand flats with little or no emergent vegetation (PCE 1) and surf-cast algae (PCE 3) for feeding, and unvegetated or sparsely vegetated sandy backbeach and washovers (PCEs 4 and 7) for roosting, sheltering, and feeding. The PCEs in this unit may require special management considerations or protections to ameliorate the threats of recreational disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; and increased predation due to recreational use. At this time, the Service is not aware of any management plans that address this species in this area.

Four units are designated as critical habitat for the wintering population of the piping plover in North Carolina. The four areas designated as critical habitat are: (1) Unit NC–1, Oregon Inlet; (2) Unit NC–2, Cape Hatteras Point; (3) Unit NC–4, Hatteras Inlet; and (4) Unit NC–5, Ocracoke Island.

Unit NC–1: Oregon Inlet. Unit NC–1 is approximately 8.0 km (5.0 mi) long, and consists of about 196 ha (485 ac) of sandy beach and inlet spit habitat on Bodie Island and Pea Island in Dare County, North Carolina. This is the northernmost critical habitat unit within the wintering range of the piping plover. Oregon Inlet is the northernmost inlet in coastal North Carolina, approximately 19.0 km (12.0 mi) southeast of the Town of Manteo, the county seat of Dare County. The unit is bounded by the Atlantic Ocean on the east and Pamlico Sound on the west and includes lands from the mean lower low water (MLLW) on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by piping plovers and where the PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The unit begins at Ramp 4 near the Oregon Inlet Fishing Center on Bodie Island and extends approximately 8.0 km (5.0 mi) south to the intersection of NC Highway 12 and Salt Flats Wildlife Trail (near Mile Marker 30, NC Highway 12), approximately 5.0 km (3.0 mi) from the groin, on Pea Island, and includes Green Island and any emergent sandbars south and west of Oregon Inlet, and the lands owned by the State of North Carolina, specifically islands DR–005–05 and DR– 005–06. However, this unit does not include the Oregon Inlet Fishing Center, NC Highway 12, the Bonner Bridge and its associated structures, the terminal groin, the historic Pea Island Life-Saving Station, or any of their ancillary facilities (e.g., parking lots, out buildings). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. Oregon Inlet has reported consistent use by wintering piping plovers dating from the mid-1960s. As many as 100 piping plovers have been reported from a single day survey during the fall migration (NCWRC unpublished data). Christmas bird counts regularly recorded 20 to 30 plovers using the area. Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). The overall number of piping plovers reported using the area has declined since the species was listed in 1986 (NCWRC unpublished data), which corresponds to increases in the number of human users (NPS 2005) and off-road vehicles (Davis and Truett 2000). Oregon Inlet is one of the first beach access points for off-road vehicles within Cape Hatteras National Seashore when traveling from the developed coastal communities of Nags Head, Kill Devil Hills, Kitty Hawk, and Manteo. As such, the inlet spit is a popular area for off-road vehicle users to congregate. The majority of the Cape Hatteras National Seashore users in this area are off-road vehicle owners and recreational fishermen. In fact, a recent visitor use study of Cape Hatteras National Seashore reported that Oregon Inlet is the second most popular off-road vehicle use area in the park (Vogelsong 2003). Furthermore, the adjacent islands are easily accessed by boat, which can be launched from the nearby Oregon Inlet Fishing Center. Pea Island National Wildlife Refuge (PINWR) does not allow off-road vehicle use;

however, Pea Island regularly receives dredged sediments from the maintenance dredging of Oregon Inlet by the Corps. The disposal of dredged sediments on PINWR has the potential to disturb foraging and roosting plovers and their habitats. As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–2: Cape Hatteras Point. Unit NC–2 consists of 262 ha (646 ac) of sandy beach and sand and mud flat habitat in Dare County, North Carolina. Cape Hatteras Point (also known as Cape Point or Hatteras Cove) is located south of the Cape Hatteras Lighthouse. The unit extends south approximately 2.8 mi (4.5 km) from the ocean groin near the old location of the Cape Hatteras Lighthouse to the point of Cape Hatteras, and then extends west 4.7 mi (7.6 km) along Hatteras Cove shoreline (South Beach) to the edge of Ramp 49 near the Frisco Campground. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by piping plovers and where PCEs do not occur). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. This unit does not include the ocean groin. Consistent use by wintering piping plover has been reported at Cape Hatteras Point since the early 1980s, but the specific area of use was not consistently recorded in earlier reports. Often piping plovers found at Cape Hatteras Point, Cape Hatteras Cove, and Hatteras Inlet were reported as a collective group. However, more recent surveys report plover use at Cape Hatteras Point independently from Hatteras Inlet. These single day surveys have recorded as many as 13 piping plovers a day during migration (NCWRC unpublished data). Christmas bird counts regularly recorded 2 to 11 plovers using the area. Cape Hatteras Point is located near the Town of Buxton, the largest community on Hatteras Island. For that reason, Cape Hatteras Point is a popular area for ORV use and recreational fishing. A recent visitor use study of the park found that Cape Hatteras Point had the most ORV use within the park (Vogelsong 2003). As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–4: Hatteras Inlet. Unit NC–4 is approximately 8.0 km (5.0 mi) long, and consists of 166 ha (410 ac) of sandy beach and inlet spit habitat on the western end of Hatteras Island and the eastern end of Ocracoke Island in Dare and Hyde Counties, North Carolina. The unit begins at the first beach access point at Ramp 55 at the end of NC Highway 12 near the Graveyard of the Atlantic Museum on the western end of Hatteras Island and continues southwest to the beach access at the ocean-side parking lot near Ramp 59 on the northeastern end of Ocracoke Island. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which itself is not used by the piping plover and where PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The Hatteras Inlet unit includes all emergent sandbars within Hatteras Inlet including lands owned by the State of North Carolina, specifically Island DR–009–03/04. The unit is adjacent to, but does not include, the Graveyard of the Atlantic Museum, the ferry terminal, the groin on Ocracoke Island, NC Highway 12, or their ancillary facilities (e.g., parking lots, out buildings). This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. Hatteras Inlet has reported consistent use by wintering piping plovers since the early 1980s, but the specific area of use was not consistently recorded in earlier reports. Often piping plovers found at Cape Hatteras Point, Cape Hatteras Cove, and Hatteras Inlet were reported as a collective group. However, more recent surveys report plover use at Hatteras Inlet independently from Cape Hatteras Point. These single-day surveys have recorded as many as 40 piping plovers a day during migration (NCWRC unpublished data). Christmas bird counts regularly recorded 2 to 11 plovers using the area. Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). The overall numbers of piping plovers reported using the area has declined in the last 10 years (NCWRC unpublished data), corresponding with increases in the number of human users (NPS 2005) and off-road vehicles (Davis and Truett 2000). Hatteras Inlet is located near the Village of Hatteras, Dare County, and is the southernmost point of Cape Hatteras National Seashore that can be reached without having to take a ferry. As such, the inlet is a popular off-road vehicle and recreational fishing area. In fact, a recent visitor use study of the park found Hatteras Inlet the fourth most used area by off-road vehicles in the park (Vogelsong 2003). Furthermore, the adjacent islands are easily accessed by boat, which can be launched from the nearby marinas of Hatteras Village. As a result, the sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Unit NC–5: Ocracoke Island. This unit consists of 203 ha (502 ac) of sandy beach and mud and sand flat habitat in Hyde County, North Carolina. The unit includes the western portion of Ocracoke Island beginning at the beach access point at the edge of Ramp 72 (South Point Road), extending west approximately 2.1 mi (3.4 km) to Ocracoke Inlet, and then back east on the Pamlico Sound side to a point where stable, densely vegetated dune habitat meets the water. This unit includes lands from the MLLW on the Atlantic Ocean shoreline to the line of stable, densely vegetated dune habitat (which is not used by the piping plover and where PCEs do not occur) and from the MLLW on the Pamlico Sound side to the line of stable, densely vegetated habitat, or (where a line of stable, densely vegetated dune habitat does not exist) lands from MLLW on the Atlantic Ocean shoreline to the MLLW on the Pamlico Sound side. The unit includes all emergent sandbars within Ocracoke Inlet. This unit contains the PCEs essential to the conservation of the species, including a contiguous mix of intertidal beaches and sand or mud flats (between annual low tide and annual high tide) with no or very sparse emergent vegetation, and adjacent areas of unvegetated or sparsely vegetated dune systems and sand or mud flats above annual high tide. The unit is adjacent to but does not include NC Highway 12, any portion of the maintained South Point Road at Ramp 72, or any of their ancillary facilities. Ocracoke Island had inconsistent recorded use by wintering piping plovers in the early 1980s, and Christmas bird counts recorded only 1 to 6 plovers using the area throughout the early 1990s. However, since the late 1990s when regular and consistent surveys of the area were conducted, as many as 72 piping plovers have been recorded during migration, and 4 to 18 plovers have been regularly recorded during the overwinter period (NCWRC unpublished data). Recent surveys have also recorded consistent and repeated use of the area by banded piping plovers from the endangered Great Lakes breeding population (Stucker and Cuthbert 2006). Ocracoke Inlet is located near the Village of Ocracoke, and is the southernmost point of the Cape Hatteras National Seashore. Ocracoke Island is only accessible by ferry. As such, the island is a popular destination for vacationers and locals interested in seclusion. The inlet is also a popular recreational fishing and ORV area. A recent visitor use study of the park reported Ocracoke Inlet was the third most popular ORV use area in the park (Vogelsong 2003). As a result, the primary threat to the wintering piping plover and its habitat within this unit is disturbance to and degradation of foraging and roosting areas by ORVs and by people and their pets. Therefore, sandy beach and mud and sand flat habitats in this unit may require special management considerations or protection.

Critical habitat was divided into 142 critical habitat conservation units that contain areas with the primary constituent elements for the piping plover in the wintering range of the species. These units are found in all eight States where piping plovers winter. See above for revised critical habitat unit descriptions in NC and TX (Units TX– 3, TX–4, TX–7, TX–8, TX–9, TX–10, TX–14, TX–15, TX–16, TX–18, TX–19, TX–22, TX–23, TX–27, TX–28, TX–31, TX–32, and TX–33).

Unit SC–1: Waites Island-North. 75 ha (186 ac) in Horry County. This unit includes the northern tip of Waites Island from the MLLW at Little River Inlet and runs west along the Atlantic Ocean shoreline 2.0 km (1.25 mi) and includes land from the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The unit continues north and west of Little River Inlet stopping at Sheephead Creek, including land from MLLW to dense vegetation line. The majority of the unit is privately owned.

Unit SC–2: Waites Island-South. 58 ha (142 ac) in Horry County.This unit includes the southern tip of Waites Island from the MLLW at Hog Inlet and runs east along the Atlantic Ocean shoreline 0.80 km (0.50 mi) and includes MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. It continues north and west of the Hog inlet, stopping at the first major tributary. Critical habitat includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Emerging sandbars within Hog Inlet and adjacent to the tip if eastern Cherry Grove Beach are also included from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begins and where the constituent elements no longer occur. The majority of this unit is privately owned.

Unit SC–3: Murrells Inlet/Huntington Beach. 135 ha (334 ac) in Georgetown County. The majority of the unit is within Huntington Beach State Park. This unit extends from the southern tip of Garden City Beach, just south of the groins (a rigid structure or structures built out from a shore to protect the shore from erosion or to trap sand) north of Murrells Inlet from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begins and where the constituent elements no longer occur stopping perpendicular with the southern end of Inlet Point Drive. It includes from MLLW south of Murrells Inlet to the northern edge of North Litchfield Beach approximately 4.5 km (3.0 mi). The unit includes the MLLW from the Atlantic Ocean up to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The lagoon at the north end of Huntington Beach State Park is also included.

Unit SC–4: Litchfield. 11 ha (28 ac) in Georgetown County. This unit includes the southern tip of Litchfield Beach beginning 0.50 km (0.30 mi) north of Midway Inlet and stopping at the MLLW at Midway Inlet. It includes from the MLLW on the Atlantic Ocean shoreline across and including land to the MLLW on the back bayside. This unit is mostly privately owned.

Unit SC–5: North Inlet. 99 ha (245 ac) in Georgetown County. The majority of the unit is within Tom Yawley Wildlife Center Heritage Preserve. This unit extends from MLLW to 1.0 km (.62 mi) north of North Inlet on Debidue Beach. It includes shoreline on the Atlantic Ocean from MLLW to the MLLW on the western side of the peninsula. This unit also includes from the MLLW south of North Inlet 1.6 km (1.0 mi). It includes the shoreline on the Atlantic Ocean from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. It includes shoreline running south and west of the inlet from the MLLW stopping at the MLLW at the first large tributary (no name).

Unit SC–6: North Santee Bay Inlet. 305 ha (753 ac) in Georgetown County. The majority of the unit is within the Tom Yawley Wildlife Center Heritage Preserve and the Santee-Delta Wildlife Management Area. This unit is at the North Santee Bay inlet and includes lands of South Island, Santee Point, Cedar Island, and all of North Santee Sandbar. This unit includes from MLLW at North Santee Bay Inlet running north along the Atlantic Ocean side of South Island 7.2 km (4.5 mi), stopping 0.60 km (0.4 mi) north of an unnamed inlet. It includes areas from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. This unit includes the eastern side of Cedar Island adjacent to the North Santee Bay Inlet from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of North Santee Sandbar to MLLW is included.

Unit SC–7: Cape Romain. 315 ha (777 ac) in Charleston County.The majority of the unit is within Cape Romain National Wildlife Refuge. This unit includes the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur on the southern and southeastern most 1.9 km (1.2 mi) portion of Cape Island, the southernmost portion of Lighthouse Island from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur, all of Lighthouse Island South to MLLW, and the southern side of the far eastern tip of Raccoon Key from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–8: Bull Island. 134 ha (332 ac) in Charleston County. The majority of the unit is within Cape Romain National Wildlife Refuge and land owned by the South Carolina Department of Natural Resources. This unit includes from Schooner Creek on north and south of the river to north of Price’s Inlet on the southern portion of Bull Island along the Atlantic Ocean 1.6 km (1.0 mi) and south of Price’s Inlet on the northeast tip of Capers Island Heritage Preserve 1.4 km (.86 mi) along the Atlantic Ocean. All areas begin at MLLW and extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–9: Stono Inlet. 495 ha (1223 ac) in Charleston County.Most of this unit is privately owned. It includes the eastern end of Kiawah Island (approximately 4.0 km (2.5 mi)) from MLLW on Atlantic Ocean running north to MLLW on first large tributary connecting east of Bass Creek running northeast into Stono River. It includes MLLW up to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur along Stono Inlet and River. All of Bird Key-Stono Heritage Preserve and all of Skimmer Flats to MLLW are included. The Golf course and densely vegetated areas are not included.

Unit SC–10: Seabrook Island. 117 ha (290 ac) in Charleston County.This unit runs from just 0.16 km (0.10 mi) north of Captain Sams Inlet to the southwest approximately 3.4 km (2.1 mi) along the Atlantic Ocean shoreline. It includes land areas from the MLLW on the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Most of this unit is privately owned.

Unit SC–11: Deveaux Bank. 130 ha (322 ac) in Charleston County. The entire unit is within Deveaux Bank Heritage Preserve. This unit includes all of Deveaux Island to the MLLW and is State-owned.

Unit SC–12: Otter Island. 68 ha (169 ac) in Colleton County.The majority of the unit is within St. Helena Sound Heritage Preserve. This unit includes the southern portion of Otter Island to the eastern mouth of Otter Creek. It includes the MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The entire unit is State-owned.

Unit SC–13: Harbor Island. 50 ha (122 ac) in Beaufort County. The majority of the unit is State-owned. This unit extends from the northeastern tip of Harbor Island and includes all of Harbor Spit. It begins at the shoreline east of Cedar Reef Drive running south, stopping at the mouth of Johnson Creek. It includes the MLLW on the Atlantic Ocean and St. Helena Sound to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Harber Spit to MLLW is included.

Unit SC–14: Caper's Island. 238 ha (589 ac) in Beaufort County. Most of this unit is privately owned. This unit includes the southern-most 4.5 km (2.8 mi) along the Atlantic Coast shoreline of Little Caper's Island beginning at MLLW on south side of the inlet (un-named). It includes the MLLW on the Atlantic Ocean shoreline to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit SC–15: Hilton Head. 43 ha (106 ac) in Beaufort County. The majority of this unit is State-owned. This unit includes the northeastern tip (Atlantic Ocean side) of Hilton Head Island and all of Joiner Bank. It begins at the shoreline east of northern Planters Row and ends at the shoreline east of Donax Road. It includes the MLLW of Port Royal Sound and the Atlantic Ocean to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Joiner Bank to MLLW is included.

Unit GA–1: Tybee Island. 37 ha (91 ac) in Chatham County. The majority of the unit is privately owned. This unit extends along the northern tip of Tybee Island starting from 0.8 km (0.5 mi) northeast from the intersection of Crab Creek and Highway 80 to 0.7 km (0.41 mi) northeast from the intersection of Highway 80 and Horse Pen Creek. The unit includes MLLW on Savannah River and Atlantic Ocean to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit GA–2: Little Tybee Island. 719 ha (1776 ac) in Chatham County. The majority of the unit is within Little Tybee Island State Heritage Preserve. This unit extends just south of the first inlet to Wassaw Sound along the Atlantic Ocean coastline, extending north along the sound 1.7 km (1.1 mi). It includes habitat from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–3: North Wassaw Island. 108 ha (267 ac) in Chatham County. The entire unit is within Wassaw National Wildlife Refuge. This unit includes the north-east tip of Wassaw Sound, 1.6 km (1.0 mi) along the inlet side and extending south along the Atlantic Ocean shoreline for 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–4: South Wassaw Island. 61 ha (151 ac) in Chatham County. The entire unit is within Wassaw National Wildlife Refuge. This unit extends from the last southern 1.6 km (1.0 mi.) on Atlantic Ocean side, around the southern tip of Wassaw Island, up to mouth of Odingsell River. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–5: Ossabaw Island. 434 ha (1072 ac) in Chatham County. entire unit is within Ossabaw Island State Heritage Preserve. This unit includes the northeastern tip from the mouth of the Bradley River east and 12 km (7.5 mi) south along the Atlantic Ocean shoreline to a point 0.4 km (0.25 mi) past the south-center inlet. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–6: St. Catherine’s Island Bar. 54 ha (135 ac) in Liberty County. The entire unit is State owned and located east-northeast of St. Catherine’s Island. This unit includes the entire St. Catherine’s Island Bar to MLLW.

Unit GA–7: McQueen’s Inlet. 215 ha (532 ac) in Liberty County. The majority of the unit is private land along the eastern-central coastline on St. Catherine’s Island. This unit extends from McQueen’s Inlet north approximately 3.5 km (2.2 mi) and south approximately 1.8 km (1.1 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–8: St. Catherine’s Island. 60 ha (147 ac) in Liberty County. The majority of the unit is private land on the southern tip of St. Catherine’s Island. This unit starts 1.2 km (0.75 mi) north of Sapelo Sound (along Atlantic Ocean shoreline) and stops inland at Brunsen Creek. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–9: Blackbeard Island. 129 ha (319 ac) in McIntosh County. The entire unit is within the Blackbeard Island National Wildlife Refuge. This unit includes the northeastern portion of the island beginning just east of the mouth of the confluence of McCloy Creek and Blackbeard Creek and continuing east and running south along the Atlantic Ocean shoreline for 1.4 km (.90 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–10: Sapelo Island. 85 ha (210 ac) in McIntosh County. The entire unit is State-owned and within Sapelo Island. The unit extends south of Cabretta Tip approximately 0.2 km (0.13 mi) and north of Cabretta Tip 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–11: Wolf Island. 238 ha (590 ac) in McIntosh County. The majority of the unit is within Wolf Island National Wildlife Refuge and private lands just north of the Refuge. This unit includes the southeastern tip of Queen's island adjacent to the Doboy Sound and includes the eastern shoreline of Wolf Island. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–12: Egg Island Bar. 61 ha (151 ac) in McIntosh County. This unit is State owned and includes all of Egg Island Bar to the MLLW.

Unit GA–13: Little St. Simon's Island. 609 ha (1505 ac) in Glynn County. The majority of the unit is private land on Little St. Simon's Island. This unit includes the entire eastern coastline along Little St. Simon's Island. It begins 1.1 km (.70 mi) west of the northeast tip of Little St. Simon's Island and runs east and then south along the Atlantic Ocean shoreline stopping at the minor tributary (no name) on the southeast tip of Little St. Simon's Island north of Hampton Creek. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All of Pelican Spit to MLLW is included when this sand bar is emergent.

Unit GA–14: Sea/St. Simon's Island. 191 ha (471 ac) in Glynn County. The majority of the unit is private land on the south tip of Sea Island and on the east beach of St. Simons Island. This unit extends north of Gould's Inlet (Sea Island) 2.5 km (1.54 mi) starting just south of the groin and extends south of Gould's Inlet (St. Simons Island) 1.6 km (1.0 mi). It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–15: Jekyll Island. 49 ha (121 ac) in Glynn County. The majority of the unit is within State lands on Jekyll Island. This unit includes the southern region of Jekyll Island beginning at the mouth of Beach Creek, running towards the tip of Jekyll Island and includes the shoreline running north along the Atlantic Ocean shoreline 1.9 km (1.20 mi) from the southern tip of Jekyll Island. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit GA–16: Cumberland Island. 1454 ha (3591 ac) in Camden County. The majority of the unit is along Cumberland Island Wilderness Area and Cumberland Island National Seashore. This unit includes the majority of the eastern Atlantic Ocean shoreline of Cumberland Island. It begins .50 km (.31 mi) north of the inlet at Long Point, continues south along the Atlantic Ocean shoreline stopping 1.8 km (1.1 mi) west of the southern tip of Cumberland Island National Seashore. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–1: Big Lagoon. 8 ha (19 ac) in Escambia County. The majority of the unit is within Big Lagoon State Recreation Area. This unit includes the peninsula and emerging sand and mudflats between 0.33 km (0.21 mi) west of the lookout tower along the shoreline and 0.24 km (0.15 mi) east of the lookout tower along the shoreline. Land along the shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. All emerging sandbars to MLLW are included.

Unit FL–2: Big Sabine. 182 ha (450 ac) in Escambia County. The majority of the unit is owned by the University of West Florida. This unit includes areas adjacent to Santa Rosa Sound of Big Sabine Point and adjacent embayment between 8.0 km (5.0 mi) and 11.6 (7.2 mi) east of the Bob Sike's Bridge. It begins 0.10 km (.06 mi) north of SR 399 to MLLW on the Santa Rosa Sound.

Unit FL–3: Navarre Beach. 48 ha (118 ac) in Escambia and Santa Rosa Counties. The majority of the unit is owned by Eglin Air Force Base and Santa Rosa Island Authority. This unit includes lands on Santa Rosa Island Sound side, between 0.09 and 0.76 mi east of the eastern end of SR 399 to MLLW on Santa Rosa Sound side.

Unit FL–5: Shell/Crooked Islands. 1789 ha (4419 ac) in Bay County.The majority of the unit is within Tyndall Air Force Base and St. Andrews State Recreation Area. This unit includes all of Shell Island, Crooked Island West, and Crooked Island East from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–6: Upper St. Joe Peninsula. 182 ha (449 ac) in Gulf County.The majority of the unit is within St. Joseph State Park. This unit includes the northern portion of the peninsula from the tip to 8.0 km (5.0 mi) south along the Gulf of Mexico from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–7: Cape San Blas. 158 ha (390 ac) in Gulf County.The entire unit is within Eglin Air Force Base. This unit includes the area known as the Cape between the eastern boundary of Eglin and mile marker 2.1, including the peninsula and all emerging sandbars. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–8: St. Vincent Island. 146 ha (361 ac) in Franklin County.The majority of the unit is within St. Vincent National Wildlife Refuge. This unit includes the western tip of St. Vincent Island that is adjacent to Indian Pass (0.80 km (0.50 mi) east of tip along Indian Pass, and 1.9 km (1.2 mi) from tip southeast along Gulf of Mexico). The unit also includes St. Vincent Point from the inlet at Sheepshead Bayou east 1.6 km (1.0 mi) to include emerging oysters shoals and sand bars and extends south 0.21 km (0.13 mi) of St. Vincent Point. The unit includes the southeastern tip of St. Vincent Island extending north 1.4 km (0.90 mi) and south and west 2.1 km (1.3 mi). The western tip of Little St. George Island 0.80 km (0.50 mi) from West Pass is included (state owned lands). All sections of this unit include land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–9: East St. George Island. 1433 ha (3540 ac) in Franklin County. The majority of the unit is within St. George State Park. This unit begins 5.3 km (3.3 mi) east of the bridge and extends to East Pass. Shell Point, Rattlesnake Cove, Goose Island, East Cove, Gap Point, and Marsh Island are included. This unit includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur on the Gulf of Mexico, East Pass and St. George Sound.

Unit FL–10: Yent Bayou. 153 ha (378 ac) in Franklin County. The majority of the unit is State owned. This unit is adjacent to the area known as Royal Bluff. It includes the St. George Sound shoreline between 5.9 km (3.7 mi) and 9.5 km (5.9mi) east of SR 65. It includes from MLLW to where densely vegetated habitat or developed structures such as SR 65, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–11: Carabelle Beach. 56 ha (139 ac) in Franklin County. The area within this unit is privately owned. This unit is the peninsula created by Boggy Jordan Bayou. It includes St. George Sound shoreline (south of US 98) 1.6 km (1.0 mi) southwest along US 98 from the Carrabelle River Bridge and extends 1.9 km (1.2 mi) east along the St. George Sound shoreline. It includes from MLLW to where densely vegetated habitat or developed structures such as US 98, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–12: Lanark Reef. 260 ha (643 ac) in Franklin County. The entire unit is State owned. This unit includes the entire island and emerging sandbars to MLLW.

Unit FL–13: Phipps Preserve. 42 ha (104 ac) in Franklin County. This unit includes all of Phipps Preserve (owned by The Nature Conservancy) and any emerging sandbars from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–14: Hagens Cove. 486 ha (1200 ac) in Taylor County. The majority of the unit is within Big Bend Wildlife Management Area. This unit includes all of Hagens Cove and extends from MLLW on north side of Sponge Point to MLLW on south side of Piney Point. The eastern boundary of this unit ends (0.20 mi) west of SR 361. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–15: Anclote Key and North Anclote Bar. 146 ha (360 ac) in Pasco and Pinellas Counties. The majority of the unit is within Anclote Key State Preserve. This unit includes all of North Anclote Bar to the MLLW and the north, south and western sides of Anclote Key from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–16: Three Rooker Bar Island. 76 ha (188 ac) in Pinellas County. The majority of the unit is within Pinellas County Aquatic Preserve. This unit includes all the islands and emerging sandbars of this complex to MLLW.

Unit FL–17: North Honeymoon Island. 45 ha (112 ac) in Pinellas County. The majority of the unit is within Honeymoon Island State Recreation Area. This unit includes from Pelican Cove north to the far northern tip of Honeymoon Island. It includes the western shoreline from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur or the MLLW on the eastern shoreline.

Unit FL–18: South Honeymoon Island. 28 ha (70 ac) in Pinellas County.The majority of the unit is private land. This unit includes the southern end (southern-most 0.32 km (0.20 mi) on western side) of Honeymoon Island and encompasses the far southeastern tip and includes any emerging islands or sandbars to Hurricane Pass. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–19: Caladesi Island. 120 ha (296 ac) in Pinellas County.The majority of the unit is within Caladesi Island State Park. This unit extends from Hurricane Pass to Dunedin Pass on the Gulf of Mexico side. It includes from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–20: Shell Key and Mullet Key. 190 ha (470 ac) in Pinellas County. The majority of the unit is within Fort Desoto Park. This unit includes the Shell Key island complex. It also includes the northwest portion of Mullet Key including the western shorelines from Bunces Pass extending south, stopping 1.4 km (.86 mi) north of Ft. Desoto County Park pier. It includes from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–21: Egmont Key. 153 ha (377 ac) Hillsborough County. The majority of the unit is within Egmont Key National Wildlife Refuge. This unit includes the entire island to MLLW.

Unit FL–22: Cayo Costa. 175 ha (432 ac) in Lee County. The majority of the unit, including its northern and southern boundaries, is within Cayo Costa State Park, and nearly all of the remaining area is in the Cayo Costa Florida Conservation and Recreation Lands (CARL) acquisition project. This unit begins at the northern limit of sandy beaches at the northern end of the island, extends through Murdock Point, which at present has a sandbar and lagoon system, and ends at the former entrance to Murdock Bayou. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–23: North Captiva Island. 36 ha (88 ac) in Lee County.The unit is within the Cayo Costa CARL land purchase project. This unit includes the western shoreline extending from 0.80 km (0.50 mi) south of Captiva Pass to approximately Foster Bay. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–25: Bunche Beach. 187 ha (461 ac) in Lee County. This unit is mostly within a CARL Estero Bay acquisition project. Bunche Beach (also spelled Bunch) lies along San Carlos Bay, on the mainland between Sanibel Island and Estero Island (Fort Myers Beach), extending east from the Sanibel Causeway past the end of John Morris Road to a canal serving a residential subdivision. The unit also includes the western tip of Estero Island (Bodwitch Point, also spelled Bowditch Point), including Bowditch Regional Park, operated by Lee County and, on the southwest side of the island facing the Gulf, the beach south nearly to the northwesterly intersection of Estero Boulevard and Carlos Circle. It includes land from MLLW to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur or, along the developed portion of Estero Island.

Unit FL–26: Estero Island. 86 ha (211 ac) in Lee County. The majority of the unit is privately owned. The unit consists of approximately the southern third of the island’s Gulf-facing shoreline starting near Avenida Pescadora to near Redfish Road. The unit excludes south-facing shoreline at the south end of the island that faces Big Carlos Pass rather than the Gulf. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–27: Marco Island. 245 ha (606 ac) in Collier County. Most of the unit is at the Tigertail Beach County Park. The unit's northern border is on the north side of Big Marco Pass, including Coconut Island and all emerging sand bars. On the south side of Big Marco Pass, the boundary starts at the north boundary of Tigertail Beach County Park and extends to just south of the fourth condominium tower south of the County Park. The placement of the southern boundary assures that the unit includes all of Sand Dollar Island, the changeable sandbar off Tigertail Beach. The western boundary includes all the sand bars in Big Marco Pass but excludes Hideaway Beach. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–28: Marquesas Keys. 2,937 ha (7,256 ac) in Monroe County. The unit comprises the roughly circular atoll that encloses Mooney Harbor, including Gull Keys and Mooney Harbor Key. The entire unit is within Key West National Wildlife Refuge. It includes land from MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur.

Unit FL–29: Boca Grande/Woman/ Ballast Keys. 56 ha (138 ac) in Monroe County. These Keys are east of the Marquesas Keys and west of Key West. Boca Grande and Woman Keys are within Key West National Wildlife Refuge. Ballast Key is privately owned. This unit consists only of sandy beaches and flats between the MLLW and to where densely vegetated habitat or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–30: Bahia Honda/Ohio Keys. 372 ha (918 ac) in Monroe County. This unit comprises Bahia Honda Key (including a small island off its southwest shore), which is almost entirely owned by Bahia Honda State Park, plus Ohio Key, which is privately owned. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–31: Lower Matecumbe Key. 19 ha (48 ac) in Monroe County. Part of the unit is at Anne's Beach park, an Islamorada village park. The remaining parts are at Sunset Drive (Lower Matecumbe Beach) and at Costa Bravo Drive (Port Antiqua Homeowners Beach) on the Florida Bay side of the island. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–32: Sandy Key/Carl Ross Key. 67 ha (165 ac) in Monroe County. This unit consists of two adjoining islands in Florida Bay, roughly south of Flamingo in Everglades National Park. The entire area is owned and managed by the National Park Service. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–33: St. Lucie Inlet. 114 ha (282 ac) in Martin County. The unit includes a small area south of the jetty on the north shore of St. Lucie Inlet, from the jetty west 0.42 km (0.26 mi). While the two sides of the inlet are privately owned, the great majority of the unit is on public land in the Saint Lucie Inlet State Preserve, administered by Jonathan Dickinson State Park. It begins on the sandy shoreline south of Saint Lucie Inlet and extends along the Atlantic Ocean shoreline 2.6 km (1.6 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur. The unit does not include sandbars within the inlet.

Unit FL–34: Ponce de Leon Inlet. 68 ha (168 ac) in Volusia County. The majority of the unit is within Smyrna Dunes Park and Lighthouse Point Park. This unit includes shoreline extending from the jetty north of Ponce de Leon Inlet west to the Halifax River and Inlet junction. It includes shoreline south of Ponce de Leon Inlet from the inlet and Halifax River junction, extending east and south along the Atlantic Ocean shoreline 1.2 km (.70 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–35: Nassau Sound-Huguenot. 950 ha (2347 ac) in Duval County. The majority of the unit is within Big Talbot Island State Park, Little Talbot Island State Park, and the Timucuan Ecological and Historical Preserve. This unit includes all emergent shoals and shoreline east of Nassau River bridge and extends to the inlet of the St. John's River. Amelia Island and the northern 2.7 km (1.7 mi) shoreline along Talbot Island are not included. It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur.

Unit FL–36: Tiger Islands. 53 ha (130 ac) in Nassau County. This unit is privately owned. This unit extends from the mouth of Tiger Creek and runs north along Tiger Island 0.8 km (0.5 mi) and south along Little Tiger Island 1.4 km (0.9 mi). It includes land from MLLW to where densely vegetated habitat (including grass or lawns) or developed structures, not used by the piping plover, begin and where the constituent elements no longer occur. Emerging sandbars to MLLW are also included.

Unit AL–1: Isle Aux Herbes. 227 ha (561 ac) in Mobile County. This unit includes the entire Isle Aux Herbes island where primary constituent elements occur to MLLW and is State owned.

Unit AL–2: Dauphin, Little Dauphin, and Pelican Islands. 880 ha (2,174 ac) in Mobile County. This unit includes all of Dauphin Island where primary constituent elements occur from St. Stephens Street approximately 17.6 km (10.9 mi) west to the western tip of the island to MLLW and all of Little Dauphin and Pelican Islands to MLLW. The area is mostly privately owned but includes State and Federal lands.

Unit AL–3: Fort Morgan. 67 ha (166 ac) in Baldwin County. This area includes Mobile Bay and Gulf of Mexico shorelines within Bon Secour National Wildlife Refuge, Fort Morgan Unit. This unit extends from the west side of the pier on the northwest point of the peninsula, following the shoreline approximately 2.8 km (1.74 mi) southwest around the tip of the peninsula, then east to the terminus of the beach access road and is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The area is State-owned but is leased by the Federal Government.

Unit MS–1: Lakeshore through Bay St. Louis. 41 ha (101 ac) in Hancock County. This unit extends from the north side of Bryan Bayou outlet and includes the shore of the Mississippi Sound following the shoreline northeast approximately 15.0 km (9.3 mi) and ending at the southeast side of the Bay Waveland Yacht Club. The landward boundary of this unit follows the Gulf side of South and North Beach Boulevard and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–2: Henderson Point. 34 ha (84 ac) in Harrison County. This unit extends from 0.2 km (0.12 mi) west of the intersection of 3rd Avenue and Front Street and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.4 km (2.7 mi) to the west side of Pass Christian Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–3: Pass Christian. 77 ha (190 ac) in Harrison County. This unit extends from the east side of Pass Christian Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 10.5 km (6.5 mi) to the west side of Long Beach Pier and Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–4: Long Beach. 38 ha (94 ac) in Harrison County. This unit extends from the east side of Long Beach Pier and Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.4 km (2.7 mi) to the west side of Gulfport Harbor. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–5: Gulfport. 39 ha (96 ac) in Harrison County. This unit extends from the east side of Gulfport Harbor and includes the shore of the Mississippi Sound following the shoreline northeast approximately 4.8 km (3.0 mi) to the west side of the groin at the southern terminus of Courthouse Road, Mississippi City, MS. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–6: Mississippi City. 62 ha (153 ac) in Harrison County. This unit extends from the east side of the groin at the southern terminus of Courthouse Road, Mississippi City, MS, and includes the shore of the Mississippi Sound following the shoreline northeast approximately 7.9 km (4.9 mi) to the west side of President Casino. The landward boundary of this unit follows the Gulf side of U.S. Highway 90 and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–10: Ocean Springs West. 11 ha (27 ac) in Jackson County. This unit extends from U.S. 90 and includes the shore of Biloxi Bay following the shoreline southeast approximately 1.9 km (1.2 mi) to the Ocean Springs Harbor inlet. The landward boundary of this unit follows the Bay side of Front Beach Drive and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–11: Ocean Springs East. 7 ha (17 ac) in Jackson County. This unit extends from the east side of Weeks Bayou and includes the shore of Biloxi Bay following the shoreline southeast approximately 1.8 km (1.1 mi) to Halstead Bayou. The landward boundary of this unit follows the

Bay side of East Beach Drive and the seaward boundary is MLLW. The shoreline of this unit is privately owned.

Unit MS–12: Deer Island. 194 ha (479 ac) in Harrison County. This unit includes all of Deer Island, where primary constituent elements occur to the MLWW . Deer Island is privately owned.

Unit MS–13: Round Island. 27 ha (67 ac) in Jackson County. This unit includes all of Round Island to the MLWW and is privately owned.

Unit MS–14: Mississippi Barrier Islands. 3,168 ha (7,828 ac) in Harrison and Jackson Counties. This unit includes all of Cat, East and West Ship, Horn, Spoil, and Petit Bois Islands where primary constituent elements occur to MLLW. Cat Island is privately owned, and the remaining islands are part of the Gulf Islands National Seashore.

Unit MS–15: North and South Rigolets. 159 ha (393 ac) in Jackson County, MS, and 12 ha (30 ac) in Mobile County, AL. This unit extends from the southwestern tip of South Rigolets Island and includes the shore of Point Aux Chenes Bay, the Mississippi Sound, and Grand Bay following the shoreline east around the western tip, then north to the south side of South Rigolets Bayou; then from the north side of South Rigolets Bayou (the southeastern corner of North Rigolets Island) north to the northeastern most point of North Rigolets Island. This shoreline is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. Approximately 4.4 km (2.7 mi) are in Mississippi and 2.9 km (1.8 mi) are in Alabama. Almost half the Mississippi shoreline length is in the Grand Bay National Wildlife Refuge.

Unit LA–1: Texas/Louisiana border to Cheniere au Tigre. 2,650 ha (6,548 ac) in Cameron and Vermilion Parishes. This unit extends from the east side of Sabine Pass (Texas/Louisiana border) and includes the shore of the Gulf of Mexico from the MLLW following the shoreline east 25.7 km (16.0 mi) to the west end of Constance Beach [approximately 2 km (1.2 mi) east of the intersection of Parish Road 528 and the beach]; it extends from the east end of the town of Holly Beach [0.25 km (0.16 mi) east of the intersection of Baritarick Boulevard and the beach] following the shoreline approximately 97 km (60.3 mi) east to the eastern boundary line of Rockefeller Wildlife Refuge [3.4 km (2.1 mi) east of Rollover Bayou]; and it extends from the east side of Freshwater Bayou Canal following the shoreline east for approximately 15 km (9.3 mi) to 1.3 km (0.81 mi) east of where the boundary of Paul J. Rainey Wildlife Sanctuary (National Audubon Society) meets the shoreline. All three sections of this unit include the land from the seaward boundary of MLLW to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The shoreline in this unit is both state and privately owned.

Unit LA–2: Atchafalaya River Delta. 921 ha (2,276 ac) in St. Mary Parish, LA. This unit is located in the eastern portion of the State-owned Atchafalaya Delta Wildlife Management Area (WMA) and includes all exposed land and islands where primary constituent elements occur east and southeast of the main navigation channel of the Atchafalaya River to the MLLW. The islands located south and southeast of the deltaic splay, Donna, T-Pat, and Skimmer Islands and the un-named bird island, are also included in this unit. This unit includes the entire islands where primary constituent elements occur to the MLLW.

Unit LA–3: Point Au Fer Island. 195 ha (482 ac) in Terrebonne Parish. This unit includes the entire small island at the northwest tip of Point Au Fer Island to MLLW, then extends from the northwest tip of Point Au Fer Island following the shoreline southeast approximately 7.7 km (4.8 mi) to the point where the un-named oil and gas canal extending southeast from Locust Bayou meets the shoreline [0.8 km (0.5 mi) southeast from Locust Bayou]. This shoreline is bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. This entire unit is privately owned.

Unit LA–4: Isles Dernieres. 795 ha (1,964 ac) in Terrebonne Parish. This unit includes the State-owned Isles Dernieres chain, including Raccoon, Whiskey, Trinity and East Islands. This unit includes the entire islands where primary constituent elements occur to the MLLW.

Unit LA–5: Timbalier Island to East Grand Terre Island. 2,321 ha (5,735 ac) in Terrebonne, Lafourche, Jefferson, and Plaquemines Parishes. This unit includes: all of Timbalier Island where primary constituent elements occur to the MLLW, all of Belle Pass West [the ‘‘peninsula’’ extending north/northwest approximately 4.8 km (3.0 mi) from the west side of Belle Pass] where primary constituent elements occur to MLLW; the Gulf shoreline extending approximately 11 km (6.8 mi) east from the east side of Belle Pass bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur; all of Elmers Island peninsula where primary constituent elements occur to MLLW and the Gulf shoreline from Elmers Island to approximately 0.9 km (0.56 mi) west of Bayou Thunder Von Tranc bounded on the seaward side by MLLW and on the landward side to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur; the Gulf shoreline of Grand Isle from the Gulf side of the hurricane protection levee to MLLW; and all of East Grand Terre Island where primary constituent elements occur to the MLLW.

Unit LA–6: Mississippi River Delta. 105 ha (259 ac) in Plaquemines Parish, LA. This unit is part of the State-owned Pass a Loutre Wildlife Management Area and includes un-named sand (spoil) islands off South Pass of the Mississippi River near Port Eads. The entire islands to MLLW are included in this unit.

Unit LA–7: Breton Islands and Chandeleur Island Chain. 3,116 ha (7,700 ac) in Plaquemines and St. Bernard Parishes, LA. This unit includes Breton, Grand Gosier, and Curlew Islands and the Chandeleur Island chain. Those islands are part of the Breton National Wildlife Refuge or are state owned. The entire islands where primary constituent elements occur to MLLW are included in this unit.

Unit TX–1: South Bay and Boca Chica. 2,920 ha (7,217 ac) in Cameron County. The boundaries of the unit are: starting at the Loma Ochoa, following the Brownsville Ship Channel to the northeast out into the Gulf of Mexico to MLLW, then south along a line describing MLLW to the mouth of the Rio Grande, proceeding up the Rio Grande to Loma de Las Vacas, then from that point along a straight line north to Loma Ochoa. The unit does not include densely vegetated habitat within those boundaries. It includes wind tidal flats that are infrequently inundated by seasonal winds, and includes the tidal flats area known as South Bay. Beaches within the unit reach from the mouth of the Rio Grande northward to Brazos Santiago Pass, south of South Padre Island. The southern and western boundaries follow the change in habitat from wind tidal flat, preferred by the piping plover, to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include areas used for roosting by the piping plover. Portions of this unit are owned and managed by the Lower Rio Grande Valley National Wildlife Refuge, the South Bay Coastal Preserve, Boca Chica State Park, and private citizens.

Unit TX–2: Queen Isabella Causeway. 2 ha (6 ac) in Cameron County. The area extends along the Laguna Madre west of the city of South Padre Island. The southern boundary is the Queen Isabella State Fishing Pier, and the northern boundary is at the shoreline due west of the end of Sunny Isles Street. The Queen Isabella causeway bisects this shore but is not included within critical habitat. The eastern boundary is the where developed areas and/or dense vegetation begins, and the western boundary is MLLW. This unit contains lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–5: Upper Laguna Madre. 436 ha (1,076 ac) in Kleberg County. The southern boundary is the northern boundary of PAIS, and the northern boundary is the Kleberg/Nueces County line. The eastern boundary is the line where dense vegetation begins, and the western boundary is MLLW. This unit includes a series of small flats along the bayside of Padre Island in the Upper Laguna Madre. It includes wind tidal flats and sparsely-vegtated upland areas used for roosting by the piping plover. These boundaries receive heavy use by large numbers of shorebirds, including piping plovers. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur, and include upland areas used for roosting by the piping plover.

Unit TX–6: Mollie Beattie Coastal Habitat. 241 ha (596 ac) in Nueces County. This unit will be described as two subunits: (1) Subunit is bounded on the north by Beach Access Road 3, on the east by the inland boundary of critical habitat Unit TX–7, on the south by Zahn road, and on the west by Zahn Road. (2) The subunit is bounded on the north by Corpus Christi Pass, on the east by US 361, on the south by the north side of Packery Channel, and on the west by the Gulf Intercoastal Watersay. Some of the uplands are privately owned and the remaining are owned and managed by the TGLO. This unit includes two hurricane washover passes known as Newport and Corpus Christi Passes, and wind tidal flats that are infrequently inundated by seasonal winds. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include upland areas used for roosting by the piping plover.

Unit TX–11: Blind Oso. 2 ha (5 ac) in Nueces County. This unit is the flats of the Blind Oso, part of Oso Bay, from Hans and Pat Suter Wildlife Refuge (owned and managed by the City of Corpus Christi) northeast to Corpus Christi Bay and then southeast along the edge of Texas A&M University—Corpus Christi. The landward boundaries extend to where densely vegetated habitat, not used by the piping plover, begins, and extends out from the landward boundaries to MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–12: Adjacent to Naval Air Station-Corpus Christi. 2 ha (6 ac) in Nueces County. This unit is along the shore of Oso Bay on flats bordered by Naval Air Station-Corpus Christi and Texas Spur 3 to a point 2.5 km (1.5 mi) south of the bridge between Ward Island and the Naval Air Station. The landward boundary is the line where dense vegetation begins, and the boundary in the Bay is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–13: Sunset Lake. 176 ha (435 ac) in San Patricio County. This unit is triangle shaped, with State Highway 181 as the northwest boundary, and the limits of the City of Portland as the northeast boundary. The shore on Corpus Christi Bay is the third side of the triangle, with the actual boundary being MLLW off this shore. This unit is a large basin with a series of tidal ponds, sand spits and wind tidal flats. This unit is owned and managed by the City of Portland within a system of city parks. Some of the described area falls within the jurisdiction of the TGLO. It includes two city park units referred to as Indian Point and Sunset Lake. Much of the unit is a recent acquisition by the city, and management considerations for the park include the area's importance as a site for wintering and resident shorebirds. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–17: Allyn's Bight. 5 ha (14 ac) in Aransas County. This unit includes shoreline of San Jose Island on Aransas Bay from Allyn's Bight to Blind Pass, the channel between San Jose Island and Mud Island. The inland boundary is where the line of dense vegetation begins, and the bay-ward boundary is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–20: Ayers Point. 397 ha (982 ac) in Calhoun County. This unit is an unnamed lake on Matagorda Island between Shell Reef Bayou and Big Brundrett Lake, with San Antonio Bay to the north. The unit boundary extends landward from the lake to the line where dense vegetation begins and where the constituent elements no longer occur and includes upland areas used for roosting by the piping plover. This unit includes marsh and flats at Ayers Point on Matagorda Island National Wildlife Refuge. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–21: Panther Point to Pringle Lake. 863 ha (2,133 ac) in Calhoun County. This unit represents a narrow band of bayside habitats on Matagorda Island from Panther Point to the northeast end of Pringle Lake. The landward boundary is the line indicating where dense vegetation begins, and the bayward boundary is MLLW. The unit is entirely within Matagorda Island National Wildlife Refuge. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–24: West Matagorda Bay/ Western Peninsula Flats. 756 ha (1,868 ac) in Matagorda County. This unit extends along the bayside of Matagorda Peninsula from 7.5 southwest of Greens Bayou to 2.5 km (1.6 mi) northwest of Greens Bayou. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–25: West Matagorda Bay/ Eastern Peninsula Flats. 232 ha (575 ac) in Matagorda County. This unit follows the bayside of Matagorda Peninsula from Maverick Slough southwest for 5 km (3 mi). The unit begins at Maverick Slough to the northeast and extends 5 km (3 mi) to the southwest, enclosing a series of flats along Matagorda Bay. The upland areas extend to where densely vegetated habitat, not used by the piping plover, begins and where the constituent elements no longer occur and include upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–26: Colorado River Diversion Delta. 5 ha (13 ac) in Matagorda County. This unit consists follows the shore of the extreme eastern northeast corner of West Matagorda Bay from Culver Cut to Dog Island Reef. The southeastern tidally emergent portion of Dog Island Reef is included within the unit. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. The upland areas includes upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–29: Brown Cedar Cut. 119 ha (294 ac) in Matagorda County. This unit extends 2 km (1.2 m.) both southwest and northeast of the main channel of Brown Cedar Cut along the bayside of Matagorda Peninsula in East Matagorda Bay, and abuts unit TX–28 to the southeast. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. The eastern boundary of TX–29 follows the change in habitat from mud flats preferred by the piping plover, to slightly vegetated dune system adjacent to TX–28. This unit includes upland areas used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–30: Northeast Corner East Matagorda Bay. 120 ha (297 ac) in Matagorda County. This is a unit bounded on the north by the Gulf Intercoastal Waterway, on the east by the northeast limit of Matagorda bay up the line where dense vegetation begins, on the south by the boundary of Unit TX–28, and on the west by MLLW. It is a system of flats associated with tidal channels. This unit includes upland areas used for roosting by the piping plover and lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–34: San Luis Pass. 110 ha (272 ac) near the Brazoria/Galveston County line. This unit extends along the Gulf side of Galveston Island from San Luis Pass to the cite of the former town of Red Fish Cove (USGS 1:24,000 map, San Luis Pass, Texas; 1963, photorevision 1974). The landward boundary is the line indicating the beginning of dense vegetation, and the gulfside boundary is MLLW. Approximately 57 percent of the unit includes flats in the floodtide delta that are State-owned and managed by the TGLO. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–35: Big Reef. 47 ha (117 ac) in Galveston County. This unit consists of beach and sand flats on the north, west, and east shore of Big Reef, down to MLLW. South Jetty is not included. The area is currently managed by the City of Galveston. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–36: Bolivar Flats. 160 ha (395 ac) in Galveston County. This unit extends from the jetties on the southwest end of the Bolivar Peninsula to a point on the Gulf beach 1 km (0.6 mi) north of Beacon Bayou. It includes 5.0 km (3 mi) of Gulf shoreline. The landward boundary is the line indicating the beginning of dense vegetation, and the gulfside boundary is MLLW. The area is leased from TGLO by Houston Audubon Society and managed for its important avian resources. The upland areas are used for roosting by the piping plover. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Unit TX–37: Rollover Pass. 6 ha (16 ac) in Galveston County. This unit consists of Rollover Bay on the bayside of Bolivar Peninsula. The landward boundary is the line indicating the beginning of dense vegetation, and the bayside boundary is MLLW. It includes flats on State-owned land managed by the TGLO. This unit captures the intertidal complex of the bay, and is bounded by the towns of Gilchrist to the east and the Gulf beach of the Bolivar Peninsula to the south. This unit includes lands known as wind tidal flats that are infrequently inundated by seasonal winds.

Primary Constituent Elements/Physical or Biological Features

Wintering piping plover's PCEs are the habitat components that support foraging, roosting, and sheltering and the physical features necessary for maintaining the natural processes that support these habitat components. The primary constituent elements are:

(1) Intertidal sand beaches (including sand flats) or mud flats (between the MLLW and annual high tide) with no, or very sparse, emergent vegetation for feeding. In some cases, these flats may be covered or partially covered by a mat of blue-green algae.

(2) Unvegetated or sparsely vegetated sand, mud, or algal flats above annual high tide for roosting. Such sites may have debris or detritus and may have micro-topographic relief (less than 20 in (50 cm) above substrate surface) offering refuge from high winds and cold weather.

(3) Surf-cast algae for feeding.

(4) Sparsely vegetated backbeach, which is the beach area above mean high tide seaward of the dune line, or in cases where no dunes exist, seaward of a delineating feature such as a vegetation line, structure, or road. Backbeach is used by plovers for roosting and refuge during storms.

(5) Spits, especially sand, running into water used for foraging and roosting.

(6) Salterns, or bare sand flats in the center of mangrove ecosystems that are found above mean high water and are only irregularly flushed with sea water.

(7) Unvegetated washover areas with little or no topographic relief for feeding and roosting. Washover areas are formed and maintained by the action of hurricanes, storm surges, or other extreme wave actions.

(8) Natural conditions of sparse vegetation and little or no topographic relief mimicked in artificial habitat types (e.g., dredge spoil sites).

See above.
See above.

Special Management Considerations or Protections

Examples of actions that have effects on wintering piping plover habitats include, but are not limited to: (1) Disturbance of foraging and roosting plovers by humans, vehicles, and domestic animals; (2) Predation, especially by falcons, hawks, coyotes, bobcats and feral cats; (3) Beach maintenance (e.g., nourishment (adding sand) and cleaning) and stabilization efforts (e.g., construction of jetties and other hard structures). (4) Oil and other hazardous materials spills and cleanup; (5) Discharge of freshwater from oil and gas activities; (6) Construction of dwellings, roads, marinas, and other structures, and associated activities including staging of materials and equipment; and/or (7) Dredging and dredge spoil placement, and associated activities including staging of equipment and materials. As described in more detail in the unit descriptions, the PCEs within each unit may require special management considerations or protection due to threats to the wintering population of the piping plover or its habitat.

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on the effective date of the rule.

See above.

Life History

Feeding Narrative

Adult: Lott et al. (2009) identified bay beaches (bay shorelines as opposed to ocean-facing beaches) as the most common landform used by foraging piping plovers in southwest Florida. In northwest Florida, however, Smith (2007) reported landform use by foraging piping plovers about equally divided between Gulf (ocean-facing) and bay beaches. Exposed intertidal areas were the dominant foraging substrate in South Carolina (accounting for 94% of observed foraging piping plovers; Maddock et al. 2009) and in northwest Florida (96% of foraging observations; Smith 2007). In southwest Florida, Lott et al. (2009) found approximately 75% of foraging piping plovers on intertidal substrates. Majka and Shaffer (2008) found a preponderance of prey species in the 3.2-5.0 mm size range in fecal samples of piping plovers breeding in Quebec. They also noted high prevalence of one beetle species, Bledius opaculus, which feeds on algae from sand- and mud-flats (USFWS, 2009). Primary prey for wintering plovers includes polychaete marine worms, various crustaceans, insects, and occasionally bivalve mollusks (Zonick and Ryan 1996, p. 26), which they peck from on top or just beneath the surface of moist or wet sand, mud, or fine shell (USFWS, 2009b). Feeding activities of both adults and chicks may occur during all hours of the day and night (Burger 1994) and at all stages in the tidal cycle (Goldin 1993b, Hoopes 1993). Territorial and agonistic interactions have been observed with other piping plovers and similar-sized plover species -- semipalmated and snowy plovers (Johnson and Baldassarre 1988, Zonick and Ryan 1993) (USFWS, 1996).

Reproduction Narrative

Adult: Overall productivity for the Atlantic Coast population 1989-2006 was 1.35 chicks fledged per pair (annual range = 1.16-1.54) (USFWS, 2009). Piping plovers nest above the high tide line on coastal beaches, sandllats atthe ends ofsandspits and barrier islands, gently slopingforedunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cutinto or between dunes. Nests are usually found in areaswith little or no vegetation although, on occasion, piping plovers willnest under stands of American beachgrass (Ammophila breviligulata) or other vegetation (Patterson 1988, Flemming et at. 1990, Maclvor 1990). Piping plovers have been observed as early as February 24 in Virginia (Cross 1991), March 11 in New York (Goldin 1990), March 15 in Massachusetts (Maclvor 1990), and March 28 in Nova Scotia (Mills 1976, cited in Cairns 1977). By early April, males begin to establish territories (Patterson 1988, Maclvor 1990, Cross 1991), which they defend aggressivelyagainst adjacent males by performing “horizontal threat,” ~parallelrun,” and aerial displays, characterized by Caims (1982). Piping plovers are monogamous, but usually shiftmates between years (Wilcox

1959, Haig and Oring 1988c,Maclvor 1990) and, less frequently,between nesting attempts in a given year(Haig and Oring 1 988c, Macivor 1990, Strauss 1990). Plovers are known to breed atone year of age (Maclvor 1990, Strauss 1990, Haig 1992), but the rate at which this occurs is unknown. Eggs may be present on the beach from mid-April to late July. Clutch initiation dates have been recorded as early as April21 in Virginia (Cross 1991), April 15 in New York (C. Brittingham, TheNature Conservancy, pers. comm. 1994), April 20 in Massachusetts (Maclvor 1990), and April 24 in Nova Scotia (Cairns 1977). Nest initiation appears to be slightly later in Quebec, Prince Edward Island, and on the eastern shoreofNew Brunswick,with a peak ofnest initiation in mid-Mayto early June (Morse 1982, Tull 1984, Shaffer and Laporte 1992). Although nests may be initiated as late asJuly 25, fewnests hatch afterJuly 15, and the latest recorded hatch date isJuly 31 in Massachusetts (Maclvor 1990). Piping plovers generally fledge only a single brood perseason, but may renest several times if previous nests are lost or, infrequently, if a brood is lost within several days ofhatching (Wrenn 1991, Goldin I 994a, Rimmer 1994). Clutch size for an initial nest attempt is usually four eggs, one laid every other day. Full-time incubation usually begins with the completion ofthe clutch, averages 27-30 days, and is shared equally by both sexes(Wilcox 1959, Caims 1977, Maclvor 1990). Chicks remain together with one or both parents until they fledge (are able to fly) at 25 to 35 days of age (USFWS, 1996).

Spatial Arrangements of the Population

Adult: Sparsely distributed (USFWS, 2009); winters in small groups or multi-species flocks (USFWS, 1996)

Site Fidelity

Adult: High (USFWS, 2009)

Habitat Narrative

Adult: New information confirms inter- and intra-annual fidelity of piping plovers to migration and wintering sites as described in the 1996 Atlantic Coast recovery plan. Nonbreeding piping plovers in North Carolina primarily used sound (bay or bayshore) beaches and sound islands for foraging and ocean beaches for roosting, preening, and being alert (Cohen et al. 2008). Several studies identified wrack (organic material including seaweed, seashells, driftwood, and other materials deposited on beaches by tidal action) as an important component of roosting habitat for nonbreeding piping plovers. Atlantic Coast and Florida studies highlighted the importance of inlets for nonbreeding piping plovers. Almost 90% of observations of roosting piping plovers at ten coastal sites in southwest Florida were on inlet shorelines (Lott et al. 2009). Piping plovers are sparsely distributed across their Atlantic Coast breeding range. A growing body of evidence reinforces information presented in the 1996 revised recovery plan regarding the importance of wide, flat, sparsely-vegetated barrier beach habitats for recovery of Atlantic Coast piping plovers. Such habitats include abundant moist sediments associated with blowouts, washover areas, spits, unstabilized and recently closed inlets, ephemeral pools,and sparsely vegetated dunes (USFWS, 2009). The habitats used by wintering birds include beaches, mud flats (nearly flat areas made up of mud), sand flats (nearly flat areas made up of sand), algal flats (nearly flat areas with a layer of algae growing on a moist mud or sand substrate), and washover passes (areas where breaks in the sand dunes result in an inlet). Wintering plovers are dependent on a mosaic of habitat patches, and move among these patches, depending on local weather and tidal conditions (Drake et al. 2001, pp. 262– 263) (USFWS, 2009b). Plovers wintering on the Atlantic Coast are generally distributed in small groups; six was the average number of piping plovers per site during Nicholls' 1986-87 survey (Nicholls 1989). Piping plovers also appear to roost in multi-species flocks (Nicholls and Baldassarre 1990b, Zonick and Ryan 1993), but are often found in a tight cluster on the fringes of a flock (J. Nicholls, U.S. Fish and Wildlife Service, pers. obs.) (USFWS, 1996).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2009)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2009)

Dispersal

Adult: High (USFWS, 2009)

Dispersal/Migration Narrative

Adult: In general, distance between stopover locations and duration of stopovers throughout the coastal migration range remain poorly understood. Piping plovers migrate through and winter in coastal areas of the U.S. from North Carolina to Texas and in portions of Mexico and the Caribbean (USFWS, 2009). Northward migration to the breeding grounds occurs during late February, March and early April, and southward migration to the wintering grounds extends from late July, August, and September. Both spring and fall migration routes are believed to follow a narrow strip along the Atlantic Coast (USFWS, 1996).

Additional Life History Information

Adult: Migrates to breeding grounds February - April; migrates to wintering grounds July - September (USFWS, 1996)

Population Information and Trends

Population Trends:

Increasing (USFWS, 2009)

Resiliency:

High (inferred from curernt range/distribution)

Representation:

High (USFWS, 2009)

Number of Populations:

4 (inferred from USFWS, 2009)

Population Size:

~1,849 pairs (USFWS, 2009). As of the last census taken in 2011, a preliminary total of 2858 piping plovers were counted during mid-winter counts in VA, NC, SC, GA, FL, AL, MS, LA, TX and Puerto Rico combined. (Table 1, USFWS 2015).

Minimum Viable Population Size:

2,000 breeding pairs (See delisting citerion 1)

Resistance to Disease:
High (see threats)

Additional Population-level Information:
Populations are sensitive to individual survival (USFWS, 2009)

Population Narrative:
The most consistent finding in the various population viability analyses (PVAs) conducted for piping plovers (Ryan et al. 1993, Melvin and Gibbs 1996, Plissner and Haig 2000, Wemmer et al. 2001, Larson et al. 2002, Calvert et al. 2006, Brault 2007) is the sensitivity of extinction risk to even small declines in adult and/or juvenile survival rates. Progress towards recovery, attained primarily through intensive protections to increase productivity on the breeding grounds, would be quickly slowed or reversed by even small sustained decreases in survival rates during migration and wintering. The New England recovery unit population has exceeded (or been within three pairs of) its 625-pair abundance goal since 1998, attaining a post-listing high of 711 pairs in 2008. The New York-New Jersey recovery unit reached 586 pairs in 2007, surpassing its 575-pair goal for the first time; in 2008, however, abundance dipped to 554 pairs. The Southern recovery unit, which attained 333 pairs in 2007 and 331 pairs in 2008, has not yet reached its 400-pair goal. Southern recovery unit population growth between 2003 and 2007 is encouraging. The Eastern Canada recovery unit has experienced the lowest population growth (9% net increase between 1989 and 2008), despite higher overall productivity than in the U.S. (see discussion under criterion 3, below). The highest post-listing abundance estimate was 274 pairs in 2002, and the 2008 estimate was 253 pairs, placing this recovery unit furthest from its goal (400 pairs). Average microsatellite heterozygosity and mitochondrial control region nucleotide diversity of Atlantic Coast piping plovers and lack of evidence of recent genetic bottlenecks indicate that current genetic risks are low (Miller et al. 2009). Since its 1986 listing, the Atlantic Coast piping plover population estimate has increased 234%, from approximately 790 pairs to an estimated 1,849 pairs in 2008, and the U.S. portion of the population has almost tripled, from approximately 550 pairs to an estimated 1,596 pairs (USFWS, 2009).

Threats and Stressors

Stressor: Shoreline development/construction (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The 1985 final rule stated that the number of piping plovers on the Gulf of Mexico coastal wintering grounds may be declining as indicated by preliminary analysis of Christmas Bird Count data. Independent counts of piping plovers on the Alabama coast indicated a decline in numbers between the 1950s and early 1980s. At the time of listing the Texas Parks and Wildlife Department stated that 30% of wintering habitat in Texas had been lost over the previous 20 years. The final rule also stated that in addition to extensive breeding area problems, the loss and modification of wintering habitat was a significant threat to the piping plover. The three recovery plans stated that shoreline development throughout the wintering range poses a threat to all populations of piping plovers. The plans further stated that beach maintenance and nourishment, inlet dredging, and artificial structures, such as jetties and groins, can eliminate

wintering areas and alter sedimentation patterns leading to the loss of nearby habitat. Structural development along the shoreline or manipulation of natural inlets upsets the dynamic processes and results in habitat loss or degradation (Melvin et al. 1991). Throughout the range of migrating and wintering piping plovers, inlet and shoreline stabilization, inlet dredging, beach maintenance and nourishment activities, and seawall installations continue to constrain natural coastal processes. Dredging of inlets can affect spit formation adjacent to inlets and directly remove or affect ebb and flood tidal shoal formation. Jetties, which stabilize an island, cause island widening and subsequent growth of vegetation on inlet shores. Seawalls restrict natural island movement and exacerbate erosion. Construction of these projects during months when piping plovers are present also causes disturbance that disrupts the birds' foraging efficiency and hinders their ability to build fat reserves over the winter and in preparation for migration, as well as their recuperation from migratory flights. Continual degradation and loss of habitats used by wintering and migrating shorebirds may cause an increase in intra-specific and interspecific competition for remaining food supplies and roosting habitats (USFWS, 2009). As of 2015, In summary, approximately 40 percent of the sandy beach shoreline in the migration and wintering range is already developed, while 43 percent is largely preserved. This means, however, that the remaining 17 percent of shoreline habitat (that which is currently undeveloped but not preserved) is susceptible to future loss to development and the attendant threats from shoreline stabilization activities. The entire coastline is susceptible to sea level rise. As of 2015, forty-four percent of the tidal inlets within the U.S. wintering range of the piping plover have been or continue to be dredged, primarily for navigational purposes (Table 3). States where more than two-thirds of inlets have been dredged include Alabama (three of four), Mississippi (four of six), North Carolina (16 of 20), and Texas (13 of 18), and 16 of 21 along the Florida Atlantic coast. Dredging can occur on an annual basis or every two to three years, resulting in continual perturbations and modifications to inlet and adjacent shoreline habitat. The volumes of sediment removed can be major, with 2.2 million cubic yards (mcy) (1.7 million cubic meters (mcm)) of sediment removed on average every 1.9 years from the Galveston Bay Entrance (Texas) and 3.6 mcy (2.8 mcm) of sediment removed from Sabine Pass (Texas) on average every 1.4 years (USACE 1992). Rice (2012a) found that the ebb shoal complexes of at least 20 inlets within the wintering range of the piping plover have been mined for beach fill. the removal of sediment from inlet complexes via dredging and sand mining for beach fill has modified nearly half of the tidal inlets within the continental wintering range of the piping plover, leading to habitat loss and degradation. Many of these inlet habitat modifications have become permanent, existing for over 100 years. The expansion of several harbors and ports to accommodate deeper draft ships poses an increasing threat as more sediment is removed from the inlet system, causing larger perturbations and longer recovery times; maintenance dredging conducted annually or every few years may prevent full recovery of the inlet system. Rice found that, as of 2011, an estimated 54 percent of 221 mainland or barrier island tidal inlets in the U.S continental wintering range of the piping plover had been modified by some form of hardened structure, dredging, relocation, mining, or artificial opening or closure (Table 3). On the Atlantic Coast, 43 percent of the inlets have been stabilized with hard structures, whereas 37 percent were stabilized on the Gulf Coast. The Atlantic coast of Florida has 17 stabilized inlets adjacent to each other, extending between the St. John's River in Duval County and Norris Cut in Miami-Dade County, a distance of 341 miles. A shorebird would have to fly nearly 344 miles to find the next unstabilized inlet along this stretch of coast. Although less permanent than construction of hard structures, the effects of inlet relocation can persist for years. For example, December-January surveys documented a continuing decline in wintering plover numbers from 20 birds pre-project (2005-2006) to three birds during the 2009 - 2011 seasons (SCDNR 2011). Subsequent decline in the wintering population on Kiawah is strongly correlated with the decline in polychaete worm densities, suggesting that plovers emigrated to other sites as foraging opportunities in these habitats became less profitable (SCDNR 2011). At least eight inlets in the migration and wintering range have been relocated; a new inlet was cut and the old inlet was closed with fill. In other cases, inlets have been relocated without the old channels being artificially filled The artificial opening and closing of inlets typically creates very different habitats from those found at inlets that open or close naturally (Rice 2012a). Rice (2012a) found that 30 inlets have been artificially created within the migration and wintering range of the piping plover, including 10 of the 21 inlets along the eastern Florida coast (Table 3). These artificially created inlets tend to need hard structures to remain open or stable, with 20 of the 30 (67 percent) of them having hard structures at present. An even higher number of inlets (64) have been artificially closed, the majority in Louisiana (Table 3). One inlet in Texas was closed as part of the Ixtoc oil spill response efforts in 1979. Thirty-two inlets were closed as part of Deepwater Horizon oil spill response efforts in 2010-2011. Of the latter, 29 were in Louisiana, two in Alabama and one in Florida. To date only one of these inlets, West (Little Lagoon) Pass in Gulf Shores, Alabama, has been reopened, and the rest remain closed with no plans to reopen any of those identified by Rice (2012a). Three groins were built in South Carolina between 2006 and 2013, bringing the statewide total to 165 oceanfront groins (SC DHEC 2010; USFWS 2013). Eleven new groins were built in Florida between 2000 and 2009. The Texas coast is armored with nearly 37 miles of seawalls, bulkheads and revetments, the mainland Mississippi coast has over 45 miles of armoring, the Florida Atlantic coast has at least 58 miles, and the Florida Gulf coast over 59 miles (Rice 2012b). Shoreline armoring has modified plover beachfront habitat in all states, but Alabama (4.7 miles), Georgia (10.5 miles) and Louisiana (15.9 miles) have the fewest miles of armored beaches. Lott (2009) found a strong negative correlation between ocean shoreline sand placement projects and the presence of piping and snowy plovers in the Panhandle and southwest Gulf Coast regions of Florida11. (11 Lott (2009) noted that sand placement projects may directly degrade plover habitat, but they may also correlate with high human density, where disturbance is higher.) The beaches along the mainland coast of Mississippi are the most modified by sand placement activities with at least 85 percent affected (Table 4). Of the oceanfront beaches, the Atlantic coast of Florida has had the highest proportion (at least 51 percent) of beaches modified by sand placement activities. Approximately 47 percent of Florida's sandy beach coastline has received sand placement of some type, with many areas receiving fill multiple times from dredge disposal, emergency berms, beach nourishment, dune restoration and other modifications (Rice 2012b). (USFWS, 2015). The quality and quantity of the macroinvertebrate prey base is threatened by shoreline stabilization activities, including the approximately 685 miles of beaches that have received sand placement of various types. The addition of dredged sediment can temporarily affect the benthic fauna of intertidal systems. Invertebrates may be crushed or buried during project construction. Although some benthic species can burrow through a thin layer of additional sediment (38-89 cm for different species), thicker layers (i.e., >1 meter) are likely to smother these sensitive benthic organisms (Greene 2002). Numerous studies of such effects indicate that the recovery of benthic fauna after beach nourishment or sediment placement projects can take anywhere from six months to two years, and possibly longer in extreme cases (Thrush et al. 1996; Peterson et al. 2000; Zajac and Whitlatch 2003; Bishop et al. 2006; Peterson et al. 2006). (USFWS, 2015).

Stressor: Invasive plants (USFWS, 2009)
Exposure:
Response:

Consequence:
Narrative: Like most invasive species, coastal exotic plants reproduce and spread quickly and exhibit dense growth habits, often outcompeting native plant species. If left uncontrolled, invasive plants cause a habitat shift from open or sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of piping plover roosting habitat, which is especially important during high tides and migration periods. Beach vitex (Vitex rotundifolia) is a woody vine introduced into the southeastern U.S. as a dune stabilization and ornamental plant (Westbrooks and Madsen 2006). It currently occupies a very small percentage of its potential range in the U.S.; however, it is expected to grow well in coastal communities throughout the southeastern U.S. from Virginia to Florida, and west to Texas (Westbrooks and Madsen 2006). Unquantified amounts of crowfootgrass (Dactyloctenium aegyptium) grow invasively along portions of the Florida coastline. It forms thick bunches or mats that may change the vegetative structure of coastal plant communities and alter shorebird habitat. The Australian pine (Casuarina equisetifolia) changes the vegetative structure of the coastal community in south Florida and islands within the Bahamas (USFWS, 2009).

Stressor: Wrack removal and beach cleaning (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Wrack on beaches and baysides provides important foraging and roosting habitat for piping plovers (Drake 1999, Smith 2007, Maddock et al. 2009, Lott et al. 2009) and many other shorebirds on their winter, breeding, and migration grounds. Man-made beach cleaning and raking machines effectively remove seaweed, fish, glass, syringes, plastic, cans, cigarettes, shells, stone, wood, and virtually any unwanted debris (Barber Beach Cleaning Equipment 2009). These efforts remove accumulated wrack, topographic depressions, and sparse vegetation nodes used by roosting and foraging piping plovers. Removal of wrack also eliminates a beach's natural sand-trapping abilities, further destabilizing the beach. In addition, sand adhering to seaweed and trapped in the cracks and crevices of wrack is removed from the beach. Although the amount of sand lost due to single sweeping actions may be small, it adds up considerably over a period of years (Neal et al. 2007). Currently, the Florida Department of Environmental Protection's Beaches and Coastal Management Systems section has issued 117 permits for beach raking or cleaning to multiple entities. The Service estimates that 240 of 825 miles (29%) of sandy beach shoreline in Florida are cleaned or raked on various schedules, i.e., daily, weekly, monthly (L. Teich, Florida DEP, pers. comm. 2009). USFWS biologists estimate that South Carolina mechanically cleans approximately 34 of its 187 shoreline miles (18%), and Texas mechanically cleans approximately 20 of its 367 shoreline miles (5.4%). The Service is not aware of what percentage of mechanical cleaning occurs in piping plover critical habitat (USFWS, 2009).

Stressor: Disease (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The Department of the Interior has tested 14,261 shorebirds in the families of Charadriidae and Scolopacidae since 2006. Bird species testing positive for low pathogenic avian influenza consist of Pacific golden-plover (1), bar-tailed godwit (3), dunlin (8), marsh sandpiper (1), red knot (1), sanderling (1), sharp-tailed sandpiper (1), and western sandpiper (1) (Acker, pers. comm. 2009). Other laboratories have ongoing shorebird testing, but results were not

available for this review. Although researchers increased vigilance following detection of several cases of West Nile virus in breeding Northern Great Plains piping plovers and Type E botulism in the Great Lakes breeding population, the USFWS is not aware of instances of disease in nonbreeding piping plovers. Based on information available to date, the Service concludes that West Nile virus and avian influenza remain a minor threat to shorebirds, including the piping plover, on their wintering and migration grounds (USFWS, 2009).

Stressor: Predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The impact of predation on migrating or wintering piping plovers remains largely undocumented. Avian and mammalian predators are common throughout the species' wintering range. Predatory birds are relatively common during fall and spring migration, and it is possible that raptors occasionally take piping plovers (Drake et al. 2001). The 1996 Atlantic Coast recovery plan summarized evidence that human activities affect types, numbers, and activity patterns of some predators, thereby exacerbating natural predation on breeding piping plovers. Regarding predation, the magnitude of this threat to nonbreeding piping plovers remains unknown, but given the pervasive, persistent, and serious impacts of predation on other coastal reliant species, it remains a potential threat. Focused research to confirm impacts as well as to ascertain effectiveness of predator control programs may be warranted, especially in areas frequented by Great Lakes birds during migration and wintering months. Recent research and reports indicate that predation poses a continuing (and perhaps intensifying threat) to Atlantic Coast piping plovers. Review of egg losses from natural and artificial nests at Breezy Point, New York, found that gulls, crows, and rats were major predators (Lauro and Tanacredi 2002). Free-roaming domestic and feral cats, particularly those associated with humansubsidized feral cat colonies, appear to be an increasing threat to piping plovers. Predation is a pervasive, persistent, and serious threat to breeding Atlantic Coast piping plovers (USFWS, 2009).

Stressor: Inadequacy of existing regulatory mechanisms (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Most state laws focus on direct protection of the birds but not their habitat. Protections for piping plovers migrating and wintering outside the U.S. include the 2005 designation of 1.5 million acres of the Laguna Madre de Tamaulipas region in Mexico as a Federal Natural Protected Area. Any land-use alterations to piping plover habitats within this area are now subject to review under a federal permitting process that encourages avoidance and minimization of impacts; however, it does not preclude alterations. This is similar to the ESA in allowing some adverse effects to designated critical habitat. Enforcement limitations and/or legal insufficiency of regulations to protect important habitat components result in continued degradation of a significant amount of wintering piping plover coastal habitat, including designated critical habitat units, resulting in a cumulative loss of habitat. At the current time, if the protections of the ESA were removed, existing local, state, and other federal regulatory provisions would provide insufficient protection to nonbreeding piping plover habitats used during migration and winter. Enhanced coordination of project review throughout the migration and wintering range could help to streamline consultations and possibly facilitate further reductions in project impacts to the piping plover and its habitat; however, nonbreeding habitat

degradation continues despite ESA protections. Other threats, such as human disturbance, are currently being managed but not eliminated. Lack of reliable funding to maintain annual implementation of intensive management programs constitutes a serious continuing threat to Atlantic Coast piping plovers (USFWS, 2009).

Stressor: Recreational disturbance (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Intense human disturbance in shorebird winter habitat can be functionally equivalent to habitat loss if the disturbance prevents birds from using an area (Goss-Custard et al. 1996), which can lead to roost abandonment and local population declines (Burton et al. 1996). Disturbance, i.e., human and pet presence that alters bird behavior, disrupts piping plovers as well as other shorebird species. Disturbance can cause shorebirds to spend less time roosting or foraging and more time in alert postures or fleeing from the disturbances (Johnson and Baldassarre 1988; Burger 1991; Burger 1994; Elliott and Teas 1996; Lafferty 2001a, 2001b; Thomas et al. 2002), which limits the local abundance of piping plovers (Zonick and Ryan 1995, Zonick 2000). Shorebirds that are repeatedly flushed in response to disturbance expend energy on costly short flights (Nudds and Bryant 2000). Off-road vehicles can significantly degrade piping plover habitat (Wheeler 1979) or disrupt the birds' normal behavior patterns (Zonick 2000). The 1996 Atlantic Coast recovery plan cites tire ruts crushing wrack into the sand, making it unavailable as cover or as foraging substrate (Hoopes 1993, Goldin 1993). The plan also notes that the magnitude of the threat from off-road vehicles is particularly significant, because vehicles extend impacts to remote stretches of beach where human disturbance would otherwise be very slight. Godfrey et al. (1980 as cited in Lamont et al. 1997) postulated that vehicular traffic along the beach may compact the substrate and kill marine invertebrates that are food for the piping plover. Zonick (2000) found that the density of off-road vehicles negatively correlated with abundance of roosting piping plovers on the ocean beach. Emerging threats include the increasing popularity of "extreme sports," such as kitebuggies and surf kites (also called "kite boards"), which accidentally land in and near breeding habitat. Disturbance by humans and dogs is a continuing widespread and severe threat to Atlantic Coast piping plovers (USFWS, 2009).

Stressor: Military actions (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: To date, five bases have consulted with the USFWS under section 7 of the ESA, on military activities on beaches and baysides that may affect piping plovers or their habitat. Camp Lejeune in North Carolina consulted formally with USFWS in 2002 on troop activities, dune stabilization efforts, and recreational use of Onslow Beach. The permit conditions require twice-monthly piping plover surveys and use of buffer zones and work restrictions within buffer zones. Naval Station Mayport in Duval County, Florida, consulted with USFWS on Marine Corps training activities that included beach exercises and use of amphibious assault vehicles. The area of impact was not considered optimal for piping plovers, and the consultation was concluded informally. Similar informal consultations have occurred with Tyndall Air Force Base (Bay County) and Eglin Air Force Base (Okaloosa and Santa Rosa counties) in northwest Florida. Both consultations dealt occasional use of motorized equipment on the beaches and associated

baysides. Tyndall Air Force Base has minimal on-the-ground use, and activities, when conducted, occur on the Gulf of Mexico beach, which is not considered the optimal area for piping plovers within this region. Eglin Air Force Base conducts twice-monthly surveys for piping plovers, and habitats consistently documented with piping plover use are posted with avoidance requirements to minimize direct disturbance from troop activities. A 2001 consultation with the Navy for training exercises on the beach and retraction operations on Peveto Beach, Cameron Parish, Louisiana, concluded informally. Overall, project avoidance and minimization actions currently reduce threats from military activities to wintering and migrating piping plovers to a minimal threat level (USFWS, 2009).

Stressor: Contaminants and pesticides (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The various piping plover recovery plans identify contaminants, particularly oil spills, as a threat. Contaminants have the potential to cause direct toxicity to individual birds or negatively impact their invertebrate prey base (Rattner and Ackerson 2008). Depending on the type and degree of contact, contaminants can have lethal and sub-lethal effects on birds, including behavioral impairment, deformities, and impaired reproduction (Rand and Petrocelli 1985, Gilbertson et al. 1991, Hoffman et al. 1996). Beach-stranded 55-gallon barrels and smaller containers, which may fall from moving cargo ships or offshore rigs and are not uncommon on the Texas coast, contain primarily oil products (gasoline or diesel), as well as other chemicals such as methanol, paint, organochlorine pesticides, and detergents (C. Lee, USFWS, pers. comm. 2009). The extent to which contaminant levels in piping plovers can be attributed to wintering and migratory stopover sites is unknown. Petroleum products are the contaminants of primary concern, as opportunities exist for petroleum to pollute intertidal habitats that provide foraging substrate. Impacts to piping plovers from oil spills have been documented throughout their life cycle (Chapman 1984; USFWS 1996; Burger 1997; Massachusetts Audubon 2003; Amirault-Langlais et al. 2007; A. Amos, University of Texas, pers. comm. 2009). This threat persists due to the high volume of shipping vessels (from which most documented spills have originated) traveling offshore and within connected bays along the Atlantic Coast and the Gulf of Mexico. Additional risks exist for leaks or spills from offshore oil rigs, associated undersea pipelines, and onshore facilities such as petroleum refineries and petrochemical plants. Chapman (1984) noted shifts in habitat use as piping plovers moved out of spill areas. This behavioral change was believed to be related to the demonstrated decline in benthic infauna (prey items) in the intertidal zone and may have decreased the direct impact to the species. To date, no plover mortality has been attributed to oil contamination outside the breeding grounds, but latent effects would be difficult to prove. Although the risk for impacts from contamination to piping plovers and their habitat is recognized, the safety contingency plans in place alleviate most of these concerns, making contaminants a minor issue at this time. Average concentrations of total polychlorinated biphenyl, dichloro diphenyl dichloroethylene (DDE), and mercury in Atlantic Coast piping plover eggs analyzed since 1990 did not exceed suggested toxicity threshold effect levels, but too few samples were analyzed to adequately characterize contaminant burdens in the population. Although average PCB, DDE, and mercury concentrations were not highly elevated, the maximum reported PCB and mercury concentrations in these composite egg samples were at toxic levels. In 2000, mortality of large numbers of wading birds and shorebirds, including one piping plover, at Audubon’s Rookery Bay Sanctuary on Marco Island, Florida, occurred following the county’s aerial application of the organophosphate pesticide Fenthion for

mosquito control purposes (Williams 2001). Fenthion, a known toxin to birds, was registered for use as an avicide by Bayer chemical manufacturer. Subsequent to a lawsuit being filed against the Environmental Protection Agency (EPA) in 2002, the manufacturer withdrew Fenthion from the market, and EPA declared all uses were to end by November 30, 2004 (American Bird Conservancy 2007, which also states that all other counties in the U.S. now use less toxic chemicals for mosquito control). With one reported plover death from pesticide use, and with the causative pesticide now removed from use, this threat to piping plovers in the U.S. currently appears low. However, it is unknown whether pesticides are a threat for piping plovers wintering in the Bahamas, other Caribbean countries, or Mexico (USFWS, 2009).

Stressor: Sea level rise (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Over the past 100 years, the globally-averaged sea level has risen approximately 10-25 centimeters (Rahmstorf et al. 2007), a rate that is an order of magnitude greater than that seen in the past several thousand years (Douglas et al. 2001 as cited in Hopkinson et al. 2008). The IPCC suggests that by 2080 sea-level rise could convert as much as 33% of the world's coastal wetlands to open water (IPCC 2007). Although rapid changes in sea level are predicted, estimated time frames and resulting water levels vary due to the uncertainty about global temperature projections and the rate of ice sheets melting and slipping into the ocean (IPCC 2007, CCSP 2008). Low elevations and proximity to the coast make all nonbreeding coastal piping plover foraging and roosting habitats vulnerable to the effects of rising sea level. Mapping by Titus and Richman (2001) showed that more than 80% of the lowest land along the Atlantic and Gulf coasts was in Louisiana, Florida, Texas, and North Carolina, where 73.5% of all wintering piping plovers were tallied during the 2006 International Piping Plover Census (Elliott-Smith et al. 2009). Inundation of piping plover habitat by rising seas could lead to permanent loss of habitat that lies immediately seaward of numerous structures or roads, especially if those shorelines are also armored with hardened structures. Sea-level rise poses a significant threat to all piping plover populations during the migration and wintering portion of their life cycle (USFWS, 2009).

Stressor: Storm events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Storms can create or enhance piping plover habitat while causing localized losses elsewhere in the wintering and migration range. Available information suggests that some birds may have resiliency to storms and move to unaffected areas without harm, while other reports suggest birds may perish from storm events. Significant concerns include disturbance to piping plovers and habitats during cleanup of debris, and poststorm acceleration of shoreline stabilization activities, which can cause persistent habitat degradation and loss. Storms are a component of the natural processes that form coastal habitats used by migrating and wintering piping plovers, and positive effects of storm-induced overwashand vegetation removal have been noted in portions of the wintering range. The adverse effects on piping plovers attributed to storms are sometimes due to a combination of storms and other environmental changes or human use patterns. Storm-induced adverse effects include post-storm acceleration of human activities such as beach nourishment, sand scraping, and berm and seawall construction. Recent climate change studies indicate a trend toward increasing hurricane numbers and intensity

(Emanuel 2005, Webster et al. 2005). When combined with predicted effects of sea-level rise, there may be increased cumulative impacts from future storms (USFWS, 2009).

Stressor: Banding (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The only utilization-related threat identified post-listing is that of leg injuries associated with banding for scientific studies. Although injuries have been reported in all breeding populations, 78% of 54 injuries (seen 1985-1989) reviewed by Lingle et al. (1999) involved the Atlantic Coast population. Seventeen apparent band-related injuries, ranging from abrasion to foot loss, were observed from 361 recaptures of banded piping plovers in eastern Canada, 1998-2004. All but two of these injuries were related to the use of novel aluminum bands (Amirault et al. 2006). Since 1989, banding of U.S. Atlantic Coast piping plovers has only been authorized in very limited circumstances (i.e., one study involving a relatively small number of birds, and birds released following treatment to remove oil). Threats to Atlantic Coast piping plovers from band-related injuries are fully regulated by the USFWS and CWS and are, therefore, of low concern (USFWS, 2009).

Stressor: Wind turbines (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Five wind turbine generators have been constructed on Sable Island, Nova Scotia, where migrating piping plovers are occasionally reported (D. Amirault-Langlais pers. comm. 2008c). Two wind turbine projects (one with 16 turbines, the other with ten) are also located near piping plover breeding sites on Prince Edward Island. The only proposed wind turbine generator project reviewed by CWS in Atlantic Canada as of March 2009 that raised concerns about piping plovers is on Cape Sable Island, Nova Scotia; this project has not yet proceeded to construction (A. Boyne, CWS, pers. comm. 2009). The major potential threat to piping plovers posed by wind turbine generators is that of collisions. In the off-shore environment, the primary risk occurs during migration, when routes and flight altitudes are largely unknown. While analysis of the best available information indicates that risk from the Cape Wind project is low (USFWS 2008a), the prospect of multiple large wind turbine generator projects along potential migration routes poses greater concern. Risk from wind turbine generators sited nearshore, on nesting beaches, or in the vicinity of intertidal flats landward of barrier islands or spits has not been assessed. Wind turbine generators pose a threat to piping plovers in the foreseeable future, but the magnitude of this threat cannot be assessed without better information about piping plover movements (USFWS, 2009).

Recovery

Reclassification Criteria:
Not available.

Delisting Criteria:
2. Verify the adequacy of a 2,000-pair population of piping plovers to maintain heterozygosity and allelic diversity over the long term (USFWS, 2009).

3. Achieve five-year average productivity of 1.5 fledged chicks per pair in each of the four recovery units described in criterion 1. Data to evaluate progress toward this criterion should be obtained from sites that collectively support at least 90% of the recovery unit's population (USFWS, 2009).

4. Institute long-term agreements among cooperating agencies, landowners, and conservation organizations to assure protection and management sufficient to maintain the target populations in each recovery unit and average productivity specified in criteria 1 and 2 (USFWS, 2009).

5. Ensure long-term maintenance of wintering habitat, sufficient in quantity, quality, and distribution to maintain survival rates for a 2,000-pair population (USFWS, 2009).

1. Increase and maintain for five years a total of 2,000 breeding pairs, distributed among the four recovery units: Atlantic (eastern) Canada - 400 pairs; New England - 625 pairs; New York-New Jersey - 575 pairs; Southern (DE, MD, VA, NC) - 400 pairs (USFWS, 2009).

(6) Criterion #3 from USFWS, 2015, combined 5-year Review: Sufficient habitat is available on the coastal migration and wintering grounds in quantity and quality to support conservation of the species at recovery levels (as defined by Criterion 1). This will include designated Critical Habitat, and additional habitat that was not designated but is regularly used by wintering piping plovers. Piping plovers should be spatially distributed in the following locations. a. Western Gulf Coast- from the Galveston Bay area, west-southwest along the coast of Texas and Mexico); b. Central Gulf Coast- east-northeast of Galveston Bay through Jefferson County in NW Florida; c. Eastern Gulf Coast- Florida's west coast-Taylor County, Florida south to Monroe County; d. Atlantic Coast Florida's east coast, including the Florida Keys up through northeastern North Carolina, Caribbean Islands and the Bahamas Islands. (USFWS, 2015).

(7) Criterion #4 from USFWS, 2015, combined 5-year Review: Ensure commitments are in place and functioning as anticipated to provide long-term funding, protection, and conservation management activities in essential breeding and wintering grounds. a. Southern Rivers (Missouri River system from Fort Randall Dam, South Dakota to Ponca, Nebraska, the Niobrara River, the Loup River system and the Platte River system); b. Northern Rivers (Missouri River system from Fort Peck Lake, Montana to Pierre, South Dakota); c. in U.S. Alkaline Lakes; d. U.S. Wintering Grounds. (USFWS, 2015).

Recovery Actions:

- Monitor and manage wintering and migration areas to maximize survival and recruitment into the breeding population (USFWS, 1996).
- Undertake scientific investigations that will facilitate recovery efforts (USFWS, 1996).
- Develop and implement public information and education programs (USFWS, 1996).
- Review progress towards recovery annually and revise recovery efforts as appropriate (USFWS, 1996).
- Manage breeding piping plovers and habitat to maximize survival and productivity (USFWS, 1996).

- New in 2015: 1W (Wintering Ground Action): Maintain natural coastal processes that perpetuate wintering and coastal migration habitat. 1.1W Protect non-breeding plovers and their habitat from direct and indirect impacts of development.; 1.2W Protect natural processes of inlet formation, migration, and closure.; 1.3W Protect habitat from direct and indirect impacts of shoreline stabilization and sand placement projects.; 1.4W Protect important foraging and roosting habitats.; 1.4.1W Protect and maintain important intertidal habitats including algal flats, sandbars, shoals, and ebb and flow tidal deltas.; 1.4.2W Maintain natural beach habitat and overwash and wrack formation processes.; 1.5W Maintain native vegetation by managing invasive species.; 1.6W Purchase, via easements or fee-title, areas used by plovers for roosting or foraging. (USFWS, 2015).
- New in 2015: 2W. Protect wintering and migrating piping plovers and their habitat from human disturbance.; 2.1W Manage sites to reduce human-caused disturbance to non-breeding plovers. (Impact – High, Scale – Widespread, Timeframe – Long to Short); 2.1.1W Manage pedestrian access to reduce disturbance to non-breeding piping plovers. (Impact – Medium, Scale – Local, Timeframe – Short); 2.1.2W Manage off-road vehicle access to reduce disturbance, mortality, and habitat degradation.; 2.1.3W Implement and enforce pet restrictions in key plover habitat areas.; 2.1.4W Prevent disturbance from other activities.; 2.2W Develop and implement site stewardship plans that address human disturbance and other limiting factors.; 2.3W Develop an effective migration and wintering range outreach strategy and customize it for use in site stewardship plans. (USFWS, 2015).
- New in 2015: 3W. Monitor non-breeding plovers and their habitat. 3.1W Monitor non-breeding piping plovers to assess regional abundance and distribution. 3.2W Monitor non-breeding sites to identify limiting factors and effects of management. 3.3W Provide robust monitoring of piping plover abundance, distribution, survival, and habitat characteristics before and after major projects that have the potential to substantially modify important migration and wintering piping plover habitat. 3.4W Record and promptly report observations of banded piping plovers. 3.5W Develop a state-by-state atlas or other database containing geospatial information on wintering and migrating piping plovers. (USFWS, 2015).
- New in 2015: 4W. Protect non-breeding plovers and their habitats from contamination and degradation from oil or other chemical contaminants. 4.1W Update and refine contaminant exposure response protocols to protect plovers and their habitats. Incorporate updated procedures and protocols into all appropriate federal, state, and local oil and chemical spill contingency plans. 4.2W Develop a rigorous experimental design to evaluate short- and long-term effects of alternative contaminant clean-up techniques on non-breeding plovers and their habitat. 4.3W Identify and remediate any sources of contaminants with potential to adversely affect piping plover survival and reproduction. 4.4W Carry out research projects to determine survival and reproductive success of individually-marked piping plovers that become oiled on the wintering grounds. (USFWS, 2015)
- New in 2015: 5W. Assess predation as a potential limiting factor for piping plovers on wintering and migration sites and take action to address predation as needed. 5.1W Survey for the presence of avian or mammalian predators (especially non-native predators, such as feral cats) on non-breeding plover sites and include appropriate monitoring and management recommendations in site stewardship plans. 5.1.1W Take actions to remove predators from sites used by piping plovers. 5.2W Consider ancillary benefits to non-breeding plovers when developing predator management plans for sites, including national wildlife refuges and state parks. (USFWS, 2015).

- New in 2015: 6W. Improve application of regulatory tools. 6.1W Fully utilize ESA authorities to conserve piping plovers and their habitats. 6.1.1W Maximize avoidance of adverse effects to piping plovers and their habitats through section 7 consultations with federal agencies. 6.1.2W Adopt effective piping plover protections in Habitat Conservation Plans under section 10(a)(1)(B) of the ESA. 6.2W Provide appropriate Coastal Barrier Resources Act determinations. 6.3W Provide exemplary protection for migrating and wintering piping plovers on federal lands. 6.4W Encourage effective use of state and local laws and regulations to enhance conservation of non-breeding piping plovers and their habitat. (USFWS, 2015)
- New in 2015: 7W. Develop mechanisms to provide long-term protection of non-breeding plovers and their habitat. 7.1W Seek long-term agreements with landowners to protect non-breeding plovers and their habitats. 7.2W Acquire important habitat if it becomes available. 7.3W Seek non-regulatory recognition for sites. 7.4W Institutionalize plover site management through long-term planning at the local, state and federal levels. 7.5W Address long-term climate change threats, including accelerating sea level rise. (USFWS, 2015).
- New in 2015: 8W. Conduct scientific investigations to refine knowledge and inform conservation of migrating and wintering piping plovers. 8.1W Evaluate factors in the coastal migration and wintering range that may affect piping plover survival and subsequent fecundity. 8.2W Refine the characterization of optimal winter and migration habitat. 8.3W Determine the effects of shoreline stabilization projects. 8.4W Develop design specifications and monitoring for restoring, creating, and enhancing roosting and foraging habitat. 8.5W Investigate methods to determine the quantity and distribution of wintering and coastal migration habitat needed for long-term conservation of the three populations. 8.6W Determine impacts of human disturbance on non-breeding plovers. 8.7W Evaluate piping plover flight patterns and behaviors to inform risk assessments for wind turbine generators. 8.8W Develop strategies to reduce threats from accelerating sea level rise. 8.9W Investigate the full spectrum of other impacts from climate change on piping plovers in their non-breeding range. 8.10W Ascertain impacts of predation on wintering and migrating piping plovers. (USFWS. 2015).
- New in 2015: 9W. Coordinate, review, and refine recovery efforts. 9.1W Foster communication among recovery partners. 9.2W Facilitate use of new information. 9.3W Support conservation of wintering piping plovers outside the continental U.S. (USFWS, 2015).

Conservation Measures and Best Management Practices:

- Develop a comprehensive conservation plan for piping plovers in the U.S. portion of their migration and wintering range. a. Acquire funds to develop a concise, cohesive plan that will address the migration and wintering needs of the three breeding populations. This is most efficiently accomplished by a qualified contractor working in close coordination with USFWS biologists. b. Develop a state-by-state wintering and migration habitat use atlas (GL tasks 2.12, 2.13, 2.16; AC task 2.1; NGP task 1.13). i. Quantify amount and distribution of currently existing habitat. ii. Determine the condition of each site, including the type and level of alteration, presence and threat level from invasive species, and whether natural coastal processes are impeded. Compare with historic habitat availability using aerial photography or other records. iii. Determine the temporal abundance and distribution of piping plover activity at sites with suitable habitat. Where appropriate data are currently lacking, conduct multiple surveys by qualified personnel across several migration and wintering seasons. Examples of reports summarizing methods and results of such surveys are available on request to the USFWS. iv. Evaluate likelihood of future actions, including human development and recreational uses, and natural events that could potentially affect habitat quantity and quality at each site. v. Evaluate factors at each site that will affect the response of habitat to accelerating sea-level rise and identify potential actions to minimize its adverse effects. c. Conduct a systematic review of recreational policies and beach management. Identify gaps in management and enforcement of regulatory mechanisms by state. Develop recommendations to improve management and enforcement of piping plover protections where warranted (AC task 2.24). d. Develop an education/outreach strategy to work with state, county, and municipal governments to develop and implement ordinances and other strategies reducing effects of habitat stabilization, beach cleaning practices, human uses, and pets in beach and bayside habitats (GL task 5.2, AC task 2.24, NGP task 5.2). e. Develop an education/outreach strategy to work with private landowners with regard to habitat stabilization, beach-cleaning practices, human uses, and pets (USFWS, 2009).

- Develop, in coordination with land managers, management plans for critical habitat sites or other sites that support or could support nonbreeding piping plovers. This may be accomplished concurrently with development of the atlas described under action 1b above or as a follow-up task (GL tasks 2.14, 2.22; AC tasks 2.13, 2.2; NGP tasks 4.42, 4.43). a. Develop and implement a conservation plan tailored to the site's conditions. A range of management measures may include, as appropriate, leash laws and dogfree zones, off-road vehicle management, and symbolic fencing of key habitats during periods of high plover use. b. Develop a recommended piping plover monitoring protocol for each site that includes suggested frequency and intensity of monitoring. c. Monitor the effectiveness of management measures (2.a above) (USFWS, 2009).
- Improve consistency in the approach used, and recommendations generated for, piping plover conservation in ESA section 7 consultations and Coastal Barrier Resources Act review across all USFWS field offices throughout the species' U.S. coastal migration and wintering range. a. Regularly update USFWS field office staff regarding latest information on piping plovers and habitat use. b. Emphasize importance of maintaining natural coastal processes to perpetuate high quality piping plover migrating and wintering habitat (AC task 2.21). c. Discourage projects that will degrade or interfere with formation or maintenance of high quality piping plover habitat (GL task 2.22, AC task 2.21, NGP task 4.43). d. Encourage project features to minimize adverse effects on piping plovers and their habitat, including creation and enhancement of habitat in the vicinity of existing stabilization projects. . e. Develop a comprehensive monitoring and management plan template for shoreline stabilization projects on the wintering and migration grounds. f. Consider effects of climate change when determining long-term impacts. Include measures to conserve and enhance the capacity of piping plover habitats to adapt to sea-level rise (USFWS, 2009).
- Develop a website specifically for wintering and migrating piping plover issues (GL task 5.2 and AC tasks 4.1, 4.2). a. Develop a piping plover contact list of all individuals in each state and other countries (Canada, Mexico, Bahamas, etc.). b. Link to other plover websites. c. Upload all pertinent literature, including research and monitoring reports not protected by copyright, to the website. d. Upload summarized section 7 consultations, conservation measures, reasonable and prudent measures, and terms and conditions (USFWS, 2009).
- Focus the non-breeding portion of the International Census on enhancing understanding of piping plover abundance, distribution, and threat levels in seasonally emergent habitat (seagrass beds, oyster reefs, and mud flats) in Texas bays, and in Mexico and the Caribbean (GL task 2.13 and NGP task 1.13). a. Continue to encourage and improve International Census efforts at priority sites in Texas. b. USFWS regional coordinators for the International Census should establish contacts in Mexico, Bahamas, Cuba, and other appropriate Caribbean countries at least a year in advance of the 2011 International Census. i. Increase efforts to maximize survey coverage. ii. Encourage collection of information describing types and levels of threats at each International Census site in addition to

physical and biological attributes of the site. iii. Provide information about color-banded birds and encourage surveyors to look for and report these marked piping plovers (USFWS, 2009).

- To further enhance understanding of spatial partitioning of the breeding populations (as well as the impacts of some threats) on the migration/winter grounds, USFWS should facilitate and encourage all efforts dedicated to (or incorporating) monitoring of color-banded piping plovers. There is urgency associated with this data collection since several large breeding grounds banding studies have recently ended or are slated for completion in the near future, and opportunities to glean information will decline as banded piping plovers die off (GL task 2.12, NGP task 1.133) (USFWS, 2009).
- Further investigate the partitioning of survival within the annual cycle, and determine whether winter habitat quality influences reproductive success and survival (GL task 4.1 and AC task 3.6). Explore opportunities for further comparison of survival rates among breeding populations to inform these issues (USFWS, 2009).
- Continue to refine characterization of optimal winter habitat and understanding of factors affecting piping plover use of different microhabitats (e.g., ocean intertidal zones, wrack, inlet shoreline, soundside flats) (GL task 4.4; AC tasks 3.11, 3.12, 3.13; NGP tasks 2.22, 2.23). Research approaches should recognize that piping plovers may move among relatively nearby habitat patches. Plover habitat use patterns and needs may also vary geographically (across their nonbreeding range) and seasonally. a. Determine how habitat modification or complete loss of a site on migration and wintering grounds affects survival given documented site fidelity. b. Develop design specifications for creating roosting and foraging habitat. c. Quantify the amount and distribution of habitat needed for recovery of each breeding population, giving due consideration to intra- and inter-species competition for use of similar habitats (USFWS, 2009).
- Develop strategies to reduce threats from accelerating sea-level rise. a. Identify human coastal stabilization practices that increase or decrease adverse effects of sea-level rise on coastal piping plover habitats. b. Identify sites most likely to maintain (or increase) characteristics of suitable piping plover breeding and/or migration habitat as sea-level rises. c. Evaluate projected effects of sea-level rise on the regional distribution of piping plover habitats over time. Facilitate use of LIDAR (a remote sensing system used to collect topographic data) mapping of coastal elevations, development of models, and timeframe analysis throughout the species wintering and migration range in the U.S. to generate projections regarding areas most likely to be inundated within given time frames (USFWS, 2009).
- Determine the extent that human and pet disturbance limits piping plover abundance and behavioral patterns in the wintering and migration habitats (GL task 2.14, AC task 3.14, NGP task 3.221) (USFWS, 2009).
- Determine the effect of human and pet disturbance on survival and reproductive fitness (GL task 4.1, AC task 3.14, NGP task 3.221) (USFWS, 2009).
- Support research to ascertain impacts of predation on wintering/migrating piping plovers, as well as to determine the effectiveness of predator control programs (USFWS, 2009).
- Increase efforts to restore and maintain natural coastal formation processes in the New York-New Jersey recovery unit, where threats from development and artificial shoreline stabilization are highest, and in the Southern recovery unit, where the plover’s habitat requirements are the most stringent (recovery task 1.2). This action is also critical to reducing adverse effects of accelerating sea-level rise (USFWS, 2009).
- Identify and secure reliable funding to support continuing management of threats from human disturbance and predation, as described in recovery plan tasks 1.1, 1.3, and 1.4 (USFWS, 2009).

- Accelerate development of agreements needed to assure long-term protection and management to maintain population targets and productivity (recovery task 1.6). Prototype agreements should be pursued at sites where there is a history of intensive and successful piping plover protection, a high degree of commitment to the piping plover protection program, and experienced on-site shorebird biologists who can provide expertise to devise and test alternative types of agreements (recovery task 1.62) (USFWS, 2009).
- Develop strategies to reduce threats from accelerating sea-level rise. Identify sites most likely to maintain (or increase) characteristics of suitable piping plover breeding and/or migration habitat. Identify human coastal stabilization practices that increase or decrease adverse effects of sea-level rise on coastal piping plover habitats (USFWS, 2009).
- Conduct studies to understand potential effects of wind turbine generators that may be located or proposed for the Outer Continental Shelf, nearshore, and within or between nesting and foraging habitats. Information needs include migration routes and altitude; flight patterns associated with breeding adults and post-fledged young of the year foraging at nearby sites that are not contiguous with nesting habitats, and avoidance rates under varying weather conditions (USFWS, 2009).
- Conduct studies, including meta-analyses of local studies, to understand factors that affect latitudinal variation in productivity needed to maintain stationary populations of Atlantic Coast piping plovers (USFWS, 2009).
- Conduct demographic modeling to explore effects of latitudinal variation in productivity, survival rates, and the carrying capacity of habitat on population viability within individual recovery units and the Atlantic Coast population as a whole. Use this information to revise recovery criterion 3 to provide recovery unit specific productivity targets sufficient to assure secure populations (recovery plan task 3.5) (USFWS, 2009).
- Review state laws within the Atlantic Coast piping plover's breeding and wintering range to assess protections that would be afforded if the species were removed from ESA listing (USFWS, 2009).
- Support effective integrated predator management (recovery plan task 1.4) through studies of ecology and foraging behavior of key predators; for example, studies assessing the adequacy of buffers between feral cat colonies and piping plover nesting sites would be useful (USFWS, 2009).
- Clarify the piping plover ESA listing to recognize the subspecies Charadrius melodus melodus and C. m. circumcinctus (USFWS, 2009).
- The International Piping Plover Census has fostered widespread involvement in survey efforts and provided extensive data. However, as piping plover conservation efforts mature, it may be beneficial to shift the Census effort to address specific questions that are not answered by other ongoing efforts. Given ongoing recovery programs on the breeding grounds, the most important future International Census contribution to ESA recovery implementation and monitoring for all piping plovers is the abundance estimate for the Northern Great Plains breeding population (including Prairie Canada). The highest benefit can be realized by emphasizing completeness and quality control of this portion of the census and by expediting synthesis and reporting, so that managers can make timely use of this information. Trends in abundance of Great Lakes and Atlantic Coast breeding populations (at least for the U.S. portion of their ranges) and progress toward their recovery are most effectively monitored through the annual surveys conducted in accordance with their recovery plans (see sections GL 2.3.2.2 and AC 2.5.2.2). During International Census years, Atlantic and Great Lakes population estimates based on the nine-day U.S. Atlantic Coast window census (see Atlantic Coast recovery task 1.11) and standard Great Lakes survey methods with special emphasis on complete coverage of all suitable habitat can be used to provide a species-wide context. The most valuable potential contribution from future winter censuses is improved understanding of the species' range in the Caribbean, Mexico, and other areas that may not have

been fully covered in the past (e.g., seasonally emergent habitats within bays lying between the mainland and barrier islands in Texas). See recommendation 5 for the migration and wintering range. In other portions of the continental U.S., the winter census continues to provide beneficial information in the form of a fairly complete one-time survey coverage of wintering habitats, but it does not provide a true wintering "census." In some areas, participation in wintering census by a broad-based group of cooperators also fosters attention to piping plover conservation needs and collects data that otherwise would not exist. However, constraints associated with single, infrequent, mid-winter counts limits inference from the International Census to the value of particular wintering sites for recovery of the species and to detect trends (USFWS, 2009).

- Regulatory Protections: International Treaties include those established between the US, Canada and Mexico, the Ramsar Convention, the Western Hemisphere/Pan American Convention, Canada/Mexico/U.S. Trilateral Committee for Wildlife and Ecosystem Conservation and Management, The Specially Protected Areas and Wildlife Protocol of the Cartagena Convention (effective in the Caribbean). Federal protections include ESA, the Migratory Bird Treaty Act, the Coastal Barrier Resources Act, Executive Order 11644, Use of Off-Road Vehicles on the Public Lands, and Executive Order 11989, Off-Road Vehicles on Public Lands. Habitats are managed by the USFWS's National Wildlife Refuge System (National Wildlife Refuge System Improvement Act of 1997), the National Park Service (The National Park Service Organic Act), and the Department of Defense (Sikes Act). Most states have their regulations at the state level. Other programs include: The Wildlife Conservation and Restoration Program and State Wildlife Grants (both administered by the USFWS), State parks and wildlife management areas. (USFWS, 2015).
- Non-regulatory conservation programs and organizations include the USFWS inter-regional piping plover team, the Atlantic Coast Joint Venture and its South Atlantic Migratory Bird Initiative (integrates North American Waterfowl Management Plan, U.S. Shorebird Conservation Plan, North American Waterbird Conservation Plan, and Partners in Flight), National Audubon Society, the U.S. partner for BirdLife International's Important Bird Area program, Partners in Flight's North American Landbird Conservation Plan (Rich et al. 2004) and Southeast Working Group, The Southeastern Coastal Plains – Caribbean Region Report of the U.S. Shorebird Conservation Plan. (USFWS, 2015).
- New in 2015: BMPs have been described in USFWS 2015 for shoreline stabilization to avoid and minimize adverse environmental impacts, and address dunes, beaches, the nearshore environment (including active littoral or surf zone), offshore environment (including hardbottoms and reefs), inlets, estuarine areas, climate change and rising sea level. (USFWS, 2015).

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SPECIES ACCOUNT: *Chasiempis ibidis (=C. sandwishensis i.)* (Oahu Elepaio)

Species Taxonomic and Listing Information

Listing Status: Endangered; 04/18/2000; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Oahu elepaio is a small (12.5 g, 0.4 oz), 15 cm (5.9 in) monarch flycatcher subspecies endemic to the island of Oahu (VanderWerf 1998a). It is dark brown above and white below, with light brown streaks on the breast. The tail is 6.5 cm (2.6 in) long and often held cocked up at an angle. Adults have conspicuous white wingbars, a white rump, and white tips on the tail feathers that are often displayed. The throat is white with black markings in both sexes, but males tend to have more black than females, especially on the chin (USFWS, 2016).

Taxonomy

The `elepaio comprises a monotypic genus of the monarch flycatcher family (Monarchidae) that is endemic to the Hawaiian Archipelago (American Ornithologists' Union 1998). The closest relatives of `elepaio are other monarch flycatchers from eastern and central Polynesia (Filardi and Moyle 2005). Three subspecies of `elepaio are recognized, each endemic to a single island: the Hawai`i `elepaio (C. s. sandwichensis); the O`ahu `elepaio (C. s. ibidis); and the Kaua`i `elepaio (C. s. sclateri). The taxonomy used here follows Pratt et al. (1987) and Pyle (2002), in which all forms are regarded as subspecies, but the form on each island originally was described as a separate species (USFWS, 2006). The scientific name of the species was officially listed as Chasiempis ibidis effective May 17, 2016. (USFWS, 2016).

Historical Range

Before humans arrived in Hawaii 1,600 years ago, forests covered about 127,000 ha (313,690 ac) of Oahu, and it is likely that elepaio once inhabited much of that area (USFWS, 2016).

Current Range

This species' range is currently limited to approximately 5,451 ha (13,464 ac) (VanderWerf et al. 2001). The Oahu elepaio occupies only about 4 percent of its presumed prehistoric range. As recently as 1975, elepaio inhabited approximately 20,900 ha (51,623 ac) on Oahu, nearly four times the area of the current range (VanderWerf et al. 2001) (USFWS, 2016).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 12/10/2001.

Legal Description

On December 10, 2001, the U.S. Fish and Wildlife Service (Service) designated critical habitat for the Oahu elepaio pursuant to the Endangered Species Act of 1973, as amended (Act). The Oahu elepaio is a forest bird found only on the island of Oahu and is listed as endangered under the Act. The critical habitat consists of five units whose boundaries encompass a total area of approximately 26,661 hectares (ha) (65,879 acres (ac)) in the Koolau and Waianae mountains on the island of Oahu, Hawaii.

Critical Habitat Designation

Critical habitat for the Oahu elepaio includes land under Federal, State, and private ownership, with Federal lands being managed by the Department of Defense and the Department of the Interior. Designated lands include most (99 percent) of the species' current range and encompass approximately 21 percent of the species' original range. Approximately 22 percent of designated lands are currently occupied by elepaio, and 78 percent are currently unoccupied but were recently occupied (since 1975).

Unit 1: Northern Waianae Mountains Unit 1 consists of approximately 4,454 ha (11,005 ac) encompassing the higher elevations of the northern Waianae Mountains. It is bounded on the south by Kolekole pass, and on the north, east, and west by forest edge created by human actions. Natural features within the unit include Mt. Kaala, the highest peak on Oahu at 1,227 m (4,025 feet), several other high peaks along the spine of the Waianae Range, and the upper portions of valleys and slopes, including Waianae Kai, Makaha, Makua, Kahanahaiki, and Kuaokala valleys on the west slope, Haleauau and Mohiakea gulches on the east slope, and several narrow valleys on the north slope. Vegetation consists primarily of mixed-species wet, mesic, and dry forest communities composed of native and introduced plants, with smaller amounts of dry shrub land and cliff plant communities (Hawaii Heritage Program 1991). Unit 1 contains two important elepaio core subpopulations: One in upper Haleauau and Mohiakea gulches above the firebreak road on U.S. Army Schofield Barracks West Range, and the other in upper Makaha and Waianae Kai valleys on Waianae Kai State Forest Reserve and City and County of Honolulu land. The unit also includes small scattered elepaio subpopulations in Pahole and Kaala State Natural Area Reserves, Mokuleia, Makua-Keaau, and Kuaokala State Forest Reserves, and the upper portion of the U.S. Army Makua Military Reservation. Thirty percent of Unit 1 is currently occupied by elepaio. Of critical habitat lands on the West Range of Schofield Barracks, approximately 70 percent are currently occupied by elepaio. The subpopulation on Schofield Barracks is of particular importance to the conservation of the species because it is the densest and third largest subpopulation on the island, contains the majority of birds remaining in the northern Waianae Mountains, and may serve as a source that supports smaller subpopulations nearby. Elepaio in the northern Waianae Mountains are morphologically and behaviorally distinct from elepaio in other parts of the island, and conservation of this population segment would not be possible without the core subpopulation on Schofield Barracks. In addition to protecting lands occupied by the two core elepaio subpopulations and six smaller subpopulations, designated lands in Unit 1 provide for expansion of these subpopulations by including currently unoccupied lands that were occupied within the past 30 years and contain the types of forest most preferred by elepaio. Specifically, currently unoccupied lands in Pahole and Kaala State Natural Area Reserves, Mokuleia, Makua-Keaau, and Kuaokala State Forest Reserves, upper Makua Valley, and upper Kahanahaiki Valley are needed for recovery to allow the number of birds in existing subpopulations to increase. The current distribution of elepaio in Unit 1 represents a remnant of what was once a single, large, continuous elepaio population in the northern Waianae Mountains. Inclusion of currently unoccupied forested lands that provide for expansion and shrub land and cliff habitats that provide for dispersal among subpopulations will provide linkage needed to approximate the original genetic and demographic conditions that once existed in this area.

Unit 2: Southern Waianae Mountains Unit 2 consists of approximately 2,422 ha (5,985 ac) encompassing the higher elevations of the southern Waianae Mountains. It is bounded on the north by Kolekole Pass, and on the east, west, and south by forest edge created by human actions. Natural features of the unit include several high peaks along the spine of the southern Waianae Range, including Palikea, Kaua, Kanehoa, and Hapapa, the upper portions of Lualualei and Nanakuli valleys on the west side of the mountains, and the upper portions of numerous narrower valleys on the east side of the mountains. Vegetation consists primarily of mixed-species mesic and dry forest communities composed of native and introduced plants, with smaller amounts of dry shrub land and cliff communities (Hawaii Heritage Program 1991). Unit 2 contains the second largest Oahu elepaio subpopulation, encompassing several land parcels, including Honouliuli Preserve (managed by The Nature Conservancy of Hawaii), Naval Magazine Pearl Harbor Lualualei Branch, Nanakuli State Forest Reserve, and other unmanaged State lands. This unit also contains several scattered elepaio territories north of the core subpopulation on U.S. Army Schofield Barracks South Range. Fifty percent of Unit 2 is currently occupied by elepaio. In addition to protecting currently occupied habitat, designated lands in Unit 2 include peripheral areas of currently unoccupied habitat in Honouliuli Preserve, Lualualei, and Schofield Barracks South Range that are needed for recovery to allow expansion of the core subpopulation, and dry shrub land and cliff habitats on unmanaged State land between Lualualei and Honouliuli and on Schofield Barracks South Range that provide for dispersal among parts of the southern Waianae subpopulation and between the northern and southern Waianae subpopulations.

Unit 3: Central Koolau Mountains Unit 3 is the largest unit, encompassing 14,801 ha (36,573 ac) of the higher elevations of the central Koolau Mountains. Natural features of the unit include the summit of the Koolau Range and the upper portions of numerous narrow valleys separated by steep ridges, including (from south to north) Manaiki, Moanalua, South Halawa, North Halawa, Kalauao, Waimalu, Waimano, Manana, Waiawa, Kipapa, Kaukonahua, and Poamoho on the leeward (western) side, and Waihee, Kaalaea, Waiahole, Waikane, and Kahana on the windward (eastern) side. Vegetation consists primarily of montane and lowland wet and mesic forest, and smaller areas of shrub land and wet cliff plant communities (Hawaii Heritage Program 1991). The higher elevations of the unit are primarily native forest dominated by ohia and koa, but the lower elevations are more disturbed and dominated by a variety of introduced plant species. Unit 3 contains two important core elepaio subpopulations: one located almost entirely on private land in Moanalua, North and South Halawa, Manaiki, and Kalauao valleys at the southern end of the unit; the other on the windward side in Kahana Valley State Park and on private lands in Waikane Valley. The unit also contains a few scattered elepaio territories in Waiahole State Forest Reserve. Thirteen percent of Unit 3 is currently occupied by elepaio. Designated lands include the existing subpopulations, and also provide for the expansion and recovery of existing subpopulations by including adjacent lands in Manaiki, Waimalu, Waimano, Manana, Waiawa, Kipapa, Kaukonahua, and Poamoho on the leeward (western) side, and in Waihee, Kaalaea, Waiahole, Waikane, and Kahana on the windward (eastern) side that are currently unoccupied but were occupied since 1975. Unit 3 also includes wet shrub land and cliff habitats along the Koolau summit that provide for dispersal of elepaio between the windward and leeward sides of the Koolau Mountains. The existing core subpopulations are geographically distant from each other and probably are isolated. Restoration of elepaio in intervening areas would increase the chances of dispersal and genetic exchange between subpopulations. Currently unoccupied habitat lies on the Oahu Forest National Wildlife Refuge, U.S. Army Schofield Barracks East Range, U.S. Army Fort Shafter, Ewa and Waiahole State Forest Reserves, Kahana Valley State

Park, and 9 privately owned parcels. The narrow indentation in the southern portion of Unit 3 reflects the H–3 freeway and adjacent cleared areas in North Halawa Valley.

Unit 4: Kalihi-Kapalama Unit 4 consists of approximately 804 ha (1,987 ac) encompassing the higher elevations of the leeward (western) side of the central Koolau Mountains above Kalihi and Kapalama. It is bounded on the north by the Likelike Highway and on the south by the Pali Highway. Natural features of the unit include the upper portions of Kalihi, Kamanaiki, and Kapalama valleys. Vegetation consists primarily of mixed-species wet and mesic forest composed of native and introduced plant species (Hawaii Heritage Program 1991). The higher elevations are primarily native forest dominated by ohia and koa, but the lower elevations are more disturbed and are dominated by introduced plant species. This unit is not known to contain any elepaio at present, but it was occupied within the last 20 years, still contains suitable forest habitat, and provides an important habitat steppingstone that increases the chances of dispersal and genetic exchange between elepaio subpopulations in the central and southern Koolau units. This unit includes lands within the State of Hawaii Honolulu Watershed Forest Reserve, two parcels owned by the City and County of Honolulu, and 3 private parcels.

Unit 5: Southern Koolau Mountains Unit 5 consists of approximately 4,180 ha (10,329 ac) encompassing the higher elevations of the southern Koolau Mountains. It is bounded on the west by the Pali Highway. Natural features of the unit include: the summit of the southern Koolau Mountains, including Konahuanui, the highest peak in the Koolau Range at 960 m (3,150 ft), the upper portion of Maunawili Valley on the windward (northern) side of the mountains, and the upper portions of numerous narrow valleys separated by steep ridges on the leeward side, including (from east to west) Kaalakei, Kuliouou, Kupaua, Pia, Kului, Wailupe, Kapakahi, Waialae Nui, Palolo, Manoa, Tantalus, and Pauoa. The vegetation consists primarily of mixed-species wet, mesic, and dry forest communities, with small areas of mesic shrub land and wet cliff plant communities (Hawaii Heritage Program 1991). The higher elevations are primarily native forest dominated by ohia and koa, but the lower elevations are more disturbed and are dominated by introduced plant species, particularly guava, kukui, christmasberry, and mango. Unit 5 contains the largest remaining elepaio subpopulation, located in Kuliouou, Kupaua, Pia, Kului, Wailupe, Kapakahi, and Waialae Nui valleys, and two smaller elepaio populations located nearby in Palolo and Manoa valleys. Twenty-nine percent of Unit 5 is currently occupied by elepaio. The current distribution of elepaio in the southern Koolau Mountains represents a remnant of what was once a single, large, continuous population. In addition to protecting the largest remaining subpopulation and two smaller subpopulations, designated lands in Unit 5 provide for recovery through expansion of existing subpopulations by including currently unoccupied lands in Maunawili, Palolo, Manoa, Nuuanu, Tantalus, and Pauoa that were occupied since 1975 and contain the most preferred forest types. Designated lands in Unit 5 also provide for recovery by including shrub land and wet cliff habitats along the Koolau summit that are used for dispersal and link subpopulations on the windward and leeward sides of the Koolau Mountains, thereby increasing the potential genetic exchange and maintenance of optimal sex ratios. Restoration of elepaio in unoccupied lands in Tantalus and Pauoa at the western end of Unit 5 would increase the chances of dispersal and genetic exchange between the southern Koolau subpopulation and the central Koolau subpopulation. Ownership within Unit 5 consists of the Honolulu Watershed, Maunawili, and Kuliouou State Forest Reserves, several parcels owned by the City and County of Honolulu, and nine private parcels.

Primary Constituent Elements/Physical or Biological Features

Critical Habitat Units are designated for the City and County of Honolulu. Within these areas, the primary constituent elements required by the Oahu elepaio are those habitat components that are essential for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young.

(i) These primary constituent elements are undeveloped wet, mesic, and dry forest habitats with a generally continuous canopy and a dense understory and that are composed of native and/or introduced plant species. Such forests are found in valleys and on mountain slopes and ridges.

(ii) The primary constituent elements associated with the biological needs of dispersal and genetic exchange are undeveloped wet or dry shrub land and wet or dry cliff habitats composed of native and/or introduced plant species that separate elepaio populations. Elepaio may not establish territories in shrub or cliff habitats and may use them only transiently, but undeveloped areas containing these habitats are important for linking populations by providing dispersal corridors and promoting genetic exchange among populations.

(iii) Within the forests and shrub lands providing the primary constituent elements, plant species composition varies with rainfall, elevation, and degree of habitat disturbance, and plant species occur in a variety of assemblages. Common native and introduced species within these plant assemblages include, but are not limited to, ohia (Metrosideros polymorpha), koa (Acacia koa), papala kepau (Pisonia umbellifera), lama (Diospyros sandwicensis), mamaki (Pipturus albidus), kaulu (Sapindus oahuensis), hame (Antidesma platyphyllum), alaa (Pouteria sandwicensis), aalii (Dodonaea viscosa), naupaka kuahiwi (Scaevola spp.), pukiawe (Styphelia tameiameiae), uluhe (Dicranopteris linearis), guava (Psidium guajava), strawberry guava (P. cattleianum), mango (Mangifera indica), kukui (Aleurites moluccana), christmasberry (Schinus terebinthifolius), ti (Cordyline terminalis), rose apple (Syzygium jambos), mountain apple (S. malaccense), and Java plum (S. cumini).

Special Management Considerations or Protections

Existing developed features and structures, such as buildings, roads, aqueducts, antennas, water tanks, agricultural fields, paved areas, lawns, and other urban landscaped areas, that do not contain one or more of the primary constituent elements, are not included as critical habitat.

No areas are adequately managed and protected to address the threats to elepaio. Several areas are covered under current management plans and are being managed in a manner that meets some of the conservation needs of the Oahu elepaio, but in no areas does the management adequately reduce the primary threats to this species. Specifically, the threat from introduced nest predators, primarily rodents, has been successfully managed on a small scale in Honouliuli Preserve by The Nature Conservancy of Hawaii, in Schofield Barracks West Range and Makua Military Reservation by the U.S. Army, and in the Honolulu Watershed Forest Reserve by the Hawaii State Division of Forestry and Wildlife, but in each case the management actions have affected only a small proportion of the elepaio in the area. Adequate reduction of the threat from rodents will require larger scale management that protects more elepaio. The other primary threat to the Oahu elepaio, introduced diseases carried by mosquitoes, has not been managed in any area. In several areas, such as Schofield Barracks, the threat from fire also has not been managed adequately.

Life History

Feeding Narrative

Adult: Eats insects obtained by foliage-gleaning, bark-picking, and aerial sallies below forest canopy (Pratt et al. 1987). Forages in areas with high foliage density, large bark surface area, and many twigs and branches (VanderWerf 1993). This species exhibits a diurnal phenology (NatureServe, 2015). In a study on Hawaii Island, VanderWerf (1993, 1994) found that elepaio foraged at all heights on all available plant species, and that they caught insects from a variety of substrates, including the ground and fallen logs (2 percent), trunks (5 percent), branches (24 percent), twigs (38 percent), foliage (20 percent), and in the air (11 percent). Elepaio are versatile and agile in pursuit of prey, using a diversity of foraging behaviors that is among the highest recorded for any bird, including perch-gleaning (48 percent), several forms of flight-gleaning (30 percent), hanging (11 percent), aerial flycatching (7 percent), and active pursuit (four percent) (VanderWerf 1994). The diet consists of a wide range of arthropods, particularly insects and spiders, and includes nonnative taxa such as fruit flies (VanderWerf 1998a). Large prey such as moths and caterpillars are beaten against a branch before being eaten (USFWS, 2016).

Reproduction Narrative

Adult: Clutch size is 2 - 3 (usually 2). Young are tended by both sexes. Sexually mature within 1 year. Monogamous; remains paired and probably territorial throughout the year (VanderWerf 1993) (NatureServe, 2015). The nesting season usually extends from February to May, but active nests have been found from January to July (VanderWerf 1998a). Oahu elepaio nests are built 2 to 19 m (6 to 62 ft) off the ground in shrubs and trees (VanderWerf and Smith 2002). Both sexes participate in all aspects of reproduction, but the female plays a slightly greater role in nest building and the male provides more food for the nestlings (VanderWerf 1998a). Although both sexes incubate and brood, only the female develops a brood patch and only the female incubates at night. Eggs hatch after 18 days (Conant 1977, VanderWerf 1998a). The nestling period averages 16 days, and fledglings are fed by their parents for more than a month after leaving the nest, remaining on the natal territory for up to 9 months at the start of the next breeding season (VanderWerf 1998a). Fecundity is low; even if nest predators are controlled, the mean number of fledglings per pair is 0.70 per year (VanderWerf and Smith 2002). Oahu elepaio will re-nest once or twice after failure, but they rarely attempt to re-nest if the first nest is successful (USFWS, 2016).

Geographic or Habitat Restraints or Barriers

Adult: Pineapple fields (USFWS, 2016; see dispersal narrative); urban and agricultural habitat, wet/stunted forest, very dry scrubland (USFWS, 2016)

Spatial Arrangements of the Population

Adult: Metapopulations (USFWS, 2016)

Environmental Specificity

Adult: Moderate (inferred from USFWS, 2016)

Site Fidelity

Adult: High (USFWS, 2016)

Habitat Narrative

Adult: Inhabits native and exotic forest (NatureServe, 2015). Adults have high site fidelity. Most elepaio populations on Oahu are separated by many kilometers of unsuitable urban or agricultural habitat. The current distribution appears to constitute a metapopulation (Hanski and Gilpin 1997). Oahu elepaio are adaptable and occur in a variety of forest types composed of both native and introduced species (Conant 1977; VanderWerf 1993, 1994, 1998a). They currently are not found in very wet, stunted forest on windswept summits or in very dry scrubland. Unlike many Hawaiian forest birds, elepaio have adapted well to disturbed forest composed of introduced plants (Conant 1977, VanderWerf 1998a). VanderWerf et al. (1997) found that: 1) forest structure was more important to elepaio than plant species composition, 2) most elepaio occurred in areas with a continuous forest canopy and a dense understory, and 3) population density was roughly twice as high in tall riparian vegetation in valleys than in scrubby vegetation on ridges (USFWS, 2016).

Dispersal/Migration

Motility/Mobility

Adult: Moderate (inferred from USFWS, 2016)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS, 2016)

Dispersal

Adult: Low to moderate (inferred from USFWS, 2016)

Dispersal/Migration Narrative

Adult: Natal dispersal distances usually are less than a km (0.6 mi) (VanderWerf 1998a). There may be infrequent dispersal among populations within each mountain range, but it is unlikely that elepaio cross the extensive pineapple fields that separate the Waianae and Koolau Mountains. Elepaio are non-migratory. The average territory size is 2.0 ha (4.9 ac) in a forest composed of alien plant species in Manoa Valley (Conant 1977) and ranged from 1.2 to 1.8 ha (3.1 to 4.5 ac) in three valleys in southeastern Oahu, depending on forest structure (VanderWerf and Smith 2002) (USFWS, 2016).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015); 75% decline in range (USFWS, 2016)

Resiliency:

Very low (inferred from USFWS, 2016; see current range/distribution)

Redundancy:

Low to moderate (inferred from USFWS, 2016)

Number of Populations:

9 - 11 (USFWS, 2016)

Population Size:

1,982 (USFWS, 2016)

Population Narrative:

This species has expereinced a long term decline of > 90%. In the year 2000, there were approximately 1,980 O`ahu `elepaio distributed in 6 relatively large populations and several small population remnants (see USFWS 2009) (NatureServe, 2015). The range of the elepaio has thus declined by roughly 75 percent in the last 25 years. In addition to the extent of this species current range decreasing, and despite its adaptability, the total number of Oahu elepaio individuals has dropped significantly since humans arrived (Shallenberger 1977, Shallenberger and Vaughn 1978, Williams 1987, VanderWerf et al. 1997). Based on the dates when elepaio were last observed in various locations, the decline of elepaio began in three areas, the northern Koolau Mountains, the northern slope of Mt. Kaala in the northern Waianae Range, and near Konahuanui in the south-central Koolau Mountains. Perhaps not coincidentally, these are also the three areas with the highest rainfall on Oahu, suggesting mosquito-borne diseases may have played an important role in the decline. Most recent surveys indicate that there are only a total of 7 birds in Makua Valley where in 2001 there had been 26 birds (a 73 percent decline) (S. Mosier, U.S. Army Natural Resources, pers. comm. 2007). Complete surveys of The Nature Conservancy's Honouliuli Preserve indicate that there are a total of 47 Oahu Elepaio on a site where in 2001, there had been 307 (an 85 percent decline) (VanderWerf et al 2000 and VanderWerf 2006). In 2001, the breeding population of Oahu elepaio was estimated to be 1,770 birds with a total population of 1,982, due to a male-biased sex-ratio; only 84 percent of territorial males within large populations have mates (E. VanderWerf, unpubl. data), and many small, declining populations contain mostly males. The genetically-effective population size probably is further reduced by the geographic isolation of populations (Grant and Grant 1992). The remaining elepaio populations are small and isolated, comprising 6 core populations that contain between 100 and 500 birds each, and several small remnant populations, most of which contain fewer than 10 birds and few or no breeding pairs (USFWS, 2016).

Threats and Stressors

Stressor: Habitat loss and degradation (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Habitat loss/degradation is caused by destruction of low-elevation forest through suburban, urban, agricultural, golf course, highway and other development activities; clearing of forest understory or the creation of monospecific, even-aged plantations; ordnance-induced fires on military reservations; activities of introduced pigs; and the spread of alien plants such as the velvet tree MICONIA CALVESCENS (USFWS 2000, Ellis et al. 1993, Sherwood 1993) (NatureServe, 2015). Fifty-six percent of the original prehistoric range has been developed for urban or agricultural use, and no elepaio remain in these developed areas (VanderWerf et al. 2001). Habitat loss thus has been a major cause of decline, but elepaio are adaptable, and moderate habitat alteration in the form of gradual replacement of native forest with alien forest has not limited their distribution (VanderWerf et al. 1997). Fires ignited by the public and military training activities are a serious long-term threat to elepaio and have reduced the amount of suitable habitat for the species, including areas designated as critical habitat for the Oahu elepaio (Service 2003c). Fire removes habitat, which is replaced by nonnative fire-adapted plants that are not used by elepaio, such as swamp mahogany (Eucalyptus robusta) and bottlebrush (Melaleuca

quinquenervia). If this pattern is allowed to continue, there eventually will be no mesic forest left at Schofield Barracks and Makua Valley, and those populations will be lost (USFWS, 2016).

Stressor: Disease and predation (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Avian diseases (specifically avian malaria and poxvirus) are spread by mosquitoes (VanderWerf 1998a and 1998b, as cited in USFWS 2000; Ellis et al. 1993). Predation by introduced predators (VanderWerf 1998b, as cited in USFWS 2000), including the threat of the accidental introduction of the Brown Tree Snake, BOIGA IRREGULARIS (NatureServe, 2015). Recent declines in Oahu elepaio populations are due to a combination of low adult survival and low reproductive success. The two main causes of reduced survival and reproduction on Oahu are nest predation by alien black rats (Rattus rattus) and diseases, particularly avian pox (Poxvirus avium), which is carried by the introduced southern house mosquito (Culex quinquefasciatus) and avian malaria (Plasmodium relictum). Oahu elepaio also are threatened by human actions, such as the potential introduction of the brown treesnake (Boiga irregularis) from the Mariana Islands, which has devastated the avifauna on Guam (Savidge 1987) (USFWS, 2016).

Stressor: Competition (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Competition with non-native species such as the Japanese White-eye (Conant 1977, as cited in USFWS 2000) and the Red-Bulbul (USFWS 2000) is a threat (NatureServe, 2015).

Stressor: Stochastic events (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: Even if the threats responsible for their decline are controlled, the existing populations will still be threatened with extinction because their small sizes and restricted distributions make them vulnerable to a variety of natural processes, including reduced reproductive vigor caused by inbreeding depression, loss of genetic variability and evolutionary potential over time due to random genetic drift, stochastic fluctuations in population size and sex ratio, and natural disasters such as hurricanes and fires (Lande 1988, International Union for the Conservation of Nature 2000) (USFWS, 2016).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2006).

2. Viability of the populations is demonstrated through either a) quantitative surveys that show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring that shows each

population or the metapopulation has an average growth rate (lambda, ?) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2006).

3. Sufficient habitat in recovery areas is protected and managed to achieve Criteria 1 and 2 above (USFWS, 2006).

4. The threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2006).

5. Existing core populations in Waikane/Kahana, southern Ko`olau, central Ko`olau, southern Wai`anae, Schofield Barracks West Range, and Makaha/Wai`anae Kai are viable, or function as viable metapopulations on both the windward and leeward sides of the Ko`olau and Wai`anae Mountains, and criteria 2 and 3 apply over a 15-year period (USFWS, 2006).

Delisting Criteria:
Same as downlisting, and criteria 2 and 3 apply over a 30-year period (USFWS, 2006).

Recovery Actions:
- Protect ecosystems for recovery of endangered forest birds (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of native forest birds (USFWS, 2006).
- Develop captive propagation and related recovery strategies. Establish or augment populations of endangered species in suitable, managed habitat using captive propagation and reintroduction techniques (USFWS, 2006).
- Conduct research as needed (USFWS, 2006).
- Monitor changes in the distribution and abundance of forest birds (USFWS, 2006).
- Public awareness and information (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Conservation efforts for the Oahu elepaio include surveys to determine current distribution and abundance (VanderWerf et al. 1997, 2001), demographic monitoring to assess population status and identify threats (VanderWerf 1999), removal of introduced predators (VanderWerf and Smith 2002), and investigation and control of disease. Long-term demographic studies have shown that the two most important current threats are nest predation by black rats and introduced mosquito-borne diseases. Rat control is a promising conservation technique for increasing both reproductive success and survival of adult females. Populations which do not receive rodent control decline at an average rate of 24 percent per year, while sites with rodent control, on average, remain unchanged (VanderWerf and Smith 2002) (USFWS, 2016).
- Ground-based rodent control using snap traps and diphacinone bait stations has been conducted in the Honolulu Watershed Forest Reserve by the Hawaii State Division of Forestry and Wildlife since 1997, at Schofield Barracks West Range and Makua by the U.S. Army Environmental Division since 1998, at Honouliuli Preserve by The Nature Conservancy of Hawaii since 2000, in Lualualei Naval Magazine by the U.S. Navy and U.S. Department of Agriculture, Wildlife Services from 2002 to 2004, in Makaha Valley by the City and County of Honolulu Board of Water Supply and the U.S. Army since 2004, and in and Moanalua Valley by the U.S. Army since 2005 (USFWS, 2016).

- Blood samples have been collected from over 150 elepaio for use in disease screening, determination of genetic population structure, and to assist in identification of potentially disease-resistant populations or individuals (USFWS, 2016).
- Habitat and natural process management and restoration - Protecting remaining forest habitat on Oahu is fundamental to the survival and recovery of the Oʻahu ʻelepaio. Although Oʻahu ʻelepaio are adaptable, they are forest birds and require some form of forest in which to forage and nest. Suitable habitat for recovery of Oʻahu ʻelepaio includes wet, mesic, and dry forest consisting of native and/or introduced plant species, but higher population density can be expected in closed canopy riparian forest with a continuous canopy and dense understory (USFWS, 2013).
- Predator / herbivore control - Control rodents over a larger areas. Rodent control programs should be continued and expanded by whatever methods are available. Ground-based methods of rodent control using snap traps and diphacinone bait stations have been effective on a small scale, but are labor intensive. Recovery of the Oʻahu ʻelepaio likely will require large-scale rat control, which can be achieved more efficiently through aerial broadcast methods. Alternatively, a strategy of constructing predator proof fencing around areas with a high density of Oʻahu ʻelepaio nests could be developed although costs maybe unfeasible at this time (USFWS, 2013).
- Threats research - No areas of Oahu are of sufficient elevation to be free from disease carrying mosquitoes, and all populations of Oʻahu ʻelepaio appear to be affected by disease. Reducing mosquito numbers by removing breeding sites or treating them with larvicides would be extremely difficult due to the abundance of breeding sites. The best long-term method of reducing the threat from disease may be to investigate disease resistance or tolerance and its genetic basis. If disease-resistant or tolerant birds can be identified, translocation or captive propagation and release of these birds might help populations recover more quickly and perhaps obviate the need to control mosquitoes. Controlling rodents also may lessen the threat from disease by providing birds that have greater natural immunity a greater chance of reproducing, thereby increasing the proportion of resistant birds more quickly) (USFWS, 2013).
- Population viability monitoring - To determine whether the overall recovery strategy is effective and whether the recovery criteria have been met, it will be necessary to conduct range-wide population surveys and monitor demography of populations. Standard survey routes should be established to determine distribution and measure population density. Surveys should be conducted at least once every five years to address whether the recovery criteria have been met, and annually if possible to more closely examine population trends and assess efficacy of management actions. Demographic monitoring will require mistnetting, banding, and resighting of birds to measure survival rate, nest searching to measure reproductive success, and data analysis. Setting a goal of demographic persistence highlights the need for monitoring and helps ensure that threats have been adequately managed and population increases are not transient. Surveys should also be conducted in the recovery areas of Waikane/Kahana, Southern Koolau Mountains, and Makaha/Waianae Kai to determine if there are any populations of ʻelepaio in those areas (USFWS, 2013).
- Captive propagation for genetic storage and reintroduction - Captive propagation and release of Oʻahu ʻelepaio are not necessary for recovery at this time because the number of Oʻahu ʻelepaio remaining in the wild is relatively large and recovery can be achieved more cost-effectively through habitat management. Moreover, the threats that caused the decline of Oʻahu ʻelepaio have not been corrected in most areas, and no suitable release sites are currently available. Captive propagation and/or rear and release of Oʻahu ʻelepaio may become necessary in the future if habitat management alone proves insufficient to allow recovery, and would be especially valuable if genetically disease-resistant birds can be identified for use as breeding stock (USFWS, 2013).

- Alliance and partnership development - Initiate planning and contribute to implementation of ecosystem-level management and restoration to benefit this species (USFWS, 2013).

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SPECIES ACCOUNT: *Coccyzus americanus* (Yellow-billed Cuckoo)

Species Taxonomic and Listing Information

Listing Status: Threatened; 11/03/2014; California/Nevada Region (Region 8)

Physical Description

Adult yellow-billed cuckoos have a fairly stout and slightly down-curved bill; a slender, elongated body with a long-tailed look; and a narrow yellow ring of colored, bare skin around the eye. The plumage is loose and grayishbrown above and white below, with reddish primary flight feathers. The tail feathers are boldly patterned with black and white below. They are a mediumsized bird about 12 inches (in) (30 centimeters (cm)) in length, and about 2 ounces (oz) (60 grams (g)) in weight. The bill is blue-black with yellow on the basal half of the lower mandible. The legs are short and bluish-gray. All cuckoos have a zygodactyl foot with two toes pointing forwards and two toes pointing backwards. Juvenile yellowbilled cuckoos resemble adults, except the tail patterning is less distinct and the lower bill has little or no yellow. Males and females differ slightly and are indistinguishable in the field (Hughes 1999, pp. 2–3).

Taxonomy

Recent research on yellow-billed cuckoo genetics using mitochondrial DNA did not find any fixed genetic differences between eastern and western yellow-billed cuckoos (Farrell 2013, pp. 165–170). The author concluded that the separation into distinct subspecies may be too recent to be expressed in a single mitochondrial gene and recommended future studies using next generation sequencing techniques. Avian geneticist Janice Hughes, Ph.D., a peer reviewer of the proposed listing rule, concluded that close examination of the DNA studies conducted to date on cuckoos infers a deeper genetic divergence between western and eastern cuckoos that with further analysis would likely support division of the yellow-billed cuckoo into two subspecies. She indicated that genetic markers used in all three previously conducted genetics studies evolve too slowly to reveal genetic structure within the species. She recommended that future studies use microsatellite techniques because they would be more informative to a study of DNA at the subspecies level. The existing DNA studies, however, show that western yellow-billed cuckoos have developed unique genetic haplotypes not present in eastern cuckoos and that these are reflected in phenotypic (outwardly visible) divergence that has been observed between eastern and western yellow-billed cuckoos. Please refer to the October 3, 2013, proposed listing rule (78 FR 61624–61645) for a more detailed discussion of information on taxonomy for the species.

Historical Range

Based on historic accounts, the species was widespread and locally common in California and Arizona, locally common in a few river reaches in New Mexico, common very locally in Oregon and Washington, generally local and uncommon in scattered drainages of the arid and semiarid portions of western Colorado, western Wyoming, Idaho, Nevada, and Utah, and probably uncommon and very local in British Columbia. Hughes (1999) summarizes the species' historic range and status in these areas.

Current Range

The yellow-billed cuckoo (Coccyzus americanus) is a member of the avian family Cuculidae and is a Neotropical migrant bird that winters in South America and breeds in North America. Yellow-billed cuckoos spend the winter in South America, east of the Andes, primarily south of the Amazon Basin in southern Brazil, Paraguay, Uruguay, eastern Bolivia, and northern Argentina (Ehrlich et al. 1992, pp. 129–130; American Ornithologists' Union (AOU) 1998, p. 247; Johnson et al. 2008b, pp. 18–29). The breeding range of the entire species formerly included most of North America from southeastern and western Canada (southern Ontario, Quebec, and southwestern British Columbia) south throughout the continental United States to the Greater Antilles and northern Mexico (AOU 1957, pp. 269– 270; AOU 1983, p. 284; AOU 1998, p. 247). Currently, the species no longer breeds in western Canada and the northwestern continental United States (Washington, Oregon, and Montana).

Distinct Population Segments Defined

Yes

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The yellow-billed cuckoo consumes insects such as cicadas, katydids, caterpillars.

Reproduction Narrative

Adult: Typically a secretive and hard-to detect bird, adult yellow-billed cuckoos have a distinctive ''kowlp'' call, which is a loud, nonmusical series of notes that slows down and slurs toward the end. Yellow-billed cuckoos advertise for a mate using a series of soft ''cooing'' notes, which they give at night as well as during daytime. Both members of a pair use a soft knocking call as a contact or warning call near the nest (Hughes 1999, pp. 8–9). Clutch size is usually two or three eggs, and development of the young are very rapid, with a breeding cycle of 17 days from egg-laying to fledging of young. Although yellowbilled cuckoos usually raise their own young, they are facultative brood parasites, occasionally laying eggs in the nests of other yellow-billed cuckoos or of other bird species (Hughes 1997). Nesting peaks later (mid-June through August) than in most co-occurring bird species, and may be triggered by an abundance of thecicadas, katydids, caterpillars, or other large prey which form the bulk of the species' diet (Hamilton and Hamilton 1965; Rosenberg et al. 1982). The species is inconspicuous on its breeding range, except when calling to attract or to contact mates.

Geographic or Habitat Restraints or Barriers

Adult: restricted to nesting in moist river bottoms

Spatial Arrangements of the Population

Adult: clumped according to suitable resources

Environmental Specificity

Adult: generalist

Tolerance Ranges/Thresholds

Adult: unknown

Dependency on Other Individuals or Species for Habitat

Adult: cottonwoods and willows

Habitat Narrative

Adult: Western yellow-billed cuckoos breed in large blocks of riparian habitats (particularly woodlands with cottonwoods and willows), while eastern yellow-billed cuckoos breed in a wider range of habitats, including deciduous woodlands and parks (Ehrlich et al. 1988). Dense understory foliage appears to be an important factor in nest site selection, while cottonwood trees are an important foraging habitat in areas where the species has been studied in California (Laymon et al. 1993). Nesting west of the Continental Divide occurs almost exclusively close to water, and biologists have hypothesized that the species may be restricted to nesting in moist river bottoms in the west because of humidity requirements for successful hatching and rearing of young (Hamilton and Hamilton 1965; Rosenberg et al. 1991).Western yellow-billed cuckoos appear to require large blocks of riparian habitat for nesting. Along the Sacramento River in California, nesting yellow-billed cuckoos occupied home ranges which included 10 hectares (ha) (25 acres (ac)) or more of riparian habitat (Gaines 1974; Laymon et al. 1993). Another study on the same river found riparian patches with yellowbilled cuckoo pairs to average 40 ha (99 ac) (Halterman 1991). Nesting densities ranging from 1 to 15 pairs per 40 ha (99 ac) were estimated in a New Mexico study (Howe 1986), and three plots in Arizona had densities ranging of 8.2, 19.8, and 26.5 pairs per 40 ha (99 ac) (Hughes 1999).

Dispersal/Migration

Motility/Mobility

Adult: high

Migratory vs Non-migratory vs Seasonal Movements

Adult: migratory

Dispersal

Adult: high

Immigration/Emigration

Adult: yes

Dependency on Other Individuals or Species for Dispersal

Adult: not applicable

Dispersal/Migration Narrative

Adult: The breeding range of the yellowbilled cuckoo formerly included most of North America from southern Canada to the Greater Antilles and northern Mexico (AOU 1957, 1998). In recent years, the species' distribution in the west has contracted. The northern limit of breeding in the coastal States is now in Sacramento Valley, California, and the northern limit of breeding in the western interior States is southern Idaho (AOU 1998; Hughes 1999). East of the Continental Divide, the species breeds from southeastern Montana, the Dakotas, Minnesota, southern Ontario, southeastern Quebec and probably southern New Brunswick south to eastern Colorado, Texas, the Gulf coast, northeastern Mexico, the Florida Keys, the Greater Antilles and the northern Lesser Antilles (AOU 1957, 1998). The species overwinters from Columbia and

Venezuela, south to northern Argentina (Ehrlich et al. 1992; AOU 1998). The extent to which yellow-billed cuckoos nesting in different regions of North America commingle during migration, or while overwintering, is unknown.Home ranges in the South Fork of the Kern River in California averaged about 17 ha (42 ac) (Laymon et al. 1993).

Population Information and Trends

Population Trends:

Declining

Species Trends:

Declining

Resiliency:

moderate

Representation:

moderate

Redundancy:

moderate

Population Growth Rate:

unknown

Number of Populations:

81 occurrences

Population Size:

in between 10000 to 1000000

Minimum Viable Population Size:

unknown

Resistance to Disease:

unknown

Adaptability:

moderate

Population Narrative:

The available data suggest that the yellow-billed cuckoo’s range and population numbers have declined substantially across much of the western United States over the past 50 years. Analysis of population trends is difficult because quantitative data, including historical population estimates, are generally lacking. However, historic and recent data are sufficient to allow an evaluation of changes in the species’ range in the western United States. Rough extrapolations, which use observed densities of yellow-billed cuckoos and historic habitat distribution, indicate that western populations were once substantial (Service 1985). The following discussion is based on information provided by the petition and in our files, and focuses on westernNorth America, the area for which the petition provides information.

Threats and Stressors

Stressor: Habitat Loss From Dams and Alteration of Hydrology Dams
Exposure:
Response:
Consequence:
Narrative: Several researchers and scientific organizations including the Service reviewed the following effects of human modific tion of natural hydrological processes on riparian abitat, including those from dams (Poff et al. 1997, pp. 769–784; Greco 1999, pp. 36–38; National Academy of Sciences (NAS) 2002, pp. 145–150; Service 2002, Appendix I, pp. 1–12). Dams result in an immediate effect of destroying riparian structure and functioning due to habitat displacement from dam construction and by permanent inundation, sometimes flooding miles of upstream riparian areas. This results in the physical loss of riparian vegetation. In the absence of vegetation, the western yellow-billed cuckoo cannot breed, feed, or find shelter. Current and future releases of water downstream from dams at unnatural rates of flow or timing that differ from preconstruction hydrologic circumstances, or at too frequent or too infrequent intervals, may lead to flooding or desiccation beyond the tolerance limits of the native riparian vegetation, thus resulting in loss of habitat of the western yellowbilled cuckoo. Dam construction has been occurring since the settlement of western North America with its peak in the mid-20th century. These include most major western rivers, many of which have a series of dams, and include, but are not limited to, the Sacramento, Kern, San Joaquin, Mojave, Snake, Gila, Salt, Verde, and Rio Grande, including 25 major reservoirs built on the Colorado and Green Rivers alone between the 1930s and 1970s (Richter et al. 1998, p. 332). In northern Mexico, these rivers include the Ri´o Conchos, Yaqui, and Mayo, Ri´o Bambuto, Ri´o Bravo, Tubutama, La Reforma, Cuchujaqui River in Alamos, Aconchi and Baviacora in Ri´o Sonora, and Upper San Pedro River in Sonora (Instituto del Media Ambiente y el Desarrollo Sustentable del Estado de Sonora (IMADES) 2003, p. 4; Kelly and Arias Rojo 2007, pp. 2–3; Cornell et al. 2008, p. 96). There are now dozens of large dams and scores of smaller dams on rivers throughout the range of the western yellow-billed cuckoo. Today, the rate of building new dams has slowed because most of the highest quality dam sites already have dams constructed on them. There were proposals to build two dams on Cottonwood Creek, one of the major tributaries of the Sacramento River (USACE 1982), but it is not clear when or if these dams will be built. A larger current threat is the enlargement (raising of dams or control structures) of existing dams. The enlargement of Terminus Dam on the Tule River in California by 21 ft (6.5 m) in height was completed in 2004 (Barcouda et al. 2006, p. 12), and proposals to enlarge Shasta Dam on the Sacramento River by up to 18.5 ft (5.7 m) in height and increasing its storage capacity (Reclamation 1999, pp. 3–8; Reclamation 2013, pp. ES 15–22) and Friant Dam on the San Joaquin River by up to 140 ft (43 m) in height are being explored (Reclamation 2003, pp. 3.1– 3.8), and the raising of Lake Isabella on the Kern River by the USACE is in the final stages of implementation (USACE 2012, pp. 1–4). Larger dams with additional storage would likely flood potential western yellow-billed cuckoo habitat upstream and cause additional hydrologic disruption downstream. While the amount of habitat lost within the construction zone of a dam is relatively small, far greater amounts of habitat are destroyed in the areas of inundation and through the ongoing effects of the amount and timing of water releases through the dam operation, which affects both upstream and downstream habitats. Ongoing downstream effects to riparian habitat from dams include changes in sediment transport due to

sediment retention behind the dams so that channels below a dam become increasingly ‘‘sediment starved.’’ This situation causes vertical erosion (downcutting), which can lead to loss of river terraces that sustainriparian vegetation (NAS 2002, pp. 145– 150; Poff et al. 2009, pp. 773–774; Poff and Zimmerman 2010, pp. 196–197). Ongoing operations of large dams can also dampen the magnitude of normal high flows, thus preventing cottonwood germination (Howe and Knopf 1991, p. 218), and dewater downstream reaches, causing substantial declines of riparian forests (NAS 2002, pp. 145–150). For example, Groschupf (1987, p. 19) found that almost all cottonwoods and over half of all willow trees were eliminated from one waterway in Arizona that was exposed to repeated large releases of water from a dam. This situation reduced the density of western yellowbilled cuckoos from 13 per 100 ac (40 ha) before the flooding to 3 per 100 ac (40 ha) after the flooding (Groschupf 1987, p. 19). In another example, a study of the San Joaquin River from downstream of the Friant Dam to the Merced River confluence found that, between 1937 and 1993, the area of riparian forest and scrub decreased 28 percent, from 6,787 to 4,914 ac (2,727 to 1,989 ha), and the herbaceous riparian vegetation decreased from 4,076 to 780 ac (1,650 to 316 ha) (Jones and Stokes Associates, Inc. 1998, Chap. 5, pp. 1–2).These losses are most likely attributed to reduced stream flow down the river as a result of water diversions. In the case of the San Joaquin River, efforts are under way for restoring a more natural functioning hydrologic system and to restore riparian habitat (Reclamation 2012, pp. 7–8). Generally, in the absence of ongoing dam operations, where areas are allowed to flood and deposit sediment, the habitat is likely to regenerate naturally. However, because of the way the majority of dams are operated, theability for the stream courses to promote natural regeneration and maintenance of riparian habitat has been greatly diminished. These impacts are happening now and are likely to continue without changes to water release strategies and management. After the completion of the larger dams on the Colorado River system starting in the 1930s, limited pulse flows reached the lower Colorado River in Mexico for nearly 50 years, resulting in the loss of cottonwood–willow forests and the establishment of tamarisk(Glenn et al. 2001, pp. 1175–1186; Nagler et al. 2005, pp. 1843–1844). Local decline of the western yellowbilled cuckoo and other riparian birds has been attributed to that habitat loss and degradation (Hinojosa-Huerta et al. 2008, p. 81). Additionally, along the Ri´o Altar in northern Mexico, completion of the Cuauhte´moc Dam and Reservoir(Presa Cuauhte´moc) in 1950 diverted surface water and contributed to increased vegetation clearing for agriculture, degradation of mature cottonwood forests, and subsequent declines in distribution and abundance of riparian bird species associated with these forests (Flesch 2008, p. 43), including the western yellow-billed cuckoo, which is known to occur there. In addition to past habitat losses, the altered hydrology caused by dams continues to have an ongoing impact on riparian habitat. While alteration of hydrology due to dam construction and other water supply projects has been widely implicated in the loss and degradation of downstream riparian habitat for the western yellow-billed cuckoo (Gaines and Laymon 1984, p. 73; Greco 1999, pp. 36–38; Greco 2012, pp. 8–9), some dams have resulted in temporary habitat expansion for the western yellow-billed cuckoo within the immediate upstream influence of the associated reservoirs. For example, one of the largest concentrations of western yellow-billed cuckoo in New Mexico occurs at the inflow to Elephant Butte Reservoir on the middle Ri´o Grande (Sechrist et al. 2009, p. 1; Ahlers and Moore 2011, pp. 19–20). Western yellow-billed cuckoo numbers increased following several years when water levels receded and riparian vegetation expanded into the exposed area of the reservoir pool. The western yellow-billed cuckoo population there continues to increase, likely as a result of continued drawdown from long-term drought that allows maturation of the riparian forest into suitable breeding habitat (Ahlers and Moore 2011, pp. 19–20). Drought patterns are cyclical, and, when wetter conditions return to the region, Elephant Butte Reservoir likely will be refilled. When this happens, approximately 92 percent of 44 to 87 pairs of

Stressor: Surface and Ground Water Diversion
Exposure:
Response:
Consequence:
Narrative: Water extractions, both from surface water diversions and ground water pumping, can negatively affect riparian vegetation (Poff et al. 1997, pp. 769– 784; Service 2002, Appendix I, pp. 1–8). Water diversions and withdrawals can lower ground water levels in the vicinity of riparian vegetation. Because ground water and surface water are generally connected in floodplains, lowering ground water levels by only about 3 ft (1 m) beneath riparian areas is sometimes sufficient to induce water stress in riparian trees, especially in the western United States (NAS 2002, p. 158). Physiological stress in native vegetation from prolonged lower flows or ground water results in reduced plant growth rate, morphological change, or mortality, and altered species composition dominated by more drought-tolerant vegetation, and conversion to habitat dominated by nonnative species (Poff et al. 1997, p. 776). These effects reduce and degrade habitat for the western yellowbilled cuckoo for foraging, nesting, and cover. The hydrologic regime (stream flow pattern) and supply of (and interaction between) surface and subsurface water is a driving factor in the long-term maintenance, growth, recycling, and regeneration of western yellow-billed cuckoo habitat (Service 2002, p. 16). As streams reach the lowlands, their gradients typically flatten and surrounding terrain opens into broader floodplains (Service 2002, p. 32). In these geographic settings, the streamflow patterns (frequency, magnitude, duration, and timing) will provide the necessary stream-channel conditions (wide configuration, high sediment deposition, periodic inundation, recharged aquifers, lateral channel movement, and elevated ground-water tables throughout the floodplain) that result in the development of riparian habitat suitable for use by western yellow-billed cuckoos (Poff et al. 1997, pp. 770–772; Service 2002, p. 16). Allowing the river to flow over the width of the floodplain, when overbank flooding occurs, is integral to allow deposition of fine moist soils, water, nutrients, and seeds that provide the essential material for plant germination and growth. An abundance and distribution of fine sediments extending farther laterally across the floodplain and deeper underneath the surface retains much more subsurface water, which in turn supplies water for the development of the vegetation that provides western yellow-billed cuckoo habitat and microhabitat conditions (Service 2002, p. 16). The interconnected interaction between ground water and surface water contributes to the quality of the riparian vegetation community (structure and plant species) and will influence the ability of vegetation to germinate, regenerate, and maintain its foliage density, vigor, and species composition (Arizona Department of Water Resources 1994, pp. 31–32). In many instances, western yellowbilled cuckoo breeding site occur along streams where human impacts are minimized enough to allow more natural processes to create and maintain the habitat. However, there are also breeding sites that are supported by various types of supplemental water including agricultural and urban runoff, treated water outflow, irrigation or diversion ditches, reservoirs, and dam outflows (Service 2002, p. D–15). Although the waters provided to these habitats might be considered ‘‘artificial,’’ they are often important for maintaining the habitat in appropriate condition for breeding western yellowbilled cuckoos within the existing environment.

Stressor: Encroachment of Levees and Flood Control and Bank Stabilization Structures Into the River Channel and Floodplain

Exposure:
Response:
Consequence:
Narrative: Other alterations in river hydrology with ongoing effects on western yellowbilled cuckoo habitat include river channelization, construction of levees, bank stabilization, and placement of any flood control structures that encroach into the river and its floodplain. These actions result in direct loss of habitat from construction and from maintenance activities that remove woody vegetation that has become established on the structures. Furthermore, these structures are effective, by design, at severing the hydrologic connection of the river's main channel and the river's immediate floodplain, thereby preventing overbank flooding. By preventing overbank flooding, levees and other similar structures reduce the amount of water available to riparian vegetation in the floodplain, which results in desiccation and eventual loss and degradation of riparian habitat (Vogl 1980, pp. 84–86; NAS 2002, p. 155; Greco 2012, pp. 8–9). Such effects are less destructive, however, for those levees located farther from the stream system, such as those outside the meander belt of a river (Greco 2012, p. 4). As an illustrative example, we provide a brief summary of how river channelization, construction of levees close to the river, and rock riprap armoring along the levees have caused destruction and modification of western yellow-billed cuckoo habitat on the Sacramento River, one of the most substantial historical nesting and foraging habitat areas for the western yellow-billed cuckoo. The Sacramento River is now disconnected from ecological processes that both renew and restore riparian and aquatic habitats (Laymon and Halterman 1987a, pp. 11– 14; Halterman 1991, pp. 1–2; Greco 2008, p. 6; Greco 2012, pp. 8–9). More than one-half of the Sacramento River's banks within the lowermost 194 mi (312 km) of river have now been rip-rapped by 40 years of bank protection (Service 2000, pp. 26–29). Rock riprap armoring a river reach often changes the river dynamics and leads to channel downcutting and erosion immediately downstream from the riprap. Therefore, riprapping banks leads to the need for more riprapping. Channelizing the river and severing the connection to the floodplain has severely altered the natural disturbance regime that would have allowed riparian habitat to regenerate now and in the future (Poff et al. 1997, pp. 769– 784; Greco 2008, p. 6; Greco 2012, pp. 8–9). The result is that much of the river's remaining riparian habitat is modified, and now occurs in narrow, disconnected, linear strips (Service 2000, pp. 26–29; Halterman et al. 2001, p. 4) that are not utilized by the western yellow-billed cuckoo for breeding (Gaines 1974, p. 204; Greco 2012, p. 9). With the example of the Sacramento River, nesting western yellow-billed cuckoos no longer occur south of Colusa as the river has been channelized and riprapped from that point into the Sacramento-San Joaquin River Delta. These flood control and bank stabilization structures also keep the riparian habitat from regenerating and maturing. The factors that reduce western yellow-billed cuckoo breeding in these areas are not well-understood, but reductions of breeding population have been attributed to lack of patches of adequate size for nesting (Greco 2012, pp. 8–9), increased predators, and the species' inability to use highly isolated patches (Halterman 1991, pp. 33–38). The Sacramento River is but one of many rivers within the range of the western yellow-billed cuckoo where these activities have destroyed and modified riparian habitat and where the ramifications of these past actions are continuing to impact the western yellow-billed cuckoo's habitat today. These ongoing impacts will likely continue for decades to come. An additional pervasive threat is the design of open-channel flood control channels with inappropriately smooth roughness coefficients. This creation over-scours the floodplains and requires removal of woody riparian vegetation that regenerates on floodplains, which in turn leads to floodplains with no western yellow-billed cuckoo habitat (Greco 2013, pp. 707–717).

Stressor: Transportation Systems
Exposure:
Response:
Consequence:
Narrative: Similarly, transportation systems have directly and indirectly altered a large number of riparian areas in western North America (NAS 2002, p. 182). Road and rail systems are frequently sited along rivers, and often entail removing riparian vegetation for construction of the roadbed, and modifying local hydrology to reroute surface water and ground water. Bridges or culverts require abutments along the bank to provide roadway support. Because abutments and roadbeds physically constrain the stream, future lateral adjustments by the stream, which can affect floodplain dynamics, are effectively eliminated, which reduces and degrades riparian habitat (NAS 2002, p. 182). Such impacts result in additional destruction and modification of habitat for the western yellow-billed cuckoo. In comparison with construction of dams and altered hydrology, this threat, by itself, is less likely to result in severe impacts to riparian habitat. However, this threat is but one of many that, in combination, results in substantial changes to physical and hydrological properties of a watercourse, which in turn contributes to a substantial curtailment in the habitat of the western yellow-billed cuckoo.

Stressor: Gravel Mining
Exposure:
Response:
Consequence:
Narrative: Other past and ongoing effects to riparian habitat result from gravel mining (Kondolf et al. 2001, pp. 54, 59). Extraction of gravel, primarily for construction products, typically occurs along rivers and adjacent floodplains where gravel deposits are naturally found. Large amounts of gravel removal from the stream and active floodplain result in channel downcutting or incision, which affects groundwater levels, frequency of overbank flows, bank stability, and the extent and character of riparian vegetation of specific stream reaches (Collins and Dunne, 1989, pp. 213–224; Kondolf 1995 pp. 133–136; NAS 2002, p. 179). Some examples of downcutting on streams in California that historically had, but no longer have, populations of western yellow-billed cuckoos, include: Cache Creek, Yolo County (15.0 ft (4.6 m) average and 26.0 ft (8.2 m) maximum downcutting); Merced River, Merced County (5.9 ft (1.8 m) average and 7.8 ft (2.4 m) maximum downcutting); Putah Creek, Yolo County (7.8 ft (2.4 m) average and 15.0 ft (4.6 m) maximum downcutting); Russian River, Sonoma County (11.4 ft (3.5 m) average and 17.9 ft (5.5 m) maximum downcutting); and Santa Clara River, Ventura County (15.6 ft (4.8 m) average and 20.2 ft (6.2 m) maximum downcutting) (Kondolf et al. 2001, p. 50). Furthermore, gravel extraction creates a knickpoint (a sharp change in channel slope) that typically erodes upstream in a process known as headcutting, which has the potential to propagate upstream for miles on the main river and its tributaries. As headcuts migrate upstream, the incision propagates upstream (Kondolf et al. 2001, p. 49). This process creates ongoing and future impacts to habitat from past as well as current gravel mining operations. Similar to the effects of manmade levees when they disconnect floodplain habitat from the active river channel, artificial channel incision as a result of gravel mining and similar activities reduces overbank flooding. This situation reduces the hydrological connection to the floodplain (Kondolf et al. 2001, p. 56), thereby resulting in subsequent loss and degradation of riparian habitat for the western yellow-billed cuckoo, throughout its range, including Mexico (Cornell et al. 2008, p. 98). The effects of incision and channel erosion are further exacerbated where gravel mining occurs in sediment-starved reaches below dams (Kondolf et al. 2001, p. 10). We expect past and ongoing gravel mining

activities, either alone or in combination with other hydrological changes in riparian areas, to continue to modify habitat and further curtail the range of the western yellow-billed cuckoo for decades. In conclusion, dams, channelization, and other manmade features that alter the watercourse hydrology and encroach into the active channel and floodplain are threats to the habitat of the western yellow-billed cuckoo because they, separately or in combination, significantly reduce and degrade nesting and foraging habitats. The natural processes that sustain riparian habitat in these and similar dammed and channelized river systems in the American West and in northwestern Mexico have been altered, resulting in only fragments or remnants of formerly large tracts of native riparian forests that no longer support breeding western yellow-billed cuckoos or support them in fewer numbers. The multiple effects from altered hydrology comprise the most widespread and greatest magnitude of current threats to habitat that supports the western yellow-billed cuckoo. Such processes continue to modify habitat and further curtail the range of the western yellow-billed cuckoo. Moreover, we expect these alterations in the hydrology to continue to affect habitat of the western yellowbilled cuckoo into the future.

Stressor: Habitat Loss and Degradation From Agricultural Activities
Exposure:
Response:
Consequence:
Narrative: Following the effects from alterations in hydrology in severity, conversion of riparian areas for agricultural crops and livestock grazing has been, and continues to be, a major contributor to riparian habitat loss and degradation (NAS 2002, p. 161; Johnson et al. 2007, p. 61). Large areas of cottonwood–willow floodplain vegetation have been converted to agricultural uses, further reducing the extent of habitat available to western yellow-billed cuckoos for breeding (Swift 1984, pp. 225–226; Rosenberg et al. 1991, pp. 18–23). For example, within areas that support the western yellow-billed cuckoo, clearing for agricultural uses occurred extensively in the past. On the floodplains of the Sacramento River (Greco 1999, pp. 2, 107), riparian habitat was reduced from 775,000 ac (314,000 ha) in the 1850s to less than 18,000 ac (7,287 ha) by 1977 (Swift 1984, p. 226). Clearing for agriculture is also extensive along the lower Colorado River (Rosenberg et al. 1991, pp. 18–23), San Pedro River, Gila River (Swift 1984, p. 226), Ri´o Grande, and several river courses in northern Mexico including, but not limited to, the Ri´o Yaqui, Ri´o Mayo, Ri´o Bambuto, Ri´o Tubutama, and Ri´o Sonora (Russell and Monson 1998, p. 11; IMADES 2003, p. 4; Villasen˜ or- Gomez 2006, p. 108). Clearing also occurred along the coasts of Sinaloa and southern Sonora, Mexico, resulting in massive losses of thorn forest to industrial agriculture (Rohwer et al. 2009, p. 19054). Although most riparian and thorn scrub habitat losses largely stem from past agricultural clearing, effects from cultivated agricultural lands are ongoing. Agricultural lands continue to dominate much of the remaining riparian landscape, particularly along the Sacramento (Greco 1999, pp. 94, 104, 107), parts of the Gila, and lower Colorado Rivers (Johnson et al. 2007, p. 207); along the latter, 65 percent of western yellow-billed cuckoo survey sites are bordered on at least one side by agriculture fields (Johnson et al. 2007, p. 61). Riparian areas are sometimes viewed as a potential source of plant and animal pests, a source of shade that may reduce crop yields, and competition for scarce water resources (NAS 2002, pp. 170–171). For example, in the Salinas Valley in California, a vigorous program is under way to comply with food safety practices that involve the clearing of riparian habitat adjacent to certain types of crops in an effort to eliminate wildlife presence, which has been linked to contamination of crops with a virulent strain of the bacteria Escherichia coli (Beretti and Stuart 2008, pp. 68–69; Gennet et al. 2013, pp. 236–242). While western yellow-billed cuckoos do not currently breed along the

Salinas River (Gaines and Laymon 1984, p. 52), if these same rules are applied to farmland along the Gila, Rio Grande, Sacramento, and Colorado Rivers, western yellow-billed cuckoo habitat could be eliminated to meet these food safety concerns. Accidental fire from farm workers operating machinery or burning weeds sporadically escapes into adjacent riparian habitat. Recent fires on western yellow-billed cuckoo and southwestern willow flycatcher conservation properties occurred in 2011, burning 58 ac (24 ha) and 6 ac (2 ha), respectively, within the Fort Thomas Preserve, on parcels owned by the Salt River Project and U.S. Bureau of Reclamation. Both fires were determined to be humancaused, likely from farm workers burning weeds along irrigation drains (SRP 2011, p. 39). Other ongoing effects from cultivated agriculture on the western yellow-billed cuckoo are addressed under Factor E. These include fragmentation of habitat into smaller, more widely disjunct patches; ongoing influence of agriculture on riparian bird community composition; and effects from pesticides, which can negatively impact insect prey populations of the western yellow-billed cuckoo.

Stressor: Habitat Loss and Degradation From Livestock Grazing Activities
Exposure:
Response:
Consequence:
Narrative: Domestic livestock grazing is a traditional agricultural land use practice in the southwestern United States since the first Spanish settlement along the Rio Grande in New Mexico in 1598 (Little 1992, p. 88; Clary and Kruse 2004, p. 239). Livestock grazing continues to be a widespread agricultural use of riparian areas in the western United States and is one of the most common sources of past and ongoing riparian habitat degradation (Carothers 1977, p. 3; Rickard and Cushing 1982, pp. 2–4; Cannon and Knopf 1984, p. 236; Klebenow and Oakleaf 1984, p. 202; Swift 1984, pp. 225–226; Clary and Webster 1989, pp. 1–2; Schultz and Leininger 1990, pp. 298–299; Bock et al. 1993, p. 300). Livestock grazing occurs in western yellow-billed cuckoo habitat along sections of the middle Rio Grande in New Mexico (Lehman and Walker 2001, p. 12), Ri´o Conchos (Cornell et al. 2008, p. 96), Ri´o Bambuto, Tubutama, La Reforma, and Cuchujaqui River in Alamos, Aconchi and Baviacora in Ri´o Sonora, and upper San Pedro River (IMADES 2003, p. 4), and several other rivers in central Sonora, Mexico (Villasen˜ or-Gomez 2006, p. 108). Grazing also occurs extensively along watercourses in a protected reserve on the Ri´o Aros and Ri´o Yaqui in Sonora, Mexico, where the western yellowbilled cuckoo has been documented (O'Brien et al. 2008, p. 8). Grazing intensity in northern Sonora, Mexico, is generally much higher than in adjacent Arizona (Balling 1988, pp. 106–107; Flesch 2008, pp. 44–45), which leads to greater degradation of riparian habitat than in Arizona. The Service (2002, Appendix G, pp. 5–7) and Krueper et al. (2003, p. 608) reviewed the effects of livestock grazing, primarily in southwestern riparian systems. The frequency and intensity of effects vary across the range of the species, due to variations in grazing practices, climate, hydrology, ecological setting, habitat quality, and other factors (Service 2002, Appendix G, p. 1). However, these effects generally include the removal and trampling of vegetation and compaction of underlying soils, which can inhibit germination and change hydrology (Rea 1983, p. 40; Belsky et al. 1999, pp. 419–431) and promote the dispersal of nonnative plant species. Such effects are most significant when riparian areas have been subject to overuse by livestock (NAS 2002, pp. 24, 168–173). Overuse occurs when grazed vegetation does not recover sufficiently to maintain itself and soils are left bare and vulnerable to erosion. Over time, livestock grazing in riparian habitats, combined with other alterations in streamflow, typically results in reduction of plant species diversity and density and may increase the distribution and density of nonnative tamarisk by eliminating competition from native cottonwood and willow saplings, which are preferred forage for livestock (Krueper et al.

2003, p. 608). Long-term cumulative effects of livestock grazing involve changes in the structure and composition of riparian vegetation (Service 2002, Appendix G, pp. 5–7), which may affect suitability of habitat for western yellow-billed cuckoo breeding and prey population abundance. The western yellow-billed cuckoo nesting habitat is structurally complex with tall trees, a multistoried vegetative understory, low woody vegetation (Halterman 1991, p. 35) andhigher shrub area than sites without western yellow-billed cuckoos (Hammond 2011, p. 48). Livestock grazing alters understory vegetation,reducing height and density or eliminating new growth in riparian areas, and thereby hampering recruitment of woody species that, when mature, provide nest sites. Furthermore, the relatively cool, damp, and shady areas favored by western yellow-billed cuckoos are those favoredby livestock over the surrounding drier uplands. This preference can concentrate the effects of habitat degradation from livestock in western yellow-billed cuckoo habitat (Ames 1977, p. 49; Valentine et al. 1988, p. 111; Johnson 1989, pp. 38–39; Clary and Kruse 2004, pp. 242–243). Removal, reduction, or modification of cattle grazing has resulted in increases in abundance of some riparian bird species. For example, Krueper (1993, pp. 322–323) documented responses of 61 bird species, most of which increased significantly 4 years after removal of livestock grazing in Arizona's San Pedro River Riparian National Conservation Area. The bird species guilds that increased most dramatically were riparian species, open-cup nesters, Neotropical migrants, and insectivores, all species that share characteristics with the western yellowbilled cuckoo. The western yellowbilled cuckoo numbers in the study increased, although not significantly (p=0.13) (Krueper et al. 2003, p. 612), but their survey methodology was not designed to detect western yellow-billed cuckoos. Recovery of vegetation inresponse to grazing removal in that study was quickest and most pronounced in the lower vegetation layers, the most accessible to grazing cattle. Thus, this situation would allowa greater number of seedlings and saplings of cottonwoods and other nesttrees to attain maturity as suitable nesting sites. In another example, livestock grazingwas terminated along portions of the South Fork Kern River at the Kern River Preserve in the 1980s, and western yellow-billed cuckoos increased in number in the years following livestock removal. Smith (1996, p. 4) contended that termination of grazing at the Kern River Preserve was responsible for the dramatic increase in riparian vegetation, which was concurrent with the increase in western yellow-billed cuckoo numbers. These examples suggest that even severely degraded riparian systems can recover quickly, in at least somecases, after livestock removal (Krueper et al. 2003, p. 615), and that damage to riparian vegetation from grazing is at least partly reversible. They alsoillustrate the extent to which livestock grazing destroys and modifies nesting and foraging habitat of the Western yellow-billed cuckoo. In conclusion, most of the direct loss of habitat from agricultural conversion has occurred in the past, but ongoing agricultural activities, in whole or in combination with other impacts, especially those that result in changes in a watercourse's hydrology, have resulted in the curtailment of nesting and foraging habitat for the Western yellow-billed cuckoo by restricting or preventing the growth of riparian plants, and such activities present an ongoing threat. Most of the current impacts from agricultural land uses arise from livestock overgrazing in riparian areas. Riparian vegetation can recover relatively quickly from these effects after livestock removal (Smith 1996, p. 4; Krueper et al. 2003, p. 615). However,without proper management to reduce overgrazing, ongoing overgrazing will continue to contribute to habitat modification in the range of the western yellow-billed cuckoo into the future.

Stressor: Habitat Loss and Degradation Due to Conversion to Nonnative Vegetation
Exposure:
Response:
Consequence:

Narrative: Throughout most of its range, habitat for the western yellow-billed cuckoo is threatened by the conversion of native riparian woodlands to riparian vegetation dominated by tamarisk and other nonnative vegetation. The major threat from this habitat conversion is the change from vegetation that supplies the western yellow-billed cuckoos with essential food and adequate thermal cover to vegetation that does not provide these necessary components of habitat for the western yellow-billed cuckoo. The establishment and persistence of tamarisk is often, but not always, aided by altered hydrology, as described above. Altered hydrology is not the cause for establishment and persistence of other types of nonnative vegetation; therefore, we present information on nonnative vegetation in this separate section. Tamarisk is the most widespread nonnative woody plant species found in habitat for the western yellow-billed cuckoo. Glenn and Nagler (2005, pp. 420–423) provide most of the following overview of tamarisk. Tamarisk is present in nearly every southwestern riparian plant community, but varies in dominance from stream to stream. On streams where altered hydrology can no longer support native species, it has replaced native plant communities entirely, but occurs at a low frequency on other streams. Tamarisk was introduced into western North America in the 1800s to serve as ornamental windbreaks, and for erosion control and other purposes. Several species escaped cultivation and have since spread rapidly. The center of tamarisk distribution is currently Arizona, New Mexico, and Utah, and it has spread throughout most of the range of the western yellow-billed cuckoo at least as far north as the Yellowstone River in Montana in the Rockies, and at least as far south as the Yaqui River Valley in Sonora, Mexico. Recent studies in the northwest have located major populations of tamarisk in southwestern Idaho, and eastern Washington and Oregon. Models based on projected climate change predict that this invasive species will become more dominant in this region over the next 100 years (Kerns et al. 2009, pp. 200–215). Tamarisk also occurs west to the Owens, San Joaquin, and Sacramento Rivers in California, although it is still nearly absent from the mainstem Sacramento River in California and suitable habitat west of the Cascades in Oregon and Washington. Tamarisk also occurs as isolated individuals along sections of the Sonora, Moctezuma, and Sahiaripa Rivers in Sonora, Mexico, where the hydrology has been little altered by human modifications (Villasen˜ or-Gomez 2006, pp. 107–108). Its presence is highly variable within sections of the Ri´o Conchos in Chihuahua, Mexico, and becomes dominant in some reaches of that river (Kelly and Arias Rojo 2007, pp. 177–178; Cornell et al. 2008, p. 4). The threshold (in terms of percent tamarisk) for abandonment of a riparian system by western yellow-billed cuckoos is not known. They are not found in areas that are totally dominated by tamarisk with the complete lack of willows or cottonwoods. In California, two nativedominated areas occupied in 1977 by several pairs of western yellow-billed cuckoos had, by 1986, converted to monotypic stands of tamarisk and were found to be uninhabited by western yellow-billed cuckoos. Above Laguna Dam on the Colorado River in 1977, at least three pairs of western yellowbilled cuckoos occupied a 30-ac (12-ha) site that was approximately 20–40 percent willow (Laymon and Halterman 1987a, p. 12). By 1986 no western yellow-billed cuckoos were detected on the site where the dominant vegetation had become tamarisk, with less than 1 percent willow cover. In the vicinity of Picacho State Recreation Area, on the California side of the Colorado River, in 1977, 21 western yellow-billed cuckoos were found in 297 ac (120 ha) of a 230- ft-wide (70-m-wide) willow forest (Gaines and Laymon 1984, p. 72). By 1986, tamarisk and aquatic vegetation dominated this area, and no western yellow-billed cuckoos were found in the 12 ac (5 ha) of scattered willow– cottonwood habitat that remained (Laymon and Halterman 1987a, pp. 12– 13). Human disturbance, such as water diversion, flood control, vegetation clearing, and improper grazing management, often facilitates replacement of native vegetation with tamarisk (Kerpez and Smith 1987, pp. 1–5; Hunter et al. 1988, p. 113; Rosenberg et al. 1991, pp. 18–23). Altered hydrologic regimes (flooding or reduction in water flows from dams) has disrupted natural flooding events that are essential for maintaining native riparian ecosystems (Vogl 1980, pp. 84– 86; Rosenberg et al. 1991, pp. 18–23), and the disruption (usually elimination) of flooding tends to favor tamarisk. In contrast to native cottonwoods, tamarisk does not need flooding to regenerate (Kerpez and Smith 1987, pp. 1–5). Tamarisk is also tolerant of high salt levels, which can be present in river systems as a combined result of water diversions that lower the near-surface ground water and irrigation water runoff that contains high levels of dissolved salts (Kerpez and Smith 1987, pp. 1–5; Busch and Smith 1993, pp. 186–194). This higher tolerance to water stress and salt accumulation is a principlemechanism by which tamarisk has become dominant on some regulated western rivers (Glenn and Nagler 2005, . 439). In addition, tamarisk takes salts from the ground water and exudes them from its leaves, rendering the soil even more unsuitable for germination of native riparian vegetation. This is a significant problem in streams with artificially reduced streamflows where salts accumulate and are not flushed from the system. These factors favor regeneration of tamarisk over native trees and shrubs and are an ongoing threat. Additional areas of native habitat are continuing to be lost to this process. In summary, the persistence and expansion of tamarisk-dominated habitat is the result of multiple forms of ongoing human-related disturbances, which result in degradation of ativedominated riparian habitat, thus reducing its suitability as breeding habitat for the western yellow-billed cuckoo. Other nonnative tree and shrub species have become established within the range of the western yellow-billed cuckoo. In western Colorado and Utah, Russian olive (Elaeagnus angustifolia) has become established and is a dominant tree species in many riparian systems. Giant reed (Arundo donax), common edible fig (Ficus carica), and the Himalayan blackberry (Rubus discolor) are some of the more conspicuous nonnative plants widely established along the Sacramento River, with Himalayan blackberry dominating the understory at some restoration sites (Borders et al. 2006, p. 310). Along the Sacramento River, western yellow-billed cuckoos were far less likely to be detected at sites with an understory dominated by Himalayan blackberry than sites with a predominant native understory. Himalayan blackberry may prevent establishment of native understory species due to its dense growth habit (Hammond 2011, pp. 48– 49). Nesting of the western yellow-billed cuckoo has not been documented in riparian stands dominated by giant reed, common fig, or Himalayan blackberry that lack at least some native canopy trees. In conclusion, because of the absence or near absence of nesting by western yellow-billed cuckoos in nearly monotypic stands of tamarisk and other nonnative vegetation, the available literature suggests that conversion of native or mixed (native and nonnative) riparian woodlands to nearly monotypic stands of tamarisk nd other nonnative vegetation, coupled with the inability of native vegetation to regenerate under altered hydrological conditions, is a significant threat to the western yellowbilled cuckoo now and in the future. Nonnative vegetation, such as tamarisk, occurs across most of the range of the western yellow-billed cuckoo; its establishment can be caused by altered hydrology or other disturbances, which are widespread throughout the range. We expect nonnative vegetation to increasingly modify and curtail habitat for the western yellow-billed cuckoo within a majority of its range in the United States and northern Mexico into the future.

Stressor: Use of Tamarisk by Western Yellow- Billed Cuckoos and the Spread of the Introduced Tamarisk Leaf Beetle Into the Southwest
Exposure:
Response:
Consequence:
Narrative: Western yellow-billed cuckoos use habitat with some tamarisk component for nesting in southern California, Arizona, and western New Mexico, but are not found in monotypic stands

of tamarisk. Western yellow-billed cuckoo presence in tamarisk-dominated habitats does not necessarily equate to habitat suitability (Sogge et al. 2008, p. 149; Hammond 2011, p. 50), and additional research is needed to determine productivity, survivorship, physiological condition, and food availability in these habitats. Tamarisk can add to foliar cover that contributes toward reducing temperatures in riparian areas (Paxton et al. 2011, p. 259). Even relatively small decreases in foliar cover may render a site unsuitable for nesting western yellow-billed cuckoos (Paxton et al. 2011, p. 260). Removal of tamarisk in drainages occupied by western yellowbilled cuckoos can have unintended negative consequences if the removal leaves little or no woody vegetation and native riparian vegetation is unable to reestablish. The available literature that pertains to riparian restoration in New Mexico and Arizona (Poff et al. 1997, pp. 769–784; Glenn and Nagler 2005, pp. 439–441; Sogge et al. 2008, pp. 151– 152; Stromberg et al. 2009, pp. 181–182) suggests that restoration of natural hydrological processes, rather than direct removal programs, would be a more effective method for promoting regeneration of native riparian vegetation and diminishing the presence of tamarisk. However, tamarisk removal programs coupled with native riparian plantings can speed up the restoration process assuming that the hydrologic system will support the native vegetation. Tamarisk leaf beetle insects (leaf beetles) (Diorhabda spp.) were released into many locations throughout the southwest to control tamarisk. Leaf beetles are now spreading within the more arid range of the western yellowbilled cuckoo in Nevada, Utah, Arizona, New Mexico, and Texas. Defoliation of tamarisk by the beetles occurs in the summer months when western yellowbilled cuckoos are in the process of nesting. Tamarisk leaf beetles could eventually occur throughout the western United States and northern Mexico (Tracy et al. 2008, pp. 1–3). The future effects of the beetle introductions to the western yellow-billed cuckoo are unknown. If beetles succeed in killing tamarisk, western yellow-billed cuckoo numbers may decline in areas where the hydrology is no longer capable of supporting a native riparian habitat and the numbers may increase in areas where native riparian vegetation is able to become reestablished.

Stressor: Wildfire
Exposure:
Response:
Consequence:
Narrative: Historically, wildfire was uncommon in native riparian woodlands (Busch and Smith 1993, pp. 186–194). However, the lack of scouring floods on regulated and unregulated rivers has resulted in the accumulation of fuel on the floodplain, which increases fire risk and intensity (Stromberg and Chew 2002, pp. 195–219). Water withdrawal, dams, climate change, drought, and human use also contribute toward an increased fuel load and probability of wildfire occurrence. Most fires today are human-caused (Service 2002, p. L–8). In degraded habitat with tamarisk the threat of fire may be greater. Tamarisk ignites quickly, further increasing the incidence of periodic fires. Exacerbating the immediate loss of native trees from fire, tamarisk recovers more quickly than native trees (Glenn and Nagler 2005, pp. 435–436). Along the Rio Grande River in New Mexico and Texas, wildfire has been documented as destroying, degrading, or setting back successional stages of vegetation development of western yellow-billed cuckoo habitat (Sproul 2000, in litt., p. 3). In summary, the alteration of riparian systems through changes in hydrologic functioning and the introduction of nonnative tamarisk have increased the incidence of wildfire into western yellow-billed cuckoo habitat. These fires further degrade, isolate, or fragment western yellow-billed cuckoo habitat.

Stressor: Environmental Impacts of Cross-Border Foot Traffic in the Southwest

Exposure:
Response:
Consequence:
Narrative: The environmental impact caused by cross border foot traffic has been increasingly occurring in more fragile and remote areas. The number of U.S. Border Patrol apprehensions of border crossers varies annually. Between October 1, 1999, and September 30, 2012, a yearly average of 333,517 border crossers were apprehended by the United States Border Patrol in the Tucson Sector, which does not account for the many others who were not caught (U.S. Border Patrol 2013, p. 1). Impacts associated with border crossings include creation of erosion and watershed degradation, loss of vegetation and wildlife, and humancaused wildfire (Defenders of Wildlife 2006, pp. 1–42). Drainages used by border crossers include the San Pedro River, Santa Cruz River, Cienega Creek, and many remote drainages in the mountain ranges of southeastern Arizona. Human-caused wildland fires have been particularly damaging to areas of riparian habitat in Arizona, especially within 100 mi (161 km) of the United States-Mexico border where border crossers are known to set fires to divert law enforcement agents. Border crossers are also responsible for campfires that can escape and spread as wildfires. At least 2,467 wildfires began along the Arizona border with Mexico from 2006 to 2010 (Government Accounting Office 2011, p. 1). Federal officials have officially investigated only 77 of those fires. Of the fires investigated, 30 were started by border crossers. The resulting environmental impacts include the expansion of nonnative plant species, degraded endangered species habitat, and soil erosion.

Stressor: Climate Change
Exposure:
Response:
Consequence:
Narrative: The available climate change models are predicting altered future environmental conditions across the breeding range of the western yellow-billed cuckoo. In the southwestern United States, northern Mexico, California, Intermountain West, and Pacific Northwest, climate change is generally predicted to result in an overall warmer, drier climate, with periodic episodic precipitation events that, depending on site conditions, are expected to have adverse effects on habitat of the western yellow-billed cuckoo. In rivers that depend on snowmelt, these changes are expected to result in more winter flooding and reduced summer stream flows. The amount of surface ground water available to regenerate and sustain riparian forests is expected to decline overall with persistent drought, favor the spread of tamarisk and other nonnative vegetation, and increase fire frequency. Precipitation events under most climate change scenarios will decrease in frequency and increase in severity. This change may reduce available nesting sites, patch size, and affect prey abundance as a result of lower humidity in riparian areas from reduced moisture retention, and through periods of prolonged desiccation followed by scouring flood events. In addition, evidence shows that climate change may disrupt the synchrony of nesting western yellow-billed cuckoos and their food supply, causing further population decline and curtailment of its occupied range. Impacts to habitat from climate change exacerbate impacts from impoundments, channelization, and alteration of river flows across the western United States and Mexico, and from conversion of habitat from native to mostly nonnative vegetation. Changing climate is expected to place an added stress on the species and its habitats. While we do not have evidence to suggest that the habitat of the western yellow-billed cuckoo is being substantially affected by climate change at this time, we expect long-term climate trends to have an overall negative effect on the available habitat throughout the breeding range of the western yellow-billed cuckoo. Moreover, a drying trend associated with global climate change

may result in more dams, levees, or other activities to ensure fresh water for human consumption, which may result in additional habitat loss from the activities described in the Habitat loss from Dams and Alteration of Hydrology section, above.

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: Little is known about diseases in the western yellow-billed cuckoo. West Nile virus has recently spread throughout portions of the western United States. It poses a potential threat to many bird species. The U.S. Geological Survey's (USGS) National Wildlife Health Center has identified the yellow-billed cuckoo as a species that is subject to the effects of West Nile virus (USGS–National Wildlife Health Center 2005, p. 2). The Centers for Disease Control's (CDC) Vector-Borne Disease Web site reports that West Nile virus has been documented in a dead yellow-billed cuckoo (CDC 2012); however, it is unknown if this yellow-billed cuckoo was from the western DPS. Although the population of the western yellow-billed cuckoo has been in decline over several decades (see Historical and Current Status section, above), no evidence suggests that it has undergone a precipitous decline coincident with the relatively recent arrival of West Nile virus in western North America. Therefore, we conclude, based on the best available scientific and commercial information, which is limited, that the adverse effects of West Nile virus to the western yellow-billed cuckoo are not significant and do not constitute a threat at this time, nor is there any information to suggest that this situation will change into the future. All bird species, including the yellowbilled cuckoo, are exposed, to some extent, to parasites. Greiner et al. (1975, pp. 1762–1787) found 5 of 16 yellowbilled cuckoos infected with Leucocytozoon, Trypanosoma, and microfilaria blood parasites. No information indicates whether these and other parasites (see Hughes 1999, p. 18, for a brief review) pose any threat to the western yellow-billed cuckoo.

Stressor: Inadequate regulations
Exposure:
Response:
Consequence:
Narrative: Various Federal, State, and international regulatory mechanisms in place provide varying degrees of conservation oversight that may to some degree address the threat of ongoing habitat loss and degradation resulting from altered hydrology, conversion of habitat to nonnative vegetation, climate change, agricultural activities, or exposure to pesticides and effects of small and isolated habitat patches. In California, where the species is listed as endangered, regulations prohibit unpermitted possession, purchase, sale, or take of listed species. Such prohibition of take does not include the species' habitat, and the western yellow-billed cuckoo continues to decline in California despite its status as a State-listed species. In addition, even though theCalifornia Department of Pesticide Regulations has a program to protect endangered species, the western yellowbilled cuckoo has not been included as a covered species. Because the yellow-billed cuckoo is not a protected or sensitive species in Canada, Mexico, or in a majority of the United States, and a variety of factors influence the species and its habitat, we have determined that the current regulatory regime does not adequately address the majority of impacts to the western yellow-billed cuckoo or its habitat. One of the primary threats with the greatest severity and magnitude of impact to western yellow-billed cuckoo is the loss of habitat as a result of altered hydrologic functioning of streams in the West. Although some protections

currently exist for the species and its habitat as a result of existing regulatory mechanisms at the Federal, State, or local level, our evaluation suggests these protections are inadequate to address the threats associated with the species and its habitat.

Stressor: Isolated populations
Exposure:
Response:
Consequence:
Narrative: The potential natural regeneration or restoration of the habitat to reconnect these areas is low due to various reasons. Under the best of circumstances, for riparian habitat (willows, cottonwoods) to mature to the point at which it provides for appropriate food, shelter, and breeding conditions for the western yellow-billed cuckoo may take 3–5 years (Golet et al. 2008, pp. 20–22). However, in areas where conditions are less than optimal, habitat may take several decades to mature to the point where it would be available for use (Strahan 1984, pp. 58–67; Briggs 1995, pp. 63–67; Opperman and Merenlender 2004, pp. 822–834; Trowbridge et al. 2004, pp. 157–164; Morris et al. 2006, pp. 106– 116; Griggs 2009, p. 12). As a result, the western yellow-billed cuckoo now primarily occurs in smaller, more widely separated populations. Compared to large populations, smaller populations are disproportionately affected by natural and manmade factors. These stressors vary in frequency, timing, and magnitude across the species' range. They are related or correlated to each other or act in combination to result in significant impacts to the western yellow-billed cuckoo within all or portions of its range. One of the ramifications of smaller, more isolated habitat patches is that the smaller the patch, the more edge it has in proportion to its area, which increases the percentage of the available habitat exposed to the surrounding land uses (Hunter 1996, pp. 186–187). This is a particularly prevalent characteristic of the western yellow-billed cuckoo's remaining disjunct habitat patches, as many patches are in proximity to agricultural and other human-altered landscapes. For example, such land use currently dominates much of the riparian landscape within many regions, particularly along some reaches of the lower Colorado River, Sacramento River, Snake River, Verde River, Gila River, Santa Cruz River, San Pedro River, and Ri´o Grande; and also in parts of northern Mexico in the vicinity of floodplain farming along the Sonora, Magdalena, and Moctezuma Rivers (Villasen˜ or-Gomez 2006, p. 111).

Stressor: Pesticides
Exposure:
Response:
Consequence:
Narrative: Pesticide use is widespread in agricultural areas in the western yellow-billed cuckoo breeding range in the United States and northern Mexico. Yellow-billed cuckoos have been exposed to the effects of pesticides on their wintering grounds, as evidenced by DDT found in their eggs and eggshell thinning in the United States. Because much of the species' habitat is in proximity to agriculture, the potential exists for direct and indirect effects to a large portion of the species in these areas through altered physiological functioning, prey availability, and, therefore, reproductive success, which ultimately results in lower population abundance and curtailment of the occupied range. While agricultural pesticides can kill prey of the yellow-billed cuckoo, and documentation exists of pesticide exposure in the wild, described above, no known data are available to determine specifically how often agricultural chemicals may be affectingyellow-billed cuckoo prey availability, locations where it may be particularly significant, or the extent to which pesticides may be responsible for population-level effects in the western

yellow-billed cuckoo. However, based on the close proximity of agricultural areas to where the western yellow-billed cuckoo breeds, the threat is potentially significant.

Stressor: Collisions With Communication Towers, Wind Turbines, Solar PowerTowers, and Other Tall Structures
Exposure:
Response:
Consequence:
Narrative: Yellow-billed cuckoos are vulnerable to collision with communication towers and other tall structures, particularly during their migration. For example, several hundred yellow-billed cuckoo mortalities were documented at a single television tower in Florida over a 29- year period (Crawford and Stevenson 1984, p. 199; Crawford and Engstrom 2001, p. 383), and at an airport ceilometer in the east (Howell et al. 1954, p. 212). Lesser numbers of yellowbilled cuckoos have been reported as killed at other sites with both television towers and wind turbines in Wisconsin, West Virginia, and northern Texas (Kemper 1996, p. 223; Schechter 2009, p. 1; Bird Watching 2011, p. 1), Although these mortalities were in the eastern segment of the population, with the number of tall towers that have been constructed in recent years in the western United States, the potential exists for collisions with the western yellow-billed cuckoo. Remains of a yellow-billed cuckoo along with 70 other species of birds have been recovered at the Ivanpah solar power tower facility (California) during its first year of operation (Kagan et al. 2014, p. 10). Without further study, we anticipate this to be a minor, but ongoing, effect to individual yellowbilled cuckoos, but in combination with all the other effects to this species mortality from collision would have an additive effect to the threats facing the western yellow-billed cuckoo.

Recovery

Reclassification Criteria:
Not availalble

Delisting Criteria:
Not availalble

Recovery Actions:
- Develop a recovery plan.

References

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SPECIES ACCOUNT: *Colinus virginianus ridgwayi* (Masked bobwhite (quail))

Species Taxonomic and Listing Information

Listing Status: Endangered, March 11, 1967 (32 FR 4001).

Physical Description

The masked bobwhite (Colinus virginianus) is a subspecies of the northern bobwhite quail (C. virginianus). The adult male masked bobwhite has a brick-red and black head and throat. Some males have a white to yellowish-white superciliary stripe, sometimes with touches of white elsewhere on the head. They have crowns mottled with black and rufous (cinnamon). The head plumage tends to become purer black with age. The back feathers are a maze of blacks, browns, rufous, and buff, somewhat similar to the back patterns of other bobwhite subspecies. The female plumage is mottled brown, buff, and white, with a buff throat and superciliary stripe very similar to females of other bobwhite subspecies; they are essentially indistinguishable from the Texas bobwhite found in subtropical Texas and Tamaulipas, Mexico (USFWS 1995; USFWS 2015).

Taxonomy

Most taxonomists recognize 21 or 22 subspecies of northern bobwhite quail, of which the masked bobwhite is a distinct subspecies. The female masked bobwhite is very similar to females of other bobwhite subspecies and is essentially indistinguishable from the Texas bobwhite found in subtropical Texas and Tamaulipas. Masked bobwhites are smaller and darker than more northern forms of the species (USFWS 2014).

Historical Range

Historic accounts and collections indicate that this subspecies was always restricted to level plains and river valleys in Sonora and extreme south-central Arizona, between 150 and 1,200 meters (492 and 3,937 feet [ft.]). The primary residence of the masked bobwhite was the grassy savanna habitats (Llanos) in Shreves' Plains of Sonora, subdivisions of the Sonoran Desert (USFWS 1995). The northern limit of the historical range is defined by the Altar and Santa Cruz valleys in Arizona (NatureServe 2015).

Current Range

The masked bobwhite is currently known to occur in Sonora, Mexico, and a small area in south-central Arizona. This subspecies was extirpated from the United States by about 1900. However, a reintroduced population now exists at the Buenos Aires National Wildlife Refuge (NWR) in southern Arizona (NatureServe 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: The masked bobwhite is a granivore and invertivore, and is considered to have a generalist feeding strategy. They eat a variety of legumes and weed seeds in fall, winter, and early spring; and plant material and insects in summer and early fall. Food resources are widespread and acquired by picking items from the substrate (NatureServe 2015). Habitat competition may exist between masked bobwhites and Gambel's quail (Callipepla gambeli) (USFWS 1995). Additionally, habitat competition is exerted from cattle grazing, which removes necessary cover, nesting habitat, and food resources from masked bobwhite habitat (NatureServe 2015). Monocultures of vegetation, even of such important food species as vine mesquite grass (Panicum obtusum) and Johnson grass (Sorghum halepense), are avoided by the masked bobwhite (USFWS 1995).

Reproduction Narrative

Adult: Masked bobwhites are oviparous, short-term brooders. Ground cover is essential to conceal the nest, and nesting may be delayed until sufficient grass or other herbaceous growth is available. Nesting success is also correlated with the amount and distribution of summer precipitation and male calling activity. Breeding season is July through September. The onset of the breeding season is heralded by the well-known "bob-white" call of the male. Calling frequency in Sonora typically reaches a maximum between August 10 and 24, after which it declines rapidly. Most nesting attempts occur on the ground and coincide with the period of peak calling activity. Northern bobwhites, in general, require 47 to 55 days to lay and incubate their first clutch, and 20 to 34 days between clutches. Clutch size is between 5 and 15 eggs. The sex ratio is 3:2 (males:females) (USFWS 2015; NatureServe 2015).

Geographic or Habitat Restraints or Barriers

Adult: The eastern and southern distribution of masked bobwhite is limited by the merging of Sonora savanna grassland and its summer-active grass-forb understories. A decrease in summer precipitation excludes masked bobwhite from the desert scrub communities of the Central Gulf Coast, Lower Colorado River, and Arizona Upland subdivisions of the Sonora Desert. At the northern limits of masked bobwhite range in the Altar and Santa Cruz valleys of Arizona, semidesert grassland replaces Sonoran savanna grassland, and the masked bobwhite is supplanted by scaled quail (Callipepla squamata) (USFWS 1995).

Spatial Arrangements of the Population

Adult: Clumped in to coveys (flocks of birds) (USFWS 1995).

Environmental Specificity

Adult: Community with key requirements common.

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: Moderate

Habitat Narrative

Adult: Habitat includes level plains and river valleys; open grasslands, semi-arid desert scrub, and desert grasslands; and weedy bottomlands, grassy and herb-strewn valleys, and forb-rich plains. Tree/shrub cover varies geographically. In Arizona, the clumped masked bobwhite coveys favor areas with relatively high vegetative structural diversity (NatureServe 2015). Survival and nesting success are believed to depend heavily on the availability of herbaceous cover. Key resources needed for habitat are 2 to 30 percent combined grass-forb cover, overstory shrub cover of 15 to 30 percent, and species diversity of ground and shrub cover. Ground cover should be at least 20 cm (8 in.) but less than 30 cm (2 ft.) (NatureServe 2015). Vegetative monocultures are generally avoided by the masked bobwhite (USFWS 1995). The eastern and southern distribution is limited by the merging of Sonora savanna grassland and its summer-active grass-forb understories. A decrease in summer precipitation excludes masked bobwhite from the desert scrub communities of the Central Gulf Coast, Lower Colorado River, and Arizona Upland subdivisions of the Sonora Desert. At the northern limits of masked bobwhite range in the Altar and Santa Cruz valleys of Arizona, semidesert grassland replaces Sonoran savanna grassland, and the masked bobwhite is supplanted by scaled quail (Callipepla squamata).

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Low

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: Home range, habitat use, and movements of reintroduced masked bobwhites were studied from 1986 through 1988 on the Buenos Aires NWR. Home ranges averaged 10.9 hectares (26.9 acres), and core areas averaged 1.1 hectares (2.7 acres). The majority of the masked bobwhites moved less than 1 kilometer (0.6 mile) between their release location and the site of first trapping. However, some long-distance movements occurred. After home ranges were established, masked bobwhite seldom left the boundaries (USFWS 1995).

Population Information and Trends

Population Trends:

Slowly declining (NatureServe 2015)

Species Trends:

Declining

Resiliency:

Low. New in 2019: Resiliency is met by increasing the number of masked bobwhite associate with each of the four populations such that masked bobwhite population numbers and productivity throughout its historical range are able to withstand effects associated with disturbances such as variations in rainfall, extreme temperature gradients, (environmental stochasticity), and random fluctuations in population (demographic stochasticity). The increase in numbers above those needed to downlist the masked bobwhite will provide greater resiliency within the overall masked bobwhite population. (USFWS, 2019).

Representation:

Low. New in 2019: Representation is met by maintaining diversity within the populations of masked bobwhite that occur within the historical range. Such a distribution allows for increased genetic diversity, but perhaps even more importantly, allows for masked bobwhite to exist across a diverse range of environmental conditions. This allows the overall population of masked bobwhite to adapt to changing conditions and provide for diverse metapopulation support that enhances the viability of the overall masked bobwhite population. (USFWS, 2019)

Redundancy:

Low. New in 2019: Redundancy is met by increasing the number of masked bobwhites in each of the four populations established under the downlisting criteria. These four population are anticipated to be distributed across the masked bobwhite's historical range in both the United States and Mexico. Because these populations are geographically independent, populations are less likely to be simultaneously affected by catastrophic events (e.g., a wildfire, hurricane, etc.). Increased size of each of these four populations enhances the redundancy of the overall masked bobwhite population. Therefore, the species is more likely to withstand these types of events. (USFWS, 2019)

Population Growth Rate:

Declining (NatureServe 2015)

Number of Populations:

Three populations exist in Sonora, Mexico; and one population exists in the U.S. on the Buenos Aires NWR (USFWS 1995).

Population Size:

There were 250 to 1,000 estimated total individuals in 2015 (NatureServe 2015). Fewer than 1,000 individuals exist in Sonora, Mexico; and 300 to 500 individuals exist in the United States on the Buenos Aires NWR (USFWS 1995).

Resistance to Disease:

Disease of masked bobwhites is not known from the wild population; but the species-to-species spread of a malaria-causing organism at the Phoenix Zoo, in particular, is of special concern (USFWS 2014).

Adaptability:

Moderate

Population Narrative:

Population level trends indicate slow decline. There are three known populations that exist in Sonora, Mexico; and one population that exists in the U.S. on the Buenos Aires NWR. There were an estimated 250 to 1,000 individuals in 2015 (NatureServe 2015). Fewer than 1,000 individuals exist in Sonora, Mexico, and 300 to 500 individuals exist in the United States on the

Buenos Aires NWR (USFWS 1995). Disease of masked bobwhites is not known from the wild population; but the species-to-species spread of a malaria-causing organism at the Phoenix Zoo, in particular, is of special concern (USFWS 2014).

Threats and Stressors

Stressor: Grazing
Exposure: Cattle ranching in masked bobwhite habitat.
Response: Intensive grazing causes removal of necessary vegetation/habitat for the masked bobwhite.
Consequence: Reduced and fragmented habitat.
Narrative: Intensive grazing from cattle ranching has diminished and fragmented available habitat for the masked bobwhite (USFWS 2014).

Stressor: Invasive grasses
Exposure: Spread of exotic grasses.
Response: Greatly reduced species richness.
Consequence: Monocultures of invasive grasses do not provide suitable habitat for the masked bobwhite.
Narrative: Pastures for livestock are typically converted to a near monoculture of buffelgrass (Pennisetum ciliare), reducing species diversity and converting once-suitable masked bobwhite habitat so that it is no longer usable by the species (USFWS 2014).

Stressor: Fire suppression
Exposure: Depletion of ground cover.
Response: Invasive woody plants become established.
Consequence: Degrades masked bobwhite habitat.
Narrative: Fire suppression and depletion of ground cover due to grazing prevents fires that kill off invading woody plants. This in turn degrades habitat for masked bobwhites (NatureServe 2015).

Stressor: Predation
Exposure: The Buenos Aires NWR has a very high density of predators (USFWS 2014).
Response: Most deaths of adult masked bobwhites have been attributed to raptors.
Consequence: Diminished population size.
Narrative: The Buenos Aires NWR is known to have a very high density of predators. Raptor predation on the refuge has been a significant contribution to masked bobwhite deaths (USFWS 2014).

Recovery

Reclassification Criteria:
Four separate, viable populations are established and have been maintained for 10 consecutive years (USFWS 1995).

Delisting Criteria:
Delisting criteria were drafted in 2019, as follows: 1. Four populations are maintained at an average of 1,000 individual masked bobwhite per population over an additional 10-year period

following downlisting. This criterion can be met by any combination of four wild populations in the United States or Mexico. (USFWS, 2019).

2. Each of the four populations described in the downlisting criteria and in Criterion 1 above has approximately 2,000 acres of habitat to support the 1,000 masked bobwhite needed to satisfy Criterion 1 above (from USFWS, 2019). The habitat in all four populations should be protected through such actions as acquisition, easements, management agreements, or similar types of land protection instruments. Management and protection of these habitats must be assured in perpetuity. (USFWS, 2019).

Recovery Actions:

- Establish and maintain at least two captive populations (USFWS 1995).
- Establish two separate viable masked bobwhite populations in Arizona (USFWS 2014).
- Maintain existing masked bobwhite populations in Sonora, Mexico, and reestablish two or more viable populations in Mexico (USFWS 1995).
- Coordinate with Mexico in developing information and education programs designed to gain public support for the protection and restoration of the masked bobwhite (USFWS 1995).

Conservation Measures and Best Management Practices:

- Develop data management systems for captive population genetics (USFWS 2014).
- Existing habitat within the Mexican historical range should be mapped (USFWS 2014).
- Potential bobwhite release sites should be evaluated and prioritized (USFWS 2014).
- Habitat improvements should be implemented in both the United States and in Mexico (USFWS 2014).
- Habitat management actions that would assist bobwhites in avoiding predators should be implemented (USFWS 2014).
- Partnerships with landowners in the U.S. and Mexico should be developed to protect and improve habitat (USFWS 2014).
- Develop and implement a comprehensive strategy to actively pursue funding for recovery actions (USFWS 2014).

Additional Threshold Information:

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SPECIES ACCOUNT: *Columba (=Patagioenas) inornata wetmorei* (Puerto Rican plain pigeon (=Patagioenas))

Species Taxonomic and Listing Information

Listing Status: Endangered; October 13, 1970; Southeast region (R4)

Physical Description

The Puerto Rican plain pigeon is a large bird (15 inches) about the size and shape of a domestic pigeon (Columba livia), but with an overall grayish-brown coloration washed with a tinge of maroon color. The legs and feet are dark red.

Taxonomy

On the basis of studies by Johnson and Clayton (2000) and Johnson et al. (2001) of nuclear and mtDNA and reviews of morphological (Ridgway 1916), serological (Cumley and Irwin 1944), and behavioral (Johnston 1962) characters, New World pigeons formerly included in the genus Columba were placed in the genus Patagioenas Reichenbach, 1853 (Banks et al. 2003, p. 69 and 73). Therefore, while listed as Columba inornata wetmorei, taxonomic research has revealed that the Puerto Rican plain pigeon be recognized as Patagioenas inornata wetmorei. This taxonomic change has been accepted by the scientific community (Integrated Taxonomic Information System 2011). It is one of three subspecies of plain pigeon recognized in the West Indies: P. inornata inornata from Cuba, Isle of Youth (Isle of Pines), and Hispaniola; P. inornata exigua from Jamaica; and P. inornata wetmorei from Puerto Rico (Bowdish 1903, p. 23; Wetmore 1927, p. 392-394; Danforth 1929, p. 365; Del Hoyo et al. 1996, p. 127-128).

Historical Range

Gundlach (1878) found the plain pigeon to be common in Puerto Rico and reported it from Lares, Utuado and in the mountains of eastern Puerto Rico. Wetmore (1922) found C. inornanta well represented in cave deposits near Morovis and Utuado. Plain pigeon bones were also found in kitchen middens near Ponce on the south coast of Puerto Rico (Wetmore 1938).

Current Range

From the rediscovery of the plain pigeon in 1963 until the late 1980s, the only confirmed populations of Puerto Rican plain pigeons occurred in the municipality of Cidra, and parts of the surrounding municipalities of Aguas Buenas, Aibonito, Caguas, Cayey, and Comerío in east-central Puerto Rico (Pérez-Rivera and Collazo-Algarín 1976a, p. 52; Ruiz-Lebrón 1994, p. 6). However, additional sightings of the species have been recorded in other municipalities; such as Aguadilla, Cabo Rojo, Camuy, Guayama, Luquillo, Mayagüez, Corozal, Morovis, Orocovis, Ponce, Utuado, Vega Alta, and Vieques (Pérez-Rivera and Collazo-Algarín 1976a, p. 53; PRDNER 1999, p. 3; Rivera-Milán 2011, p. 3).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Plain pigeons frequent dairy farms and croplands where they supplement their diet with grass seeds and grains leftover from farming activities (Pérez-Rivera and Collazo-Algarín 1976a, p. 54). The plain pigeon feeds on a wide variety of plants; the principal foods at Cidra are royal palm (Roystonea borinquena), mountain immortelle (Erythrina poeppigiana), West Indies trema (Trema lamarckiana), and white prickle (Zanthoxylum martinicense).

Reproduction Narrative

Egg: The minimum incubation period observed in 14 days.

Juvenile: The mean fledging period at 8 nests was 23 days (range 22 to 24 days). Chicks are dependent on the adults for several days after fledging.

Adult: Both sexes participate in nest building which averages 7 days. The plain pigeon lays one egg and is multibrooded. Up to three broods have been produce by a pair in one year.Between 1986 and 1999, 377 plain pigeon nests were monitored in east-central Puerto Rico (i.e., Aguas Buenas, Caguas, Cayey, Cidra and Comerio) and an average of 0.5 fledglings were produced per nesting pair (Rivera-Milán et al. 2003b, p 473). The plain pigeon appears to nest year-round (Pérez-Rivera 1978, p. 95). However, a peak of nest density usually occurs between the second week of April and second week 7 of June, with flocking behavior becoming conspicuous in July-August (Rivera-Milán 2001, p. 335, Rivera-Milán et al. 2003b, p. 471-476). For breeding and roosting, the species seems to prefer areas of secondary mature forest, usually in close proximity to creeks or rivers. In fact, sites selected for nesting are always characterized by the presence of dense vegetation and proximity to water (Pérez-Rivera 1978, p. 90). These vegetation associations are common in the lower montane regions of Puerto Rico. Bamboo (Bambusa vulgaris) and hardwood canyon habitats are used for nesting. Nests are constructed on the branches that radiate from a node of a bamboo (Bambusa vulgaris) stem, or in a cradle of vines which intertwine with the outer branches of the nest tree, or a crotch in a branch (Pérez-Rivera 1978, p. 91). The plain pigeon has not been observed nesting outside east-central Puerto Rico (Pérez-Rivera and Collazo-Algarín 1976a, p. 53-54; Rivera-Milán 2001, p. 339).

Environmental Specificity

Adult: Broad

Habitat Narrative

Adult: Plain pigeons are habitat generalists that behave as an edge species, nesting, foraging, and roosting in trees at or near roads (Rivera-Milán et al. 2003a, p. 49). It also may be found in areas of continuous secondary growth forest (e.g., gallery forests) or flying through farmlands and urban areas when traveling to feeding or roosting sites (Ruiz-Lebrón et al. 1995, p. 6; Rivera-Milán et al. 2003a, p. 48-49). Lago de Cidra is located 16 km south of Caguas in the lower montane rainforest zone. Other habitat types used include lowland swamp, lowland woodland, open woodland, cultivated land in mountains, limestone karst forest, and coffee plantations.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements
Adult: Non-migratory

Dispersal
Adult: Moderate

Dispersal/Migration Narrative
Adult: The plain pigeon is sedentary (Wetmore 1938).

Population Information and Trends

Population Trends:
Stable

Resiliency:
Moderate

Representation:
Low

Redundancy:
Moderate

Population Size:
6,749 Since 2011, the PLPI population in east-central Puerto Rico was estimated between 5,578 individuals in 2011 and 4,257 individuals in 2017, with a notable decline to 660 individuals in 2018 after Hurricane María. (USFWS, 2019).

Additional Population-level Information:
The PLPI density and population size fluctuated between 0.051 individuals/hectare (ind/ha) (5,578 individuals) in 2011, and 0.039 ind/ha (4,257 individuals) in 2017 (Table 1). A survey conducted during April-June 2018, after Hurricane María, showed that the PLPI density and population size declined to 0.006 ind/ha and 660 individuals, respectively. This decline represents more than 85 percent reduction of the species in the east-central region of Puerto Rico (Rivera-Milán, Service, 2018b, pers. comm.). According to Rivera-Milán (Service, 2018b, pers. comm.), this is the lowest abundance estimate since monitoring of the species began in 1986. The eastcentral region was surveyed again in August 2018, and according to this data and that of April-June 2018, little reproduction occurred after the hurricane, and, therefore, the population probably continued declining (Rivera-Milán, Service, 2018b, pers. comm.). (USFWS, 2019).

Population Narrative:
The status of this species is stable. The Puerto Rican plain pigeon was considered almost extinct in the 1930s (Danforth 1931, p. 68), but in 1963 a small population of 52 individuals was found in Cidra. The plain pigeon population declined after 1998 and is currently at low numbers (Rivera-Milán 2011, p. 5). In 2010, the estimated density and population size of the species was

0.02 individuals/hectare (ind/ha) and 5,809 individuals, respectively (Rivera-Milán 2011, p. 1). During April-June 2011, the predicted density is 0.02 ind/ha, and predicted population size is 6,749 individuals (Rivera-Milán 2011, p. 1). Miyamoto et al. (1994, p. 911) studied the genetic variation among 20 surviving founders (9 males and 11 females) of the plain pigeon captive breeding program held at the University of Puerto Rico, Humacao Campus. The results indicated that the 20 founders of the recovery program were characterized by low levels of genetic variability (Miyamoto et al. 1994, p. 914).

Threats and Stressors

Stressor: Habitat destruction and modification
Exposure:
Response:
Consequence:
Narrative: The massive deforestation in Puerto Rico in the early part of the twentieth century probably caused the decline of the plain pigeon. Extensive clearing of forests began early in the nineteenth century (Capó 1925, p. 48), and by 1828 about one-third of the island had been cleared for agriculture (USFWS 1982). The recent rapid development (urbanization and industrialization) of Cidra (Pérez-Rivera 1978, p. 96) and the surrounding municipalities within the last 15 years is the most serious threat to the species' survival. These habitat modification processes have caused the fragmentation of remaining potential habitat for the plain pigeon, and apparently have been the cause of movement of plain pigeons outside their traditional range (Pérez-Rivera 1990, p. 24; Rivera-Milán 1996, p. 100 and 105; PRDNER 2000, p. 17; Rivera-Milán et al. 2003b, p 467 and 477). New in 2019: Although the forest cover on the Island has increased during the past decades, reaching 54.8 percent in 2014 (Marcano-Vega 2017), the PLPI appears to have been affected by previous deforestation and habitat fragmentation. In fact, a recent study found that between 2000-2010, while human population declined around protected areas in Puerto Rico, the number of houses continued to increase (Catro-Prieto et al. 2017). This finding highlights that despite the existence of regulatory mechanisms habitat modification through small-scale development continues to pose a threat to the PLPI habitat. (USFWS, 2019).

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Rat predation is probably a secondary effect of human disturbance (e.g., rats may destroy the egg or chick after the adult has been flushed from the nest), at least in some cases (Pérez-Rivera, pers. comm. 2001). Red-tailed hawks prey upon adult and juvenile plain pigeons, while red-legged thrushes (Turdus plumbeus), pearly-eyed thrashers, night herons (Nyctanassa violacea and Nycticorax nycticorax), green herons (Butorides virescens), cats (Felis domesticus), and rats prey on eggs and young chicks (Pérez-Rivera 1978, p. 92; Ruiz-Lebrón et al. 1995, p. 6; PRDNER 1999, p. 7; PRDNER 2000, p. 19; Rivera-Milán et al. 2003b, p. 475,). Green herons also have been observed displacing plain pigeons from their nests (PRDNER 1999, p. 7). Rivera-Milán et al. (2003b, p. 476) found that predator density had a significant negative relationship with nesting success and number of fledglings produced by plain pigeons.

Stressor: Parasitism
Exposure:

Response:
Consequence:
Narrative: Pérez-Rivera and Collazo-Algarín (1976b, p. 51) reported parasitism by the warble fly (Philornis pici). Fifteen out of 36 captive-raised plain pigeon nestlings (42%) examined by Pérez-Rivera and Ruiz-Lebrón were infected with Philornis larvae (Pérez-Rivera, pers. comm. 1999). One nestling infected with 12 warble fly larvae died apparently from the effects of these parasites. Although infestations from internal parasites, such as the trematode Tanaisia bragai, were documented only in captive birds (Arnizaut et. al. 1991, p. 203), such events may occur in wild plain pigeons. However, the effect of this trematode on the plain pigeon population is unknown.

Stressor: Adverse weather
Exposure:
Response:
Consequence:
Narrative: Severe storms and hurricanes are potential threats to the plain pigeon population. Hurricanes may destroy nesting areas and strip trees of the fruits and seeds upon which plain pigeons feed, potentially causing starvation of adult and young pigeons (Pérez-Rivera 1990, p., 24; PRDNER 2000, p. 22; Rivera-Milán et al. 2003b, p. 477). Plain pigeons, however, have shown resilience through successful reproduction in response to forest regeneration and increased food availability after a hurricane (Rivera-Milán et al. 2003a, p. 48). Impacts from Hurricane María exacerbated the human-induced habitat modification by causing extensive damage on the cover forest of Puerto Rico (Feng et al. 2018, Hu and Smith 2018). An initial impact estimate indicated that Hurricane María may have cause mortality and severe damage to 23-31 million trees across the Island (Feng et al. 2018). (USFWS, 2019).

Stressor: Hunting
Exposure:
Response:
Consequence:
Narrative: Unintentional killing of plain pigeons may occur while legally hunting other columbid species. The plain pigeon is similar in size and shape to the legally hunted scaly-naped pigeon, thus plain pigeons could be mistakenly shot. Wetmore (1916, p. 55) stated that, because sportsmen were familiar with the plain pigeon, the species was no doubt shot in the early 1900s. Wetmore (1938, p. 52) reported plain pigeon bones collected by Dr. 15 Froelich G. Rainey from an extensive midden deposit in the municipality of Ponce; which may suggest that this species was hunted and consumed regularly. The plain pigeon displays exceptional tameness around humans, and besides being unwary, it flocks seasonally for roosting and feeding and sometimes nests in loose colonies (i.e., nesting pairs not necessarily close to one another) close to urban areas (Ruiz-Lebrón, Environmental Consultant, pers. comm., 2001). These behaviors may increase the ease of poaching the species. Plain pigeons have been observed eating livestock feed (Pérez-Rivera and Collazo-Algarín 1976a, p.54; Wiley, unpubl. data). Feeding of plain pigeons on crops, as reported by Cidra residents, may have also led to hunting of pigeons because they may have been perceived as competitors, pests (i.e., damaging crops), or easy targets attracted to feeding on crop fields. Records of poaching or unintentional killing of plain pigeons, however, are scant (Wetmore 1916, p. 300-303; Pérez-Rivera et al. 1994, p.7; PRDNER 2000, p. 18). New in 2019: Rivera-Milán et al. (2016) suggested that an increase in illegal hunting of the PLPI might be responsible for some of its abundance decline during 2008-2014, and projected that population sustainability of this species might be affected by illegal hunting in 2015-2025. Therefore, these

authors recommended the collection of illegal hunting data, and the control of illegal hunting as a management priority. (USFWS, 2019).

Recovery

Delisting Criteria:

1. Achieve a minimum of two, distinct, wild plain pigeon populations, each consisting of at least 250 nesting pairs (5-year average).

2. Secure most of the existing plain pigeon habitat of the Cidra-Cayey population.

3. Commit the Río Abajo Commonwealth Forest or its equivalent as a reintroduction and management site for a second, disjoint population of plain pigeons.

Recovery Actions:

- 1. Increase net recruitment of Cidra plain pigeon population until population reaches target level.
- 2. Once target population is reached maintain population at this level by maintaining habitat quality and quantity, and by controlling enemies.
- 3. If wild population is decimated by predation, disease, or natural catastrophe, re-establish population at Cidra with captive-bred stock.
- 4. Evaluate and secure adequate site(s) for release.
- 5. Establish captive reproducing flock.
- 6. Establish functional aviary at re-introduction site(s).
- 7. Implement release program until target population is reached.
- 8. Determine feasibility of relocating birds from Cidra stock to new site(s).
- 9. Maintain population at target level by maintaining habitat quality and quantity, and maintaining predator control.
- 10. Establish a system of census stations and lookouts in known range and release site(s).
- 11. Conduct regular simultaneous counts from census stations.

Conservation Measures and Best Management Practices:

- 1. Revise the Recovery Plan for the Puerto Rican Plain Pigeon
- 2. Roost surveys conducted after the listing of the plain pigeon were poorly standardized and variable, making population trend monitoring unreliable. Point and line transect surveys serve as tools to estimate the plain pigeon population density. Therefore, the existing surveillance monitoring program should continue and be refined for management purposes (Rivera-Milán 2011, p. 6). In addition, a well-designed method to census the roosting sites should be implemented to complement the existing line transect surveys.
- 3. Groups of free ranging plain pigeons as well as fledglings should be fitted with radio transmitters and unique color leg band combinations to determine population movement patterns, habitat use, distribution, dispersal, and survival. (USFWS, 2011). As of 2019, it was recommended this be done by satellite telemetry. (USFWS, 2019)
- 4. Incorporate GIS and remote sensing technologies to refine occupancy and abundance maps, and to identify potential areas to conduct management experiments, including habitat restoration efforts and experimental releases of plain pigeon flocks (cohorts) to increase the chances of survival

and nesting outside the traditional center of abundance in east-central Puerto Rico (Rivera-Milán 2011, p. 6).

- 5. Incorporate existing private landowners programs (e.g., cooperative agreements, conservation plans, conservation easements, habitat mitigation banks, and economic incentives) to promote restoration, management, and conservation of private lands to help on the recovery of the plain pigeon. (USFWS, 2011). This continues to be a recommended action in 2019. (USFWS, 2019).
- 6. Determine the effect of known predators (particularly red-tailed hawks), inter-specific competition with the scaly-naped pigeon, and parasites on the plain pigeon to develop management strategies to control possible adverse effects of these potential threats.
- 7. Contacts should be established with the media (television, radio, and newspaper) to assist in the preparation and dissemination of information on plain pigeon conservation issues. Traditional methods to disseminate information such as mass mailings and newspaper display ads should be explored as possible tools at key junctures to implement outreach plans.
- 8. Revise the current listing to reflect the taxonomic name change.
- (9) Existing regulations: Commonwealth Law No. 241 and Regulation 6766 (USFWS, 2019).
- (10) 2019 Recommended future action: Continue population monitoring and update modeling to assess population state post-Hurricane María. (USFWS, 2019).
- (11) 2019 Recommended future action: Conduct management actions to enhance reproductive success, which is a key demographic parameter for pigeons due to life-history traits (e.g. multiple brooding and extended nesting). (USFWS, 2019).
- (12) 2019 Recommended future action: Continue nest predator control at nesting sites in east-central Puerto Rico. (USFWS, 2019).
- (13) 2019 Recommended future action: Conduct a study to gather data on illegal hunting in Puerto Rico to determine its effects on the PLPI and minimize illegal hunting through hunter education and law enforcement in east-central Puerto Rico. (USFWS, 2019).
- (14) 2019 Recommended future action: Work with State partners and universities to gather potential data on illegal hunting and work to improve education to the local community about this unique listed species. (USFWS, 2019).
- (15) 2019 Recommended future action: Generate density gradient map and update GAP map, correcting count data for detection probability. (USFWS, 2019).
- (16) 2019 Recommended future action: Conduct a structured decision making workshop to determine management options, including captive breeding for the species. (USFWS, 2019).
- (17) 2019 Recommended future action: Relate post-hurricane PLPI survey data to the model developed by Vilella and Weitzel (2018) to determine the effect of the habitat impacted by the hurricane on the species. (USFWS, 2019).
- (18) 2019 Recommended future action: Estimate juvenile and adult survival to help develop management strategies for the species. (USFWS, 2019).

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SPECIES ACCOUNT: *Corvus hawaiiensis* (Hawaiian (='alala) Crow)

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The ʻAlala is a large black crow or small raven (48 centimeters (cm) long, 520 grams (g)) with a heavy bill. Males and females are similar, although males are larger and heavier than females (Banko et al. 2002, Wildlife Rehabber 2015). Juveniles resemble adults, but may appear "fluffy" and retain a bright red mouth lining for about 18 months after hatching. Like many crows, the ʻAlala is raucous and gregarious. Vocalizations are extremely varied, including loud, humanlike shrieks and howls and softer growls and mutterings (Banko et al. 2002). Based on subfossils, at least five crow species occurred in Hawaiʻi; all likely descended from a raven-like ancestor (James and Olson 1991).

Historical Range

See current range/distribution.

Current Range

Historically, the ʻAlala was only known from Hawaiʻi Island, but subfossils indicate it or a closely related species occurred on Maui (Banko 2009). On Hawaiʻi, it was restricted to a mid-elevation (300 to 2,500 m elevation) belt on the slopes of the Hualalai and Mauna Loa volcanoes (Perkins 1903, Munro 1944, Banko and Banko 1980). Historical distribution records should be regarded as an ongoing progression of range contraction and fragmentation. Similarly, documented habitat use may not reflect the full range of habitats historically used by ʻAlala.

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: In the wild, ʻAlala feed on fruits, invertebrates gleaned from tree bark and other substrates, and eggs and nestlings of other forest birds. Nectar, flowers, and carrion were minor diet components. A strong association was noted with ʻieʻie (Freycinetia arborea) vines (Banko 2009), which formerly blanketed extensive tracts of mid-elevation mesic and wet forest (Menzies 1920). This plant has edible flowering bracts and fruit, and was a prominent item in the ʻAlala diet. This close association with forested habitats and reliance on fruit as a primary component of its diet are among the factors that sets ʻAlala apart from their continental relatives (USFWS, 2016). Omnivore, especially fond of fruits such as those of ieie (Pratt et al. 1987). Fruits constitute 1/3 to 1/2 of adult diet; fruits taken primarily from small trees and shrubs of understory and mid-canopy. Nestling are fed diet similar to that of adults, including various fruits (especially of CHEIRODENDRON TRIGYNUM and CLERMONTIA spp.), passerine nestlings, and arthropods (Sakai and Carpenter 1990). Other food items include lizards, mice, and nectar.; Food Habits: Frugivore (Adult, Immature) (NatureServe, 2015)

Reproduction Narrative

Adult: In the wild, nest construction usually began in March and first clutches were laid in April. Nests were generally built in ʻohiʻa, although other trees and ʻieʻie vines also were used (Tomich 1971). All known nests were documented between 1,000 and 1,800 meters (m) elevation, although the ʻAlala historically nested at lower elevations (Munro 1944). In the wild, females laid from two to five (usually three) eggs per clutch and raised one brood of one or two chicks per year (Banko et al. 2002). Information about the age at first reproduction is based on small sample sizes but is thought to be two years in females and two to four years in males (Banko et al. 2002); in captivity, males 18 months old have copulated (Service 2009). The ʻAlala is monogamous and often form long-term pair bonds, although extra-pair copulations have been observed. In the wild, nesting territory size probably varied with resource and population density; the shortest distance between active nests observed in recent times was 300 m. The median home range was 480 hectares (ha) (range 59 to 1,456 ha; n = 20; Service 1999). After the breeding season, ʻAlala often disappeared for extended periods, and their actual home ranges probably were larger than documented. When the species was more abundant, flocks moved seasonally in response to weather and fruit (Munro 1944). Flocking behavior has not been well studied due to low population densities in recent decades (Service 2009). ʻAlala are known to live up to 18 years in the wild and 25 years in captivity (Banko et al. 2002). The annual survival rate of wild adult ʻAlala was estimated to be 81% (NRC 1992). This estimate was documented during a period of population decline, and survival presumably was historically higher when populations were more stable.

Habitat Narrative

Adult: The ʻAlala was naturally found in dry woodlands and mesic ʻohiʻa (Metrosideros polymorpha) and ʻohiʻa-koa (Acacia koa) forests (Banko et al. 2002), with a closed to moderately open canopy and an abundance of fruit-bearing understory vegetation. Between 1970 and 1982, the habitat with the highest breeding densities was relatively undisturbed ʻohiʻa-koa forest; ʻAlala avoided disturbed forest (Giffin et al. 1987). A dense understory may have allowed ʻAlala to escape predation by the ʻIo or Hawaiian Hawk (Buteo solitaries) (Service

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal/Migration Narrative

Adult: Spends spring and summer at higher elevations than in fall and winter (Giffin 1987). (NatureServe, 2015). In the wild, nesting territory size probably varied with resource and population density; the shortest distance between active nests observed in recent times was 300 m. The median home range was 480 hectares (ha) (range 59 to 1,456 ha; n = 20; Service 1999). After the breeding season, ʻAlala often disappeared for extended periods, and their actual home ranges probably were larger than documented. When the species was more abundant, flocks moved seasonally in response to weather and fruit (Munro 1944). Flocking behavior has not been well studied due to low population densities in recent decades (Service 2009).

Population Information and Trends

Population Trends:

Extinct in wild

Number of Populations:

0 (zero) (NatureServe, 2015)

Population Size:

1 - 50 individuals (NatureServe, 2015). As of 2015, The last observation of alala in the wild was in 2002 (USFWS 2009b). Since then there have been reported sightings of alala, however, none have been confirmed. There are 115 alala in captivity: 74 at the Keauhou Bird Conservation Center, Hawaii; 40 at the Maui Bird Conservation Center, Hawaii; and one bird at the San Diego Safari Park (not on display), California. (USFWS, 2015).

Population Narrative:

Formerly abundant in the Kona region; numbers declined from 100s in the 1960s to 2 birds in 2002. Now none remain in the wild. Fledglings have not been produced in the wild since 1992, and eggs have not been produced since 1996, despite annual nesting activity. Productivity within the captive flock (35 birds in captivity in 2002, not including hatch-year young) has been relatively low and unreliable since 1973 when these birds were first captured for propagation. Birds released to the wild from 1993 to 1996 died or were recaptured, and none reproduced. Decline of >90% As of early 2006, a few dozen were in captivity and none remained in the wild. From Banko et al. (2002): In 2002, the last wild individuals, a single pair, occupied less than 20 square kilometers of habitat on the western slope of Mauna Loa. Fledglings had not been produced in the wild since 1992, and eggs had not been produced since 1996, despite annual nesting activity. Productivity within the captive flock (35 birds in captivity in 2002, not including hatch-year young) had been relatively low and unreliable since 1973 when these birds were first captured for propagation. Birds released to the wild from 1993 to 1996 died or were recaptured, and none reproduced. The species formerly was abundant in the Kona region; numbers declined from 100s in the 1960s to 76 in 1978 to perhaps 10 in 1986; only 2 were located in the wild in 1987; in 1989, there was one known breeding pair in the wild and 5 breeding pairs in captivity (Sakai and Carpenter 1990); total of 9 in the wild in early 1990, and 11 in captivity, with two functional breeding pairs (USFWS 1990); 11 adults and 1 nestling in the wild, including 3-5 breeding territories, reported in 1992 (Science News, Vol. 141, p. 426, National Research Council 1992). As of late 1993, total population was 31, including those in captive flock and only a few wild pairs. In the mid-1990s, total wild population was less than 50 individuals. Recently, the entire wild population was restricted to one locality on one island. Now (early 2006) none remain in the wild. (NatureServe, 2015). The ‘Alala is listed as “Extinct in the Wild” by the IUCN and was listed as endangered under the Endangered Species Preservation Act on March 11, 1967 (35 FR 4001).

Threats and Stressors

Stressor: Habitat destruction
Exposure:
Response:
Consequence:

Narrative: Prior to the arrival of humans, the Hawaiian archipelago supported a remarkable avifauna comprised of at least 107 endemic species, including flightless geese, ibis, and rails and a radiation of at least 59 species in the subfamily Drepanidinae (Olson and James 1991, James and Olson 1991, James 2004). In the years since human colonization, 67 bird species have been confirmed lost, 46 prior to the arrival of Europeans and 23 since 1778 (Olson and James 1991, James and Olson 1991, Pyle 1997, Banko et al. 2001). Of the 42 extant endemic taxa, 31 are federally listed (29 species and 2 sub-species). Ten of these taxa have not been observed in as many as 40 years and their status is unknown (Service 2006). Habitat destruction, non-native diseases and predators, and habitat degradation by introduced ungulates and invasive plants are the main threats now facing Hawaii's remaining endemic birds (van Riper and Scott 2001, Service 2006).

Stressor: Non-native diseases
Exposure:
Response:
Consequence:
Narrative:

Stressor: Non-native predators
Exposure:
Response:
Consequence:
Narrative:

Stressor: Invasive plants
Exposure:
Response:
Consequence:
Narrative:

Stressor: Climate change destruction or degradation of habitat (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Climate change destruction or degradation of habitat – According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. In Hawaii, the threshold temperature for transmission of avian malaria has been estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak P. relictum prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Benning et al. 2002). Benning et al. (2002) used GIS simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by some climate models (e.g., IPCC 2013; ICAP 2010), would result in 100 years in a nearly 100 percent decrease in the land area where malaria transmission currently is only periodic. (USFWS, 2015)

Recovery

Conservation Measures and Best Management Practices:

- The ʻAlala has been legally protected by the State of Hawaiʻi since 1931 and was recognized as federally endangered in 1967. The first recovery plan for the ʻAlala was published in 1982 (Service 1982) and in 1991, the Service commissioned the National Research Council of the National Academy of Sciences to review the status of the ʻAlala and to recommend recovery actions. A report was published in 1992 (NRC 1992) and from this the Service developed a long-term management plan (Service 1993). The ʻAlala Recovery Team was formed in 1992 to provide recommendations, and a related group, the ʻAlala Partnership, was formed to facilitate implementation of conservation actions on private lands. A revised recovery plan was completed in 2009 (Service 2009). Beginning in 1958, due to concern over the rapid decline of the ʻAlala in the wild, the State of Hawai'i began retaining sick or injured ʻAlala for rehabilitation and between 1970 and 1981, 12 ʻAlala were brought into captivity. In 1993, The Peregrine Fund (TPF) assumed management of the ʻAlala program. A new captive propagation facility dedicated to the ʻAlala and other endangered Hawaiian forest birds was completed on Hawaiʻi Island in 1996 (KBCC 1996). In 1996, TPF assumed operations of the Olinda Endangered Species Propagation Facility from the State and renamed it the MBCC. The SDZ took over operation of both the KBCC and the MBCC in 2000, and titled the combined program the HEBCP. Fledgling production was low between 1993 and 2008, averaging six individuals annually, but has increased over the last several years (2008-2014) and annual production of between 15 and 20 fledgling ʻAlala now appears sustainable. In the 1990s, captive ʻAlala were released to bolster the declining wild population. Between 1993 and 1998, TPF, with support from the Service and the U.S. Geologic Survey (USGS), released 27 juveniles into suboptimal habitat that supported the remaining wild population consisting of 11 adults and a juvenile. Unfortunately, the wild population declined throughout the release period. Habitat management was not implemented prior to or during the releases, but predators were controlled. Intensive field studies were conducted between 1992 and 2002. Twenty-one of the captive birds subsequently died from a variety of causes, although some lived for four years in the wild. ʻIo predation was suspected in the loss of seven birds, and five birds died from toxoplasmosis. The remaining six birds were recaptured in 1998 and 1999 and re-integrated back into the captive flock (Work et al. 2000, Service 2009). In 1984, DOFAW created the 1,541 ha Puʻu Waʻawaʻa Forest Bird Sanctuary on the northern slope of Hualalai for the protection of native birds including the ʻAlala. In 1997, the Service purchased the 2,145 ha Kona Forest Unit of Hakalau Forest National Wildlife Refuge (NWR) on the western slope of Mauna Loa primarily for ʻAlala. Legal disputes with the former landowners impeded management for years, but fencing was completed in 2012. In 1999, a draft Environmental Assessment was prepared evaluating five potential ʻAlala release sites (Service 1999). In 2007, a vegetation assessment of six potential release sites was conducted (Jacobi and Price 2007) and the ʻAlala Recovery Team ranked these sites. The Kulani-Keauhou area was ranked as the best site and the southwestern Kaʻu Forest Reserve ranked second. Parts of the Kulani-Keauhou area have been fenced and ungulate-free for 20 years, which has resulted in significant habitat recovery. Other sites evaluated included the Kona Forest Unit of the Hakalau Forest NWR, the TNC's Kona Hema Preserve, central Kaʻu Forest Reserve, and the Kapapala Forest Reserve. Restoration of habitat at Kulani-Keauhou, and Kona Hema is ongoing. In 2012, an Environmental Assessment was completed for fencing, ungulate control, and other management actions in the Kaʻu Forest Reserve (State of Hawai'i 2012) and fencing is underway. In 2010, an ʻAlala Restoration Working Group was formed to plan for the re-establishment of a wild population; members included the Service, DOFAW, SDZ, and the TMA. The Kulani-Keauhou area was selected as the site for the initial releases. The Kaʻu Forest Reserve was selected as a site for future releases once the habitat has been restored. A release plan was completed in 2013, although plans are on hold until funding is secured. An ‘Alala Outreach program was initiated in 2010 to facilitate public support for the release of captive birds and for management in the Ka‘u Forest Reserve. Lack of community support was a major obstacle to past recovery efforts for ‘Alala.

- New as of 2015 5-Year Review (1): Reintroduction / translocation – The Alala Working Group began meeting in 2011 to plan alala reintroduction at Puu Makaala NAR. (USFWS, 2015).
- (2) New as of 2015: Surveys / inventories – Conduct searches for alala in areas where there have been credible sightings. (USFWS, 2015).
- (3) New as of 2015: Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. We encourage continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds. (USFWS, 2015)
- (4) New as of 2015: Habitat and natural process management and restoration – o We recommend continued habitat management including fencing and ungulate removal to support native forest regeneration in areas suitable for reintroduction (USFWS 2009b). o Hawaiian forest birds susceptible to avian disease may become extinct following a drastic reduction in disease-free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Acquisition and management of transmission-free high-elevation habitat is crucial to the preservation and restoration of some native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, we recommend securing deforested and pasture lands on Hawaii at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for alala and other Hawaiian forest birds. (USFWS, 2015).
- (5) New as of 2015: Predator / herbivore monitoring and control – Implement mammalian predator control efforts in native forest areas suitable for reintroduction to minimize predation and disease risk (particularly Toxoplasmosis (Toxoplasma gondii), which is carried by small mammals and known to kill captive-released alala (Work et al. 2000). (USFWS, 2015).
- (6) New as of 2015: Captive propagation for reintroduction and genetic storage – Continue captive propagation and initiate reintroduction program. (USFWS, 2015).

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SPECIES ACCOUNT: *Corvus kubaryi* (Mariana (=aga) Crow)

Species Taxonomic and Listing Information

Listing Status: Endangered; 08/27/1984; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Mariana crow is the only member of the genus Corvus occurring in Micronesia (Jenkins 1983, p. 25).

Taxonomy

The Mariana crow is the only member of the genus Corvus occurring in Micronesia (Jenkins 1983, p. 25).

Historical Range

See Current Range/Distribution

Current Range

This species is known historically only from the islands of Rota and Guam, but is now extirpated from Guam. Preliminary genetic studies indicate that the Rota population is most likely a genetic subset of the Guam population (Tarr and Fleischer 1999, p. 946).

Critical Habitat Designated

Yes; 10/28/2004.

Legal Description

On October 28, 2004, the U.S. Fish and Wildlife Service (Service) designated critical habitat for the Mariana crow (Corvus kubaryi) pursuant to the Endangered Species Act, as amended (Act or ESA) (69 FR 62944 - 62990). For the Mariana crow, approximately 376 ac (152 ha) was designated on the island of Guam and approximately 6,033 ac (2,442 ha) on the island of Rota in the Commonwealth of the Northern Mariana Islands (CNMI). On Guam, the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher critical habitat unit boundaries are identical. On Rota, critical habitat is designated only for the Mariana crow. Approximately 6,409 ac (2,594 ha) are designated on Guam and Rota.

Critical Habitat Designation

Lands designated as critical habitat for the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher all occur in one unit on Guam. Lands designated as critical habitat for the Mariana crow occur in one unit on Rota.

Unit A: Guam - Unit A consists of approximately 376 ac (152 ha) of land in the fee simple portion of the Guam National Wildlife Refuge. Unit A includes limestone, secondary, and coastal forests composed of native and nonnative plants and contains the full range of primary constituent elements needed for longterm conservation of the Mariana crow on Guam. This area includes lands in the 1994 historical distribution of Mariana crows in northern Guam (Wiles et al. 1995) and areas that contained crows in northern Guam in 1981 (Engbring and Ramsey 1984). Unit A was also identified by our Mariana crow recovery team as important recovery habitat in the draft revised Mariana crow recovery plan (USFWS in prep.). Excluded from designation (see

‘‘Exclusions from Critical Habitat’’) are 10,838 ac (4,386 ha) of Air Force lands, 7,977 ac (3,228 ha) of Navy lands, 2,768 ac (1,121 ha) of Government of Guam lands, and 1,941 ac (785 ha) of private lands in northern and southern Guam that were proposed as critical habitat in the October 15, 2002, proposed rule (67 FR 63738), leaving a final designation of 376 ac (152 ha). Although Air Force, Navy, Government of Guam, and private lands are excluded from final critical habitat designation, they still contribute to the conservation of the Mariana crow.

Unit B: Rota - Unit B consists of approximately 6,033 ac (2,442 ha) of forested land encompassing much of the undeveloped areas on Rota. This area contains the Afatung Wildlife Management Area, I Chenchon Bird Sanctuary, and forested areas on public and private lands around the Sabana and Sinapalu plateaus. Unit B is composed of limestone, secondary, agricultural, coastal, and ravine forests consisting of native and nonnative plants and contains the full range of primary constituent elements needed for longterm conservation of the Mariana crow on Rota. This area includes the known breeding territories of at least 63 Mariana crow pairs and possibly those of an additional 25 pairs (Morton et al. 1999). This area also includes the areas on Rota identified by our Mariana crow recovery team as important conservation areas in the draft revised Mariana crow recovery plan (USFWS in prep.). The critical habitat designated in Unit B consists of five sections. The first section includes the Afatung Wildlife Management Area in the Palii region and the forested areas in the Finata, Alaguan, and I Koridot regions. The second section includes the I Chenchon Bird Sanctuary and the forested areas in the I Chiugai and As Dudo regions of eastern Rota. The third section consists of much of the forested areas in the As Matmos, Mochong, Lalayak, Pekngasu, and I Batko regions, as well as the forested areas adjacent to the Rota Resort. The fourth section includes much of the forested areas in the Mananana, Uyulan Hulo, Sailgai Hulo, Gayauga, Lempanai, and Lupok regions. The fifth section includes much of the forested areas, as well as some of the grassland areas, in the Talakhaya and Gaonan regions of southern Rota. None of Unit B was excluded.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units for the Mariana crow are designated for the Territory of Guam and the island of Rota, Commonwealth of the Northern Mariana Islands. The primary constituent elements required by the Mariana crow for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are found in areas that support limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. These forest types provide the primary constituent elements of:

(i) Emergent trees and subcanopy trees with dense cover for breeding, such as Neisosperma oppositifolia (fagot), Macaranga thompsonii (pengua), Intsia bijuga (ifit), Premna obtusifolia (ahgao), Eugenia reinwardtiana (aabang), Ficus spp. (fig), Elaeocarpus joga (yoga), and Tristiropsis obtusangula (faniok);

(ii) Sufficient area of predominantly native forest to allow nesting at least 950 ft (290 m) from the nearest road and 203 ft (62 m) from the nearest forest edge and to support Mariana crow breeding territories (approximately 30 to 91 ac (12 to 37 ha)) and foraging areas for nonbreeding juvenile crows; and

(iii) Standing dead trees and plant species for foraging such as Aglaia mariannensis (maypunayo), Artocarpus spp. (breadfruit), Cocos nucifera (coconut palm), fagot, Hibiscus tiliaceus (pago), ifit, Leucaena spp. (tangantangan), Ochrosia mariannensis (langiti), Pandanus tectorius (kafu), ahgao, fig, and joga.

Special Management Considerations or Protections

Critical habitat does not include existing features and structures within the boundaries of the mapped units, such as buildings, roads, aqueducts, antennas, water tanks, agricultural fields, paved areas, lawns, and other urban landscaped areas not containing one or more of the primary constituent elements.

Life History

Feeding Narrative

Adult: Mariana crows are omnivorous, and their diet includes a wide variety of plants and animals, including insect larvae, centipedes, grasshoppers, mole crickets, praying mantis, earwigs, hermit crabs, skinks, geckos, and bird eggs (Jenkins 1983, p. 26, 31; Tomback 1986, p. 399; Ha and Ha 2010a, pp. 8-10; Faegre in press). Faegre (in press) observed 619 food captures from approximately 36 wild crows and found that 14 percent of food captures were of plant-based foods, and 86 percent were from animal prey; 65 percent of animal prey were of insects or their larvae.

Reproduction Narrative

Adult: Breeding likely occurs all year on Rota, while peak nesting activity generally occurs between August and February (Morton et al. 1999, p. 12; Ha et al. 2013, p. 31). A minimum of 65 days is necessary to build the nest, incubate the eggs, and rear the brood through fledging (Morton et al.1996, p. 21). Both parents generally participate in all aspects of breeding, although the female incubates most of the time (Morton et al. 1996, p. 21). The incubation period is 21 to 23 days, and the nestling period is 36 to 39 days (Morton et al. 1996, p. 21). After fledging, Mariana crows will typically remain in family groups until the following breeding season, a period that averaged 241 days (SE = 33, median 197 days) for 15 banded family groups (Morton et al. 1996, p. 21). However, the period of parental attendance after fledging varies widely, from 99 to 537 days (USFWS 2005a, p. 19). Mariana crows will often reinitiate the nest cycle within two weeks after abandoning an empty nest, and within four weeks after losing a clutch or brood (USFWS 2005a, p. 18). Mariana crows generally produce only a single brood per year; however, nest failure and other factors lead to multiple nest attempts each breeding season. From 1996 to 1999, 32 crow pairs on Rota constructed a mean of 2.2 nests per year (SE = 0.14, n = 78), with one pair building as many as seven nests in one season; however, not all nests resulted in egg deposition (Morton et al. 1999, p. 14, 36). Zarones et al. (2014, pp. 6-7) examined 204 active nests on Rota from the 1996 to 2009 breeding seasons and documented, on average, a clutch size of 2.57 (SD = 0.8, n = 82), 1.39 nestlings per nest that hatched (SD = 0.5, n = 106), 1.25 fledglings per nest that fledged (SD = 0.4, n = 68), and an overall nest success rate of 25.7 percent. The proportion of monitored pairs that produced at least one fledgling per breeding season ranged from 0.21 to 0.73, with an overall rate of 0.49 over the entire study period. During the 2013 breeding season, 16 of the 46 pairs (35 percent) successfully fledged young (Kroner 2014, p. 3). The estimated pair breeding success rate for 2013 was down from 60 percent in 2008 (Zarones et al. 2014, p. 7) and 57 percent in 2012 (Ha et al. 2013, pp. 59-60). Little is known regarding lifespan, age of sexual maturity, and length of reproductive life in Mariana crows. The oldest known wild crow was at least 18 years old when last observed on Rota in 2014 (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). This same adult male was at least 17 years old when he was last seen feeding a fledgling in 2013. Another male was 14 years old when he last produced a chick in 2009, and a 15-year-old female was observed with a fledgling in 2014 (S. Faegre, University of Washington, pers. comm. 2014). Although it was originally thought that Mariana crows begin breeding around 3.5 years old (Morton et al. 1999, p. 2), a radio-tagged male Mariana crow built his first nest at 16 months of age and was observed feeding a fledging at 21 months of age. Two other banded crows, a female and a male, successfully fledged young in 2011 and 2013, just after they turned two years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). A banded female was observed at a recently failed nest when she was approximately 1.5 years old (A. Kroner and S. Faegre, University of Washington, pers. comm. 2014). Survival to one year of age for male and female Mariana crows banded on Rota between 1990 and 2010 was 49.9 and 75.2 percent, respectively (Ha et al. 2010b, p. 25). Annual survivorship for adult males and females was 83.5 and 82.7 percent, respectively (Ha et al. 2010b, pp. 25-26). Recent analyses suggest that first-year survival has increased to 0.65 and adult survival has remained steady at about 0.80 since 2010 (R. Ha, University of Washington, pers. comm. 2014). Mariana crows are known to be highly susceptible to disturbance from human activities (Morton 1996, p. 60, 62, 72; Ha, R. 2015, pers. com.; Ha et al. 2011, p. 5). Based on observations of disturbance of crow nests on Guam, Morton (1996, p. 72) recommended a 300-meter radius for a buffer zone around active crow nests; Morton's recommendations were based on observations of crows reacting to facility/grounds maintenance, brown treesnake trapping, research activities, loud music, and human voices. One Mariana crow nest on Guam was abandoned due to disturbance from maintenance activity and from radio noise coming from a sound system 150 meters away (Morton 1996, p. 62). Ha et al. (2011, p. 236) found that nest sites were always greater than 300 meters from any buildings, and that actual nest sites were almost twice as far from roads and buildings as random sites.

Habitat Narrative

Adult: Mariana crows use forested habitats including limestone, strand, ravine, agricultural forests, and secondary forests (Jenkins 1983, p. 25, 32). However, evidence suggests they are most abundant in native limestone forests (Morton et al. 1999, p. 13, 41; Ha et al. 2011a, p. 25; Ha et al. 2011b, p. 240) and nests are found exclusively in native trees (Morton et al. 1999, p. 13, 33; Ha et al. 2011a, 2012, and 2013, pp. 32, 25, and 24-31, respectively). Nesting occurs in closed canopy forests in trees that are on average 17 cm in diameter at breast height, 8.7 m high, and 290 m from roads (Morton et al. 1999, p. 32).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Population Information and Trends

Population Narrative:

Guam Although the Mariana crow was once present throughout Guam (Baker 1951, p. 246), the population has been declining since at least the 1960's (Engbring and Ramsey 1984, p. 30;

Engbring et al. 1986, p. 92) and is now extirpated. The last known crow of Guam origin was observed in 2001, and the last known wild Mariana crow that was captive-reared from Rota and released on Guam was observed in 2012 (J. Quitugua, DAWR, pers. comm. 2014). Predation by brown treesnakes is the overriding factor in the extirpation of Mariana crows from Guam (USFWS 2005a). Suitable habitat for Mariana crows is still present on Guam. As described below in the Environmental Baseline for the Mariana Crow, we estimate that 24,919 acres (10,084 ha) of Mariana crow habitat is left on Guam. More information on crow habitat is provided in the Environmental Baseline for the Mariana Crow section below. Rota In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234). Reanalysis of the first island-wide survey for the species on Rota in 1982 using current density estimate methods resulted in a population estimate of 1,491 birds (815-3115 birds, 95 percent confidence interval) (Engbring et al. 1986, pp. 92-95; F. Amidon, USFWS, pers. comm. 2014). The most recent island-wide pair survey on Rota was conducted during the 2013 breeding season and documented 46 breeding pairs; an approximate 94 percent decrease in the population since 1982 (Kroner 2014, p. 3). The primary threats to the Mariana crow on Rota are suspected to be predation by cats, human persecution, and habitat destruction (USFWS 2014b, p. 3), but evidence is limited and substantially more research is needed. Mariana crow telemetry studies were conducted from 2009-2013 and will begin again in the 2014-2015 nesting season. Before telemetry studies began on Rota there was no evidence available to suggest feral cats (Felis silvestris) were predating crows. The lack of evidence was likely due to high scavenging and decomposition rates, and the extreme unlikelihood of finding a fresh carcass in time to retrieve any useful information regarding cause of death. Since telemetry efforts began, nine recently-deceased, radio-tagged Mariana crows have been found with evidence suggesting cat predation, and one untagged adult was taken in for care and later died after receiving what a veterinarian confirmed as an infected cat bite (Ha et al. 2013, pp. 5-6).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Guam: Although the Mariana crow was once present throughout Guam (Baker 1951, p. 246), the population has been declining since at least the 1960's (Engbring and Ramsey 1984, p. 30; Engbring et al. 1986, p. 92) and is now extirpated. The last known crow of Guam origin was observed in 2001, and the last known wild Mariana crow that was captive-reared from Rota and released on Guam was observed in 2012 (J. Quitugua, DAWR, pers. comm. 2014). Predation by brown treesnakes is the overriding factor in the extirpation of Mariana crows from Guam (USFWS 2005a). Suitable habitat for Mariana crows is still present on Guam. As described below in the Environmental Baseline for the Mariana Crow, we estimate that 24,919 acres (10,084 ha) of Mariana crow habitat is left on Guam. More information on crow habitat is provided in the Environmental Baseline for the Mariana Crow section below. Rota: In 1976, Mariana crows were considered relatively common and widely distributed on Rota (Pratt et al. 1979, p. 234). Reanalysis of the first island-wide survey for the species on Rota in 1982 using current density estimate methods resulted in a population estimate of 1,491 birds (815-3115 birds, 95 percent confidence interval) (Engbring et al. 1986, pp. 92-95; F. Amidon, USFWS, pers. comm. 2014). The most recent island-wide pair survey on Rota was conducted during the 2013 breeding season and documented 46 breeding pairs; an approximate 94 percent decrease in the population since

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Recovery

Reclassification Criteria:

1. The Mariana crow may be considered for downlisting from endangered to threatened status when all of the following criteria are met: Mariana crow occur in two populations, one on Rota consisting of a minimum of 75 territorial pairs, and 1 in northern Guam consisting of a minimum of 75 territorial pairs;

Both populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (?) not less than 1.0 over a period of at least 10 consecutive years.

Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above.

Brown treesnakes and other introduced predators found to be a threat to Mariana crow are controlled at a sufficient level to achieve criteria 1 and 2 above.

Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota.

Efforts to resolve Mariana crow and landowner conflicts have been implemented.

Delisting Criteria:

The Mariana crow may be removed from the Federal list of threatened and endangered species when all of the following criteria are met: Mariana crow occur in three populations, one on Rota consisting of a minimum of 75 territorial pairs, one on northern Guam consisting of a minimum of 75 territorial pairs, and one in southern Guam consisting of a minimum of 75 territorial pairs

All three populations are stable or increasing based on quantitative surveys or demographic monitoring that demonstrates an average intrinsic growth rate (?) not less than 1.0 over a period of at least 10 consecutive years.

Sufficient Mariana crow habitat, based on quantitative estimates of territory and home range size, is protected and managed to achieve criteria 1 and 2 above.

Brown treesnakes and other introduced predators are controlled at a sufficient level to achieve criteria 1 and 2 above.

Brown treesnake interdiction efforts are in place to prevent the establishment of brown treesnakes on Rota.

Efforts to resolve Mariana crow and landowner conflicts have been implemented.

A monitoring plan has been developed and is ready for implementation, to cover a minimum of five years post-delisting, to ensure the ongoing recovery of the species and the continuing effectiveness of management actions.

Recovery Actions:

- Since the draft revised recovery plan was published in 2005, additional work on population viability of the Mariana crow has occurred. This recent assessment of population viability indicated that 75 territorial breeding pairs may not be viable over the long-term due to potential inbreeding depression (O'Grady et al. 2006) and projected increases in tropical storm intensity, duration, and frequency (Emanuel et al. 2008) and that 100 territorial breeding pairs may be a more appropriate recovery target (Amidon 2012, unpubl. data).Therefore, the Service now considers 100 territorial breeding pairs as our recovery target for each of the three regions identified above.
- Survival and Recovery Needs on Rota Management and recovery actions that have occurred in the last five years (USFWS 2014b, pp. 3-4) include: • Banding: The University of Washington's Rota Avian Behavioral Ecology Program (RABEP) has banded 80 Mariana crows since 2005 (Ha et al. 2013 pp. 5-6; Kroner 2014, p. 3). Re-sight data has been used to develop age-specific survivorship models. • Nest monitoring: RABEP have conducted nest monitoring for the Mariana crow on Rota since 2005. Efforts provide data that is used for analyses of nesting success and demographics. • Mariana crow mortality monitoring: From 2009 to 2013, transmitters were attached by RABEP to 32 Mariana crows that were tracked and monitored for the life of the battery (n=14), until death of the bird (n=12), loss of the signal (n=1), or until the harness was removed (n=5) (Ha et al. 2013, pp. 5-6). • Habitat and natural process management and restoration: The Mariana Crow Conservation Area (MCCA) was established on Rota through an MOA between the Commonwealth of the Northern Mariana Islands (CNMI) and PIFWO (USFWS 2011, pp. 1-4). • Human interaction monitoring and management: The Mariana Crow Incentive Plan (2012-2014) compensated participants on Rota with a monetary award in exchange for protecting occupied crow habitat and allowing access for population monitoring and feral cat control on their land (USFWS 2012a, pp. 1-8). The goal of the plan was to change human perceptions of the Mariana crow and protect valuable habitat. • Predator monitoring and control: The University of Washington Rota Island Feral Cat Removal Project began cat removal efforts on Rota in February 2012 (Ha et al. 2013, p. 49). As of June 2014, the project removed 589 cats from areas in and around crow territories (Leo 2014, p. 3). The Institute for Wildlife Studies took over cat control efforts on Rota in October 2014. • Captive care: Captive care of sick or injured crows is conducted on an as-needed basis by RABEP captive care specialists. • Release of rehabilitated crows: Crows are released into the wild after they have been rehabilitated and reared to at least 2 years of age. Two crows were successfully released after being taken in as fledglings and reared to adulthood in captivity (Hannon 2014, pp. 1-3). • Strategic

planning / threats management planning: The Service in cooperation with the Mariana Crow Recovery Team conducted an exercise in structured decision making (SDM) to determine which actions should be taken now and over the next several years to maximize the probability of preventing extinction and set the foundation for at least one stable to increasing population in the wild (see below). The two primary objectives driving the SDM were to prevent the extinction of the Mariana crow and to ensure a viable stable or increasing population in the wild. Recovery actions still needed to prevent the extinction of the Mariana crow on Rota: • Implement priority actions identified in the Mariana crow SDM exercise: o Predator control on Rota o Phased approach to captive propagation, beginning with rear and release program • Identify and manage sources of adult and juvenile mortality • Improve public perception of the crow to reduce potential human persecution • Protect important habitat on Rota and Guam • Research and reduce the threat of the brown treesnake on Rota and Guam Survival and Recovery Needs on Guam Management and recovery actions that have occurred in the last five years include: • Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per Biological Opinion requirements (USFWS 2006b). However, the DON has proposed to build the proposed LFTRC within this mitigation site, which is also located on Overlay Refuge. • Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at AAFB. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006c). • Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point. • Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per Biological Opinion requirements (USFWS 2010a). The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing. • In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study within the approximately 136-acre (55-hectare) HMU on AAFB may result in the reduction of snake numbers to a low enough level to allow kingfishers to survive and reproduce within this snake-proofed area on Guam. The knowledge gained from this study will help with potential future improvements to the method and efficiency of the delivery of the acetaminophen to snakes on Guam. Recovery actions still needed to allow the reintroduction of the Mariana crow to Guam • Development and implementation of large-scale, long-term methods for brown treesnake control that will reduce the brown treesnake population on a landscape level. • Protection and restoration of Mariana crow habitat in northern and southern Guam including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates. • Continued management of the fenced exclosures at Northwest Field, the HMU, and NBG as described above.

References

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U.S. Fish and Wildlife Service. 2004. Endangered and Threatened Wildlife and Plants

Designation of Critical Habitat for the Mariana Fruit Bat and Guam Micronesian Kingfisher on Guam and the Mariana Crow on Guam and in the Commonwealth of the Northern Mariana Islands

Final Rule. 69 FR 62944 - 62990. October 28, 2004.

SPECIES ACCOUNT: *Corvus leucognaphalus* (White-necked crow)

Species Taxonomic and Listing Information

Listing Status: Endangered/extirpated from U.S. jurisdiction (PR); 04/03/1991; Southeast Region (R4) (USFWS, 2016)

Physical Description

The white-necked crow (Corvus leucognapholus) resembles the crows of the mainland United States in physical appearance, but is distinguished by the pure white base of the feathers of the hind neck(Wetmore and Swales 1931).

Taxonomy

By virtue of its extirpation in Puerto Rico, it is now considered endemic to the island of Hispaniola (Keith et al. 2003, Latta et al. 2006).

Historical Range

The white-necked crow was originally distributed across Hispaniola and Puerto Rico (Wiley 2006). The white-necked crow in Puerto Rico was known from the main Island. In the last quarter of the 19th century, the crow could still be found in good numbers in the interior moist karst forests of north-central Puerto Rico (e.g., municipalities of Lares and Utuado) and had been reported in the eastern region of the Island (Gundlach 1878). The last confirmed sighting of the species in Puerto Rico (1963) was in the Sierra de Luquillo (Bond 1973, Raffaele 1983)

Current Range

Unevenly distributed island-wide in Hispaniola, and present in about 7 protected areas. The white necked crow is considered extirpated in areas under U.S. jurisdiction. Presently, the white-necked crow is restricted to the island of Hispaniola, including some of its larger satellite islands (i.e., Gonave and Saona Islands), where it is more common in areas with large tracts of forest habitat (Latta et al. 2006). Wiley (2006) reported white-necked crows were more widely distributed and abundant in the northeastern region of the Dominican Republic, namely Los Haitises, Miches and the Samaná Peninsula. Further, the crow is seasonally abundant on Saona Island when white-crowned pigeons (Patagioneas leucocephala) aggregate for nesting. Flocks of =35 crows have been recently reported in coastal forest and mangroves on the southern coast of Saona Island (www.ebird.org). White-necked crow observations documented by researchers working in Hispaniola, and birders, include 195 records during the period of 1976-2012. Of these, 137 observations were recorded in the Dominican Republic and the rest (58) in Haiti. Per Keith et al. (2003) the white-necked crow has also occurred on the islands of Navassa and Ile a-Vache, west and south-west of Haiti, respectively.

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: While crows will on occasion forage at ground level, and indeed, have been documented feeding on crops, they are largely arboreal and feed mostly on fruit and seeds (Wiley 2006). In the moist karst forest of Los Haitises, crows are particularly active among vines, bromeliads, and orchid masses, where they probe for invertebrates, reptiles, and amphibians (F.J. Vilella, Mississippi Cooperative Research Unit, pers. obs.).

Reproduction Narrative

Egg: The only available information on reproductive traits of the white-necked crow comes from a limited number of nests monitored by Wiley (2006) in the Dominican Republic. Eggs are incubated for 18- 22 days.

Juvenile: Nestlings fledge after 35-44 days.

Adult: Nest building initiates in late January and into February. Crows place nest structures high in trees. Adults exhibit high nest attendance during incubation, which gradually declines through the nestling period, with breeding ending by late May.

Spatial Arrangements of the Population

Adult: Uneven (see current range/distribution)

Environmental Specificity

Adult: Broad

Tolerance Ranges/Thresholds

Adult: Moderate

Habitat Narrative

Adult: Available information suggests white-necked crows may be somewhat tolerant to habitat alteration from agriculture in occupied areas. It seems to thrive only where there are extensive growths of natural forest. Areas of special importance for the white-necked crow in Hispaniola include: Los Haitises National Park (Dominican Republic): this reserve is dominated by continuous tracts of wet karst forest); Sierra de Bahoruco National Park (Dominican Republic); Jaragua National Park (Dominican Republic): this park harbors extensive tracts of mature mangrove, coastal scrub and dry forest as well as two large islands associated with the reserve (Latta 2005); Macaya Biosphere Reserve (Haiti): this reserve includes pine forest, savanna, montane broadleaf forest, karst forest, and other habitats in varying stages of disturbance.

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available

Population Information and Trends

Population Trends:

Declining

Resiliency:
Moderate

Representation:
Unknown

Redundancy:
Moderate

Number of Populations:
7 (see current range/distribution)

Population Size:
2,500 - 10,000

Adaptability:
Moderate

Population Narrative:
Species status is declining. Current available estimates (2,500-10,000 individuals) are based on assessment of known records, including descriptions of abundance and range size (BirdLife International 2012). However, no studies have been conducted to developabundance estimates with precision across the species' range. No information on genetic structure or levels of variation is available for the species.

Threats and Stressors

Stressor: Habitat loss and degradation
Exposure:
Response:
Consequence:
Narrative: Past and ongoing habitat loss and degradation from forest clearing for timber and agricultural purposes has likely contributed significantly to the extirpation of the white-necked crow in Puerto Rico, and recent declines in Hispaniola. While the species has been described as somewhat tolerant of disturbed habitat, levels of tolerance to varying types of disturbance are unknown. Although forest cover remains in Hispaniola, mostly in the Dominican Republic, historical habitat has been diminished or degraded with unknown consequences for the species. As previously stated, only an average of less than 3.7% of the territory in Haiti remains with forest cover, and although in Dominican Republic the network of protected areas has been expanded, deforestation and alteration of many habitats still ongoing

Stressor: Hunting
Exposure:
Response:
Consequence:
Narrative: White-necked crow is still persecuted in the Dominican Republic and Haiti (Wiley 2006). Crows are shot by farmers, mainly in the Dominican Republic, as they are mistakenly considered crop pests and are also hunted for food.

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: West Nile virus (WNV) has been documented in the Dominican Republic, specifically in Los Haitises and Sierra de Bahoruco reserves (Komar et al. 2003). However, while the virus was not reported in white-necked crows, corvids have been documented to be particularly susceptible to WNV infection and propagation due to their highly sociable nature (Reisen et al. 2006).

Stressor: Inadequacy of existing regulatory mechanisms
Exposure:
Response:
Consequence:
Narrative: Even as many laws protect forests and watersheds in the Dominican Republic, there is lack of enforcement. Government agencies responsible for forest administration and management (i.e., Ministerio de Medio Ambiente y Recursos Naturales) are underfunded and understaffed. As a result, habitat degradation and land use conversion continues to the detriment of resident wildlife, including the white-necked crow (Wiley 2006). In Haiti, high population density, poverty, political instability, absence of trained staff, lack of clear policies, and shifting government priorities have prevented any sustained conservation efforts. Nature reserves in Haiti are few and essentially unprotected.

Recovery

Reclassification Criteria:
Not available - this species does not have a recovery plan.

Conservation Measures and Best Management Practices:

- 1. Develop a conservation strategy to improve the status of the white-necked crow in cooperation and coordination with the governments of Puerto Rico, the Dominican Republic, and Haiti. The conservation strategy should assess the most up to date information on the species geographic distribution, and reliable information on population dynamics, and resource selection patterns. The conservation strategy also needs to include the preparation of a recovery plan, and an outreach and educational component to make people aware of the status of the species and its protection need.
- 2. Upon availability of funds, the reintroduction of the white-necked crow in Puerto Rico should be explored as an integral component of the recovery program for the species. The successful implementation of this recovery action would help reassess the status of the species by restoring its original geographic range, which spanned both Hispaniola and Puerto Rico. The benefits of reintroducing the white-necked crow back to its historic range should also be contemplated from its role in the natural restoration process of the Island. Being primarily a frugivore species (Wiley 2006), the white-necked crow probably played an important role in the dispersal of seeds of many large tree species in Puerto Rico (Latta 2014). If determined that expanses of forest habitat existing in Puerto Rico are suitable for the species, assisted colonization, also termed managed relocation, is a viable strategy for species restoration and conservation (Seddon 2010).

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SPECIES ACCOUNT: *Dendroica chrysoparia* (Golden-cheeked warbler (=wood))

Species Taxonomic and Listing Information

Commonly-used Acronym: GCWA or GCW

Listing Status: Endangered; 05/04/1990; Southwest Region (Region 2) (USFWS, 2016)

Physical Description

The golden-cheeked warbler (Dendroica chrysoparia, GCWA) is a small, neo-tropical songbird weighing about 10 grams (0.34 ounces) and is about 12 cm (4.7 inches) long (Pulich 1976, pp. 126-128). Adult GCWA males have yellow cheeks outlined in black with a thin black line through each eye and extending backwards from the eye (Oberholser 1974, p. 750; Ridgway 1902, p. 565). Upper breast, throat, and back are black, and the lower breast and belly are white with some lateral black spotting or streaking (Oberholser 1974, pp. 750, 753; Ridgway 1902, p. 565). Wings are blackish with two white wingbars, and tail feathers are black, except the outermost tail feather on each side is white with a black shaft line (Oberholser 1974, p. 753; Ridgway 1902, p. 565). The beak, legs, and feet are black, and eyes are dark brown (Oberholser 1974, p. 753). Adult GCWA females are similar to adult males but less strikingly marked (Pulich 1976, p. 121). For example, the cheeks and center of the throat of females are yellowish, grading to pale buff or white on the abdomen (Oberholser 1974, pp. 750, 753; Ridgway 1902, p. 566). Additionally, the back is dark olive-green with thin black streaks (Oberholser 1974, p. 750; Ridgway 1902, p. 566). Sides of the throat are black with feathers tipped in white, and the flanks (sides) are covered with black streaks (Oberholser 1974, p. 753; Ridgway 1902, p. 566). (USFWS, 2016)

Taxonomy

The American Ornithologists' Union Committee on Classification and Nomenclature transferred all species in genus Dendroica to the genus Setophaga (Chesser et al. 2011, pp. 600). In this 5-Year Review, the Service is adopting this change in nomenclature for the GCWA, and we refer to the species as Setophaga chrysoparia throughout this document. In accordance with this current information, the Service officially accepted the new scientific name of the GCWA as Setophaga chrysoparia. (USFWS, 2014)

Current Range

Breeding range encompasses central Texas from Dallas, Palo Pinto, and Bosque counties south through the eastern and south-central portions of the Edwards Plateau (AOU 1998, Ladd and Gass 1999). During the nonbreeding season, the range includes highlands (1,500-2,500 meters) of from Chiapas (Mexico) through Guatemala, Honduras, and north-central Nicaragua; transients occur from June to August and in March in Coahuila, Nuevo Leon, Tamaulipas, and western Veracruz, Mexico (AOU 1998, Ladd and Gass 1999). Breeding range extent appears to be roughly 20,000 square kilometers. (NatureServe, 2015)

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Golden-cheeked warblers eat only insects, including caterpillars, spiders, and beetles typically found on foliage (Pulich 1976, p. 113; Oberholser 1974, p. 751). (USFWS, 2016)

Adult: Golden-cheeked warblers eat only insects, including caterpillars, spiders, and beetles typically found on foliage (Pulich 1976, p. 113; Oberholser 1974, p. 751). Pulich (1976) also observed warblers feeding on spiders, caterpillars, lacewings, small cicadas, katydids, walking sticks, deer flies, crane flies, adult moths, and adult butterflies. In Texas, the birds are thought to take advantage of insect blooms, large insect populations, associated with different plants as the growing season progresses (Kroll 1974, p. 41). Forages mostly in hardwoods (oaks) on breeding range, in shrubby understory of winter habitat (Kroll 1980). Nonbreeders in Chiapas foraged in the upper half of trees (Vidal et al. 1994). (USFWS, 1992; USFWS, 2016; NatureServe, 2015)

Reproduction Narrative

Adult: Male GCWAs can often be located through their territorial song, described as a rather hurried, buzzy "tweah-tweah-twee-sy" (Oberholser 1974, p. 752). Single, sharp "chipping" calls can frequently be heard by both male and female GCWAs (Oberholser 1974, p. 752; Pulich 1976, p. 119; Keddy-Hector 1992, pp. 2-5-2-6). The female GCWA does most of the work of nest building and incubating the eggs (Pulich 1976, p. 82; Oberholser 1974, p. 751). Nesting in the same tree for two or more years in succession has been noted (Pulich 1976, p. 82). Eggs are laid mostly April-June (May-June nests evidently represent renesting after failed first tries). Clutch size is 3-5 (usually 4). Incubation, by female, lasts about 12 days. Young are tended by both parents, fledge in about 9 days, may accompany an adult for 30-40 days after fledging. Nests usually in loose groups of fewer than 6 pairs (sometimes up to 21 pairs) (Pulich 1976). The birds are dependent on Ashe juniper (Juniperus asheii) for fine bark strips used in nest construction (Pulich 1976, p. 86; Kroll 1980, p. 61). All nests contain strips of Ashe juniper bark typically woven together with spider webs and lined with feathers, fine grass, or hair (Oberholser 1974, pp. 751, 753; Kroll 1974, p. 44; Pulich 1976, pp. 83, 86-87; Griscom and Sprunt 1957, p. 143). (NatureServe, 2015)

Geographic or Habitat Restraints or Barriers

Adult: Breeding habitat typically occurs at elevations from 180 to 520 meters; prefer moderate to high density of trees and foliage; require bark of Ashe juniper for nests (USFWS, 1992; NatureServe, 2015)

Environmental Specificity

Adult: Medium, with some key requirements (USFWS, 1992)

Site Fidelity

Adult: Low (NatureServe, 2015)

Habitat Narrative

Adult: Breeding habitat consists of old-growth and mature regrowth Ashe juniper-oak woodlands in limestone hills and canyons, at elevations of 180 to 520 meters (summarized in Ladd and Gass 1999), including edges and open mosaics of Ashe juniper-scrub oak association in broken terrain in canyons and slopes, and closed canopy stands with plenty of old junipers and a sufficient proportion of deciduous oaks in the canopy (Sexton 1992); occupied sites contain junipers at least 40 years old. This species may occupy habitat patches as small as perhaps 50 hectares (larger if close to urban areas) (Sexton 1992). Nests usually are in upright forks of mature junipers, about 1.5-9 meters above ground. Sloughed juniper bark is an important nesting material material. Both males and females tend to return to the previously occupied nesting territory. In migration and winter, golden-cheeked warblers occur mainly in montane pine or pine-oak associations (Vidal et al. 1994) but also in broadleaf associations in lower montane wet and tropical forest (Vannini, in Collar et al. 1992). In Honduras and Guatemala, the species occurs primarily above 1,300 meters in pine-oak forest; dominant pine species was ocote (Pinus oocarpa) and dominant oaks were "encino" oaks (Quercus sapotifolia, Q. eliptica, Q. elongata, and Q. cortesii) (Rappole et al. 1999). (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: High (NatureServe, 2015)

Immigration/Emigration

Adult: Immigrates/Emigrates (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: GCWs nest on the Edwards Plateau, Lampasas Cut-Plain, and Llano Uplift regions of central Texas. The GCW has been reported as a breeding species from the following counties: Bandera, Bastrop, Bell, Bexar, Blanco, Bosque, Burnet, Comal, Concho, Coryell, Dallas, Eastland, Edwards, Erath, Gillespie, Hamilton, Hays, Hood, Johnson, Kendall, Kerr, Kimble, Kinney, Lampasas, Lee, Llano, McLennan, Medina, Palo Pinto, Real, San Saba, Somervell, Stephens, Tom Green, Travis, Uvalde, and Williamson. GCWs winter in the highlands of southern Mexico (Chiapas) and Central America. Arrives on breeding grounds in early to mid-March (Pulich 1976). Departs on southward migration mid-June; most are gone by end of July, some present to early August (Texas Ornithological Society 1995, Wauer 1996, Ladd and Gass 1999). Reported on wintering grounds in Chiapas, Mexico, from early August to early April (Vidal et al. 1994). Most migrants pass through a narrow Mexican cloud-forest along the eastern slope of the Sierra Madre Oriental (Perrigo et al. 1990, Ehrlich et al. 1992). (USFWS, 1992; NatureServe, 2015)

Additional Life History Information

Adult: Arrives on breeding grounds in early to mid-March (Pulich 1976). Departs on southward migration mid-June; most are gone by end of July, some present to early August (Texas Ornithological Society 1995, Wauer 1996, Ladd and Gass 1999). Reported on wintering grounds in Chiapas, Mexico, from early August to early April (Vidal et al. 1994). Most migrants pass through a narrow Mexican cloud-forest along the eastern slope of the Sierra Madre Oriental (Perrigo et al. 1990, Ehrlich et al. 1992). (NatureServe, 2015)

Population Information and Trends

Population Trends:

Long-term trends suggest a decline of 30-50% (NatureServe, 2015)

Resiliency:

Medium (inferred from NatureServe, 2015)

Representation:

Medium (inferred from NatureServe, 2015)

Redundancy:

Medium (inferred from NatureServe, 2015)

Population Size:

20,000 - 40,000 individuals (NatureServe, 2015)

Population Narrative:

USFWS (1992) estimated that the number of territories declined by about 25 percent between 1962 and 1990. Long-term population trends suggest a decline of 30-50%. USFWS (1992) estimated population size in 1990 at 13,800 territories (presumably 27,600 adults). Rich et al. (2004) estimated population size at 21,000; they cited the 1991 and 1992 recovery plans for the black-capped vireo and golden-cheeked warbler, respectively, as the sources for that estimate. Ladd and Gass (1999) estimated population size at 9,644-32,032 adults. Rappole et al. (2003) estimated winter population size at 35,527 individuals, including young birds produced during the previous breeding season. (NatureServe, 2015)

Threats and Stressors

Stressor: Habitat loss (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The GCWA is threatened by ongoing and imminent habitat loss. Historically, the primary cause of habitat loss was juniper clearing to create pastures for cattle grazing (Pulich 1976, pp. 72-73). Other causes of habitat loss included cutting junipers for fence posts, furniture, and cedar oil. However, recent habitat loss in Travis, Williamson, and Bexar Counties is due to rapid suburban development (Biological Advisory Team 1990, p. 19; Groce et al. 2010, p. 142). Further, the human population is projected to continue to increase throughout the GCWA's range (Groce et al. 2010, p. 118). This growth will continue to bring additional residential and commercial development, which will further reduce and fragment GCWA breeding habitat. (USFWS, 2014)

Stressor: Habitat fragmentation (USFWS, 2014)

Exposure:
Response:
Consequence:
Narrative: The loss of habitat through activities such as residential development often results in the fragmentation of larger contiguous patches of habitat and increased isolation of habitat patches which can prevent the interaction between nearby populations of the GCWA. Habitat fragmentation has been shown to influence habitat quality for woodland songbirds, such as the GCWA, in the following ways: (1) small patch size and thus small population size make extant populations more susceptible to random extinction or effects of inbreeding; (2) increased distance between patches reduces gene flow between populations and makes recolonization of vacant patches more difficult; and (3) increased proportion of habitat edge in small patches may alter patterns of insect abundance, vegetation structure, and songbird foraging activity (due to changes in the microclimate) (Brett 1989, pp. 7-8; Reville et al. 1990, p. 23; Saunders et al. 1991. p. 18, 22, 24). Fragmentation also heightens rates of nest parasitism and nest predation to the point at which the surviving songbird populations cannot maintain themselves (Lovejoy et al. 1986, p. 263; Wilcove et al. 1986, p. 248, 251). Many GCWA populations may be impacted by the adverse effects of habitat fragmentation, particularly due to their dependence on mature forest habitat for foraging and nesting. Selection of nesting habitat is especially important, because nest location often affects reproductive success (Martin 1998, p. 656) and population viability. In addition, the fragmentation of large blocks of breeding habitat can reduce occupancy and breeding success (Peak 2007, p. 632; Groce et al. 2010, p. 10). For example, DeBoer and Diamond (2006, p. 186, 188) found that GCWA were more likely to occupy large contiguous patches of habitat that contained less edge. (USFWS, 2014)

Stressor: Reduced oak recruitment (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Additional threats to the GCWA breeding habitat include reduced oak recruitment due to herbivory from native and non-native animals, death of mature oaks from oak wilt, and the potential for catastrophic wildland fires from increasing fine fuel loads and urban encroachment (Groce et al. 2010, pp. 137-139, 141). (USFWS, 2014)

Stressor: Pine-oak forest conversion (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The ongoing destruction and fragmentation of pine-oak forests throughout the GCWA's migration and wintering habitat has been due to unsustainable forestry practices, fires from agricultural conversion, extraction of timber, and cattle ranching (Dinerstein et al. 1995, p. 87; Redo et al. 2009, p. 95; Groce et al. 2010, p. 131). While some countries have a legal framework that encourages sustainable forestry, they still allow clearcutting, which results in forest fragmentation, reduced species diversity, and soil loss (ACMPOF 2008, p. 34). (USFWS, 2014)

Stressor: Long-term land protection (USFWS, 2014)
Exposure:
Response:

Consequence:
Narrative: Several properties have been acquired in the GCWA's breeding range that provide long-term protection. They include 77,198 ac (31,241 ha) of Department of Defense lands (Fort Hood, Camp Bullis, and U.S. Army Corps Engineers); 39,428 ac (15,956 ha) on Texas Parks and Wildlife Department lands; 2,844 ac (1,151 ha) on Lower Colorado River Authority properties; 14,789 ac (5,742 ha) on the Balcones Canyonlands National Wildlife Refuge; and over 50,000 ac (20,234 ha) of additional lands owned across the range by cities, counties, conservation organizations, and others (Groce et al. 2010, pp. 11, 151, 155-156). The land management practices vary on these lands; however, many are managed for the GCWA. (USFWS, 2014)

Stressor: Predation (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Red-imported fire ants (Solenopsis invicta), snakes, other bird species, and mammals have all been documented to prey on GCWA adults and/or young (Stake et al. 2004, p. 341; Reidy et al. 2008, pp. 462-463; Reidy et al. 2009, p. 418). Two separate studies have documented nest predation by red-imported fire ants (Stake et al. 2004, p. 341; Reidy et al. 2008, p. 462). Texas rat snakes have been observed preying on female warblers while on the nest (Stake et al. 2004, p. 341; Reidy et al. 2008, p. 462; Reidy et al. 2009, p. 418). Other likely or documented GCWA predators include western coachwhip (Masticophis flagellum testaceus), Great Plain's rat snake (Elaphe guttata emoryi), western scrub-jay (Aphelocoma californica), Cooper's hawk (Accipiter cooperii), American crow (Corvus brachyrhynchos), greater roadrunner (Geococcyx californianus), brown-headed cowbird (Molothrus ater), and mice (Peromyscus sp.) (Stake et al. 2004, p. 341; Reidy et al. 2008, p. 463). (USFWS, 2014)

Stressor: Climate change (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: According to the Intergovernmental Panel on Climate Change (IPCC), "Warming of the climate system is unequivocal, as is now evident from observations of increases in global average air and ocean temperatures, widespread melting of snow and ice, and rising global average sea level." Average Northern Hemisphere temperatures during the second half of the 20th century were very likely higher than during any other 50-year period in the last 500 years and likely the highest in at least the past 1,300 years (IPCC 2007, p. 1). It is very likely that over the past 50 years, cold days, cold nights and frosts have become less frequent over most land areas, and hot days and hot nights have become more frequent (IPCC 2007, p. 1). It is likely that heat waves have become more frequent and the frequency of heavy precipitation events has increased over most areas (IPCC 2007, p. 1). Localized projections suggest the southwest may experience the greatest temperature increase of any area in the lower 48 States (IPCC 2007, p. 8). The IPCC also predicts that hot extremes and heat waves will increase in frequency and that many semi-arid areas like the western United States will suffer a decrease in water resources (IPCC 2007, p. 8). Others project a 10–30 percent decrease in precipitation in mid-latitude western North America by the year 2050 (Milly et al. 2005, p. 349). (USFWS, 2014)

Stressor: Increased wildlife (USFWS, 2014)
Exposure:

Response:
Consequence:
Narrative: Climate change projections indicate continued droughts and increased wildfire risk, which can further restrict existing breeding habitat (EPA 2009, p. 49). Throughout the GCWA's range, urban development encroaches into Ashe juniper woodlands and this alone contributes to the risk of catastrophic wildfires. As large wooded ranches are subdivided into smaller parcels, it becomes more challenging to defend against large wildfires (Hermansen-Báez et al. 2009, p. 1). Additionally, in the absence of naturally occurring fire, juniper needles can persist on the ground for 40 to 50 years (White et al. 2009, p. 9). This build-up of dry material contributes to the potential for large stand replacement fires that can burn so hot that they destroy the seed bank in the soil and lengthen woodland recovery time (Reemts and Hansen 2008, pp. 1062-1064; White et al. 2009, p. 9). Typically these large stand replacement fires occur during the mid-summer months when rain is lacking, which makes the air and trees very dry (White et al. 2009, p. 9). (USFWS, 2014)

Stressor: Range shifts/restrictions (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The Environmental Protection Agency (EPA) developed an evaluation framework and assessment of the vulnerability of several species to the effects of climate change (EPA 2009, p. 1). The GCWA was classified as "critically vulnerable" to climate change due to the species' dependence upon Ashe juniper, the historical and continued loss of the species' breeding habitat, and the fact that the geographical extent of this habitat is probably limited by surface geology (EPA 2009, p. 50). Stands of mixed juniper-oak woodlands are restricted to areas in central Texas containing suitable geology, soil, precipitation, and land use practices (Diamond 1997, p. 1-4). Increased temperatures in the southern portions of the breeding range of many species is predicted to shift breeding ranges northward; however, GCWA are currently limited to the northern extent of their breeding range by distributional limits of their associated breeding habitat (EPA 2009. pp. 45-46). Expansion of juniper woodlands to the north is unlikely because just north of its current range the soil becomes deeper, more fertile, and more suitable for grasslands and deciduous trees. The land is also intensively farmed, creating unsuitable habitat for junipers. Further, the Dallas-Ft. Worth metropolis lies on the northern edge of the species' range. This is an urban barrier approximately 90.5 kilometers (km) wide by 48 km deep (50 miles [mi] wide by 30 mi deep). Even if suitable soils and land-use patterns existed to the north, it is unlikely that Ashe juniper could expand through such a barrier (EPA 2009, p. 46). (USFWS, 2014)

Stressor: Recreation (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: There are few studies on the effects of recreation on GCWA. One study found no difference in GCWA relative abundance, return rate, male age structure, or productivity between a mountain biking area and a non-mountain biking area (Peak 2003, pp. 6-7). However, only one study site was used and sample sizes were small. Conversely, Davis and Leslie (2008, pp. 27-28, 30) found GCWA nest success was 50 percent less in mountain biking areas than in non-mountain biking areas, but direct cause-and-effect relationships could not be made. We are unaware of other specific studies on the effects of recreation on GCWA. However, studies on

other forest birds have shown impacts from recreation can include, but are not limited to, increased potential for wildfire, soil compaction/erosion, and increases in edge-adapted predators and invasive plants (Sykes et al. 1989, p. 556; Hickman 1990, pp. 4-5; Miller et al. 1998, pp. 14-15; Leung and Marion 2000, p. 24.). Therefore, although we lack certainty about how recreation impacts GCWA, limited data have shown that mountain biking may impact nest success. Because several local and state lands that support GCWA also allow public access (camping, hiking, biking, and horseback riding), additional research is needed on effects from recreation on GCWA. (USFWS, 2014)

Recovery

Reclassification Criteria:
Reclassification criteria are not available.

Delisting Criteria:
1. Sufficient breeding habitat has been protected to ensure the continued existence of at least one viable, self-sustaining population in each of eight regions outlined in the plan. (USFWS, 1992)

2. The potential for gene flow exists across regions between demographically self—sustaining populations where needed for long-term viability. (USFWS, 1992)

3. Sufficient and sustainable non-breeding habitat exists to support the breeding populations. (USFWS, 1992)

4. All existing golden-cheeked warbler populations on public lands are protected and managed to ensure their continued existence. (USFWS, 1992)

5. All of these criteria have been met for 10 consecutive years. (USFWS, 1992)

Recovery Actions:
- Studies of golden-cheeked warbler population status and biology, ecology, habitat requirements, and threats on the breeding ground and in the winter range and along their migration corridor. (USFWS, 1992)
- Protection of existing populations and habitat in the breeding range, wintering range, and along the migration corridor. (USFWS, 1992)
- Increased voluntary protection of warbler habitat. (USFWS, 1992)
- Enhancement and maintenance of the quality of warbler habitat on public and private lands. (USFWS, 1992)
- Increased public awareness of the importance of the species and other endangered species. (USFWS, 1992)
- Regulatory protection. (USFWS, 1992)

Conservation Measures and Best Management Practices:
- Protect GCWA habitat in the breeding, migration, and wintering ranges. (USFWS, 2014)
- Monitor GCWA throughout the breeding range to verify adult survival and productivity levels. (USFWS, 2014)

- Manage habitat in the breeding, migration, and wintering ranges to ensure long-term survival of the habitat necessary to support viable GCWA populations (USFWS, 2014).
- Adapt monitoring and management strategies based on new information. (USFWS, 2014)
- Provide education and outreach on the GCWA throughout the breeding, migration, and wintering ranges. (USFWS, 2014)
- Since the greatest threat to GCWA is habitat loss, permanent protection of large blocks of contiguous habitat is necessary for the long-term survival and recovery of the GCWA. (USFWS, 2014)
- To assist with the planning and recovery efforts, the following additional information is needed: (1) identification of focal areas within breeding habitat; (2) development of management guidelines for achieving recovery criteria; (3) developing a monitoring protocol for verifying recovery criteria; (4) determining the effects of recreation on GCWA and their habitat; (5) determining the effects of climate change on GCWA habitat; (6) identifying priority stopover sites within their migration corridor; (7) identifying, promoting, and implementing sustainable forestry practices within the wintering range; and (8) providing education and outreach on GCWA throughout their range. (USFWS, 2014)

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SPECIES ACCOUNT: *Drepanis (=Vestiaria) coccinea* (I'iwi)

Species Taxonomic and Listing Information

Listing Status: Proposed Threatened; 09/20/2016; Pacific Region (R1) (USFWS, 2016). Threatened October 20, 2017 (USFWS, 2017).

Physical Description

The ‘i’iwi is a medium-sized forest bird (total body length is approximately 5.5 inches (in) (14 centimeters (cm)), with bright scarlet feathers, black wings and tail, and a small white patch on its inner secondaries (shorter flight feathers along the inner wing). The bill is long, curved, and salmon in color. Juveniles are a buff color with black spots, and have shorter bills that change in color from dusky yellow to salmon as they mature (Hawaii Audubon Society 2011, p. 97) (USFWS, 2012).

Taxonomy

The ‘i’iwi is a member of the family Fringillidae, and the endemic subfamily Drepanidinae (Hawaiian honeycreepers) (Pratt et al. 2009, pp. 114, 122). The ‘i’iwi is placed in the monotypic genus (a genus of only one species) Vestiaria, and is classified as a discrete species by the American Ornithologists’ Union (AOU 1998, p. 677) (USFWS, 2012).

Historical Range

The iiwi was considered one of the most common of the native forest birds in Hawaii by early naturalists, described as ‘‘ubiquitous’’ and found from sea level to the tree line across all the major islands (Banko 1981, pp. 1–2) (USFWS, 2016).

Current Range

Today the iiwi is no longer found on Lanai and only a few individuals may be found on Oahu, Molokai, and west Maui. Remaining populations of iiwi are largely restricted to forests above approximately 3,937 feet (ft) (1,200 meters (m)) in elevation on Hawaii Island (Big Island), east Maui, and Kauai (USFWS, 2016).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: The iiwi’s diet consists primarily of nectar from the flowers of ohia and mamane (Sophora chrysophylla), various plants in the lobelia (Campanulaceae) family (Pratt et al. 2009, p. 193), and occasionally, insects and spiders (Pratt et al. 2009, p. 193; Hawaii Audubon Society 2011, p. 97) (USFWS, 2016). Adult diet includes nectar obtained from native and exotic flowers (e.g., Waring et al. 1993), and various insects and spiders, sometimes mollusks. Young are fed caterpillars. This species exhibits a diurnal phenology (NatureServe, 2015).

Reproduction Narrative

Adult: Although iiwi may breed anytime between October and August (Hawaii Audubon Society 2011, p. 97), the main breeding season occurs between February and June, which coincides with peak flowering of ohia (Fancy and Ralph 1997, p. 2). Iiwi create cupshaped nests typically within the upper canopy of ohia (Hawaii Audubon Society 2011, p. 97), and breeding pairs defend a small area around the nest and disperse after the breeding season (Fancy and Ralph 1997, p. 2). An iiwi clutch typically consists of two eggs, with a breeding pair raising one to two broods per year (Hawaii Audubon Society 2011, p. 97) (USFWS, 2016). Incubation, by female (fed by male away from nest), lasts 14 days. Young are tended by both sexes, leave nest at about 3 weeks (NatureServe, 2015).

Geographic or Habitat Restraints or Barriers

Adult: > 3,937 ft. elevation (see current range/distribution); limited to malaria-free areas (USFWS, 2016)

Spatial Arrangements of the Population

Adult: 4 - 7/ha (NatureServe, 2015)

Habitat Narrative

Adult: The species is found primarily in closed canopy, montane wet or montane mesic forests composed of tall stature ohia (Metrosideros polymorpha) trees or ohia and koa (Acacia koa) tree mixed forest. The present distribution of iiwi corresponds with areas that are above the elevation at which the transmission of avian malaria readily occurs (‘‘disease-free’’ habitats) (USFWS, 2016). On Hawaii, density was generally 4 - 7 per ha, up to 24 per ha (monthly mean) (NatureServe, 2015).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2016)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Seasonal movement (USFWS, 2016)

Dispersal

Adult: Moderate (inferred from USFWS, 2016)

Dispersal/Migration Narrative

Adult: Well known for their seasonal movements in response to the availability of flowering ohia and mamane, iiwi are strong fliers that move long distances following their breeding season to locate nectar sources (Fancy and Ralph 1998, p. 3; Kuntz 2008, p. 1; Guillamet et al. 2015, pp. EV–8—EV–9). The iiwi’s seasonal movement to lower elevation areas in search of nectar sources is an important factor in the exposure of the species to avian diseases, particularly malaria (USFWS, 2016).

Population Information and Trends

Population Trends:

Kauai: 92% decline (USFWS, 2016)

Species Trends:
Kauai: declining; Maui: declining; Hawaii: stable/declining to increasing (USFWS, 2016)

Resiliency:
Low (inferred from USFWS, 2016)

Population Size:
550,972 - 659,864 (USFWS, 2016)

Resistance to Disease:
Low (see threats)

Population Narrative:
The current abundance of iiwi rangewide is estimated at a mean of 605,418 individuals (range 550,972 to 659,864). Ninety percent of all iiwi now occur on Hawaii Island, followed by east Maui (about 10 percent), and Kauai (less than 1 percent) (Paxton et al. 2013, p. 10). Iiwi population trends and abundance vary across the islands. The population on Kauai appears to be in steep decline, with a modeled rate of decrease equivalent to a 92 percent reduction in population over a 25-year period (Paxton et al. 2013, p. 10); the total population on Kauai is estimated at a mean of 2,551 birds (range 1,934 to 3,167) (Paxton et al. 2013, p. 10). Trends on Maui are mixed, but populations there generally appear to be in decline; East Maui supports an estimated population of 59,859 individuals (range 54,569 to 65,148) (Paxton et al. 2013, p. 10). On Hawaii Island, which supports the largest remaining numbers of iiwi at an estimated average of 543,009 individuals (range 516,312 to 569,706), there is evidence for stable or declining populations on the windward side of the island, while trends are strongly increasing on the leeward (Kona) side (USFWS, 2016).

Threats and Stressors

Stressor: Disease (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: Avian malaria is a disease caused by the protozoan parasite Plasmodium relictum; the parasite is transmitted by the mosquito Culex quinquefasciatus, and invades the red blood cells of birds. Birds suffering from malaria infection undergo an acute phase of the disease during which parasitemia, a quantitative measure of the number of Plasmodium parasites in the circulating red blood cells, increases steadily. Because the parasite destroys the red blood cells, anemia and decline of physical condition can quickly result. In native Hawaiian forest birds, death may result either directly from the effects of anemia, or indirectly when anemia-weakened birds become vulnerable to predation, starvation, or a combination of other stressors (LaPointe et al. 2012, p. 213). Studies have demonstrated that native Hawaiian birds that survive avian malaria remain chronically infected, thus becoming lifetime reservoirs of the disease (Samuel et al. 2011, p. 2,960; LaPointe et al. 2012, p. 216) and remaining capable of further disease transmission to other native birds. Avian pox can be transmitted through cuts or wounds upon physical contact or through the mouth parts of blood-sucking insects such as the mosquito Culex

quinquefasciatus, the common vector for both the pox virus and avian malaria (LaPointe et al. 2012, p. 221). Tumors or lesions caused by avian pox can be crippling for birds, and may result in death (USFWS, 2016).

Stressor: Climate change (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: The natural susceptibility of native forest birds to introduced diseases, in combination with the observed restriction of Hawaiian honeycreepers to high-elevation forests, led Atkinson et al. (1995, p. S68) to predict two decades ago that a shift in the current mosquito distribution to higher elevations could be ''disastrous for those species with already reduced populations.'' Thus, climate change has significant implications for the future of Hawaiian forest birds, as predictions suggest increased temperatures may largely eliminate the high-elevation forest currently inhospitable to the transmission of mosquito-borne diseases (Benning et al. 2002, pp. 14,247–14,249; LaPointe et al. 2012, p. 219; Fortini et al. 2015, p. 9). Samuel et al. (2015, p. 15) predict further reductions and extinctions of native Hawaiian birds as a consequence, noting that the iiwi is particularly vulnerable due to its high susceptibility to malaria. Several independent studies project consistently significant negative impacts to the iiwi as a result of climate change and the increased exposure to avian malaria as disease-free habitats shrink. As iiwi are known to exhibit 95 percent mortality on average as a result of avian malaria, the current numbers of iiwi are of little consequence should all or most of the remaining individuals become exposed to the disease in the future (USFWS, 2016).

Stressor: Rapid ohia death (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: The USFWS species status report identified rapid ohia death (ROD), a type of Ceratosystis spp. vascular wilt (fungal) disease, as a factor with the potential to exacerbate the impacts currently affecting iiwi habitat and reduce the amount of disease-free habitat remaining by destroying high-elevation ohia forest. ROD was first detected in 2012 as ohia trees began mysteriously dying within lowland forests of the Puna Region of Hawaii Island. In June 2015, researchers identified the disease as ROD with an estimated area at the time of 15,000 ac (6,070 ha) of infected ohia trees (Keith et al. 2015, pp. 1–2). ROD affects non-contiguous ohia forest stands ranging in size from <1 ac (<0.4 ha) up to 247 ac (100 ha) with nearly all trees in these areas infected. Affected trees are found at elevations ranging from sea level up to approximately 5,000 ft (1,524 m), including at Wailuku Forest near Hakalau Forest NWR (Hughes 2016, pers. comm.), which contains a stable to increasing iiwi population (Paxton et al. 2013, p. 12). While ROD is presently reported only from the island of Hawaii, it has spread across a large portion of the island, which is home to 90 percent of the current iiwi population. In some areas, affected trees have been observed within the range of iiwi (Hughes 2016, pers. comm.) (USFWS, 2016).

Stressor: Inadequacy of exisitng regualtory mechanisms (USFWS, 2016)
Exposure:
Response:
Consequence:

Narrative: Many of the efforts to tackle the primary stressors to iiwi are still in the research and development stage, or are implemented only on a small or limited scale. Because the primary stressor, avian malaria, continues to have negative impacts, and these impacts are exacerbated by climate change, the Service concludes that no current conservation measures or regulations are sufficient to offset these impacts to the species (USFWS, 2016).

Stressor: Nonnative animals (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Introduced mammals have greatly impacted the native vegetation and native fauna of the Hawaiian Islands, with impacts accelerating following the arrival of Captain James Cook in 1778. Pigs are widely recognized as one of the greatest threats to forest ecosystems in Hawaii (Aplet et al. 1991, p. 56; Anderson and Stone 1993, p. 195; Pratt et al. 2009, p. 54), and occur on each of the five islands where the ‘i’iwi occurs. Pigs are extremely destructive, and directly and indirectly impact native forest communities. While rooting in the earth in search of invertebrates and plant material, pigs disturb and destroy native vegetation, and trample plants and seedlings. They may also reduce or eliminate plant regeneration by consuming seeds and seedlings (Diong 1982, pp. 161–164). In forest habitats, pigs consume many native plants including lobelioids (plants in the bellflower family), which are an important nectar source for nectarivorus birds such as the ‘i’iwi (Pratt et al. 2009, p. 150). Pigs also tear open tree fern trunks when feeding, leaving troughs that fill with rain water and develop into mosquito breeding sites (Pratt et al. 2009, p. 150); mosquitoes may carry avian malaria. Goats occupy a wide variety of habitats on each of the five islands where the ‘i’iwi occurs. Goats are able to access and forage in extremely rugged terrain, have a high reproductive capacity (Clarke and Cuddihy 1980, pp. C–19, C–20; Culliney 1988, p. 336; Cuddihy and Stone 1990, p. 64), and are believed to have completely eliminated some plant species from the islands (Atkinson and Atkinson 2000, p. 21). Mouflon sheep were introduced to Lanai and Hawaii islands in the 1950s for sport hunting purposes, and have become widely established (Tomich 1986, pp. 163–168; Cuddihy and Stone 1990, p. 66; Hess 2008, p. 1). Mouflon sheep are grazers and browsers, and have decimated vast areas of native forest and shrubland as a result of this behavior (Stone 1985, p. 271; Cuddihy and Stone 1990, pp. 63, 66; Hess 2008, p. 3). Studies on the island of Hawaii found that two of the plant species most affected are Acacia koa and Sophora chrysophylla, both of which provide food and habitat for the ‘i’iwi (Giffin 1981, pp. 22–23; Scowcroft and Conrad 1992, pp. 628–662; Hess 2008, p. 3). The reproductive potential, extreme habitat flexibility and ability to use diverse types of forage makes axis deer a serious threat to forest bird habitat, including the forest habitat used by the ‘i’iwi (Pratt et al. 2009, p. 152). During dry periods, black-tailed deer have been reported in native forest bird habitat, including ‘i’iwi habitat, in the Alakai Swamp on Kauai (Pratt et al. 2009, p. 152). In addition to directly impacting native plants through browsing, they likely serve as a primary source for spreading nonnative plants by distributing seeds through their feces as they travel (Center for Invasive Plant Management 2009, p. 2). According to Pratt et al. (2009, p. 149), cattle are present on Kauai, Molokai, Maui, and Hawaii, where the ‘i’iwi occurs. They eat native vegetation, trample roots and seedlings, cause erosion, create disturbed areas into which alien plants invade, and spread seeds of alien plants in their feces and on their bodies. The nonnative black rat impacts forest bird habitat by feeding on native plant fruits and flowers (Petition, p. 8), which impacts native plant regeneration. Pratt et al. (2009, pp. 152–153) reported that rats feed on seeds and flowers, and strip bark from plants, changing the composition of native forest plant communities, including habitat that supports the ‘i’iwi. introduced predatory insects may reduce

or eliminate specialized native insects that pollinate plants important to the ‘i’iwi. According to Pratt et al. (2009, p. 153), Metrosideros polymorpha, the native tree that provides habitat and food for the ‘i’iwi, may be particularly susceptible to damage by the nonnative two-spotted leaf-hopper (Sophonia rufofascia) (USFWS, 2014).

Stressor: Nonnative plants (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Native vegetation on all the main Hawaiian Islands has undergone extreme alteration because of past and present land management practices such as ranching, nonnative species introductions, and agricultural development (Cuddihy and Stone 1990, pp. 27, 58). Nonnative plants adversely impact native habitat in Hawaii, including forest habitat used by the ‘i’iwi, by modifying or altering light availability, soil-water regimes, and nutrient cycling processes. They also alter fire characteristics by opening areas where successive fires can burn farther into native habitats, destroying native vegetation and creating conditions that favor the establishment of nonnative species (Cuddihy and Stone, 1990, p. 74; D’Antonio and Vitousek 1992, p. 73; Smith 1985, pp. 180–181; Vitousek et al. 1997, p. 6) (USFWS, 2016).

Stressor: Predation (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: At least three rat species have been introduced to the Hawaiian Islands. The Polynesian rat (Rattus exulans) and the black rat (Rattus rattus) occur primarily in dry to wet habitats, while the Norway rat (Rattus norvegicus) is typically observed in manmade habitats, such as urban areas or agricultural fields (Tomich 1986, p. 41). The Polynesian rat is an agile climber but is seldom observed in trees, which may be due to competitive exclusion by the larger black rat (Pratt et al. 2009, p. 276). The black rat is considered to be the most significant avian predator among the three rat species (Pratt et al. 2009, p. 275). It is known to prey on incubating forest birds, their eggs, and nestlings in mesic and wet forest habitats (Snetsinger et al. 2005, p. 83; Tweed et al. 2006, p. 753). Forest bird predation by feral cats has been documented since the late 1800s (Pratt et al. 2009, p. 277). Feral cats are believed to prey on roosting or incubating native forest bird adults, on eggs, and on young (Scott et al. 1986, pp. 363–364; VanderWerf and Smith 2002, p. 73). Although most common at lower elevations, they have been observed in high-elevation rain forests on Kauai, Maui, and Hawaii (Scott et al. 1986, p. 363; Tweed et al. 2006, p. 753) (USFWS, 2014).

Stressor: Small population size/stochastic events (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: The ‘i’iwi may be threatened by environmental changes triggered by global warming, changes in disturbance regimes (e.g., storms and hurricanes), and the movement of mosquitoes and bird diseases to higher elevations. Certain ‘i’iwi populations may also be threatened because of their small size and isolation from other populations, making them susceptible to inbreeding depression, genetic drift, and random demographic fluctuations, or natural catastrophes (USFWS, 2012).

Recovery

Reclassification Criteria:
Not available - this species does not have a recovery plan.

Delisting Criteria:
Not available - this species does not have a recovery plan.

Recovery Actions:
- Not available - this species does not have a recovery plan.

Conservation Measures and Best Management Practices:
- Not available
- Protection through the Endangered Species Act: Recognition from listing will result in public awareness and conservation by Federal, State, Tribal, and local agencies, private organizations, and individuals. The Act encourages cooperation with the States and other countries and calls for recovery actions to be carried out for listed species. (USFWS, 2017).

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SPECIES ACCOUNT: *Empidonax traillii extimus* (Southwestern willow flycatcher)

Species Taxonomic and Listing Information

Listing Status: Endangered; 1995

Physical Description

The flycatcher is a small, insect-eating, neotropical migrant bird. Adults are about 5.8 inches (15 centimeters) in length. It has a grayish-green back and wings; a light grey-olive breast; a whitish throat that contrasts with the olive breast; a pale yellow belly; and two light wing bars. It is generally lacking a conspicuous eye ring. As in other flycatchers, the bill is depressed and wide at the base. The upper mandible is dark, and the lower is light. The most distinguishing characteristic between the southwestern willow and other willow flycatchers is their song, a sneezy “fitz-bew” (NatureServe 2015; USFWS 2014; USFWS 2015).

Taxonomy

This subspecies was omitted from the 1957 AOU checklist but has been recognized in all taxonomic studies of E. traillii since its original description (Unitt 1987). Genetic studies (Paxton et al. 2007) have been used to define the taxonomic/geographic scope of this subspecies to the extent possible (USFWS 2013). The southwestern willow flycatcher (Empidonax traillii extimus), from the taxonomic order Passeriformes, is one of four subspecies (E.t. adastus, E.t. brewsterii, E.t. traillii) of the willow flycatcher currently recognized (Hubbard 1987, pp. 3–6; Unitt 1987, pp. 137–144), although Browning (1993, p. 248) suggests a possible fifth subspecies (E. t. campestris) in the central and midwestern United States that does not overlap the range of the southwestern willow flycatcher. Detailed discussion regarding taxomonmy of the subspecies is presented in USFWS, 2017. (USFWS, 2017).

Historical Range

The flycatcher’s current breeding range is similar to the historical range, but the quantity of suitable habitat within that range is reduced from historical levels (USFWS 2014).

Current Range

U.S.: Arizona, California, Colorado, New Mexico, Nevada, Texas, Utah. The southwestern willow flycatcher occurs in the southwestern United States and extreme northwestern Mexico. Most of the population is in New Mexico and Arizona. The northern distributional limit of this subspecies cannot be precisely defined. Elevational range extends from near sea level to more than 8,520 feet (2,600 meters); the majority of territories are below 5,250 feet (1,600 meters) (NatureServe 2015). The breeding range of the southwestern willow flycatcher includes southern California, Arizona, New Mexico, extreme southern portions of Nevada and Utah, far western Texas, perhaps southwestern Colorado, and extreme northwestern Mexico. In Nevada, this subspecies can be found along the Virgin River, lower Muddy River, Colorado River, and Pahranagat Valley (USFWS 2015).

Distinct Population Segments Defined

No.

Critical Habitat Designated

Yes; 1/1/2013.

Legal Description

On January 3, 2013, the U.S. Fish and Wildlife Service (Service) designated revised critical habitat for the southwestern willow flycatcher (Empidonax traillii extimus) (flycatcher) under the Endangered Species Act. In total, approximately 1,975 stream kilometers (1,227 stream miles) are being designated as critical habitat. These areas are designated as stream segments, with the lateral extent including the riparian areas and streams that occur within the 100-year floodplain or flood-prone areas encompassing a total area of approximately 84,569 hectares (208,973 acres) (78 FR 343 - 534).

Critical Habitat Designation

Stream segments in 24 Management Units found in six Recovery Units are designated as flycatcher critical habitat. The designated stream segments occur in California, Nevada, Utah, Colorado, Arizona and New Mexico and include a total of approximately 1,975 km (1,227 mi) of streams.

Coastal California Recovery Unit in California: (1) Santa Ynez Management Unit— Santa Ynez River and Mono Creek. (2) Santa Clara Management Unit— Santa Clara River, Ventura River, Piru Creek, Castaic Creek, Big Tujunga Canyon, and San Gabriel River. (3) Santa Ana Management Unit— Bear Creek, Mill Creek, Oak Glen Creek, San Timoteo Creek, Santa Ana River (including portions of Prado Basin), Waterman Creek, and Bautista Creek. (4) San Diego Management Unit— Santa Margarita River, DeLuz Creek, San Luis Rey River, Pilgrim Creek, Agua Hedionda Creek, Santa Ysabel Creek, Temescal Creek, Temecula Creek, Sweetwater River, and San Diego River.

Basin and Mojave Recovery Unit in California and Nevada: (5) Kern Management Unit—South Fork Kern River (including upper Lake Isabella) and Canebrake Creek, California. (6) Mojave Management Unit—Deep Creek, Holcomb Creek, Mojave River, and West Fork Mojave River, California. (7) Salton Management Unit—San Felipe Creek and Mill Creek, California. (8) Amargosa Management Unit— Willow Creek, California; Amargosa River, California and Nevada; and five separate riparian areas within Ash Meadows National Wildlife Refuge, Nevada.

Lower Colorado Recovery Unit in Nevada, California and Arizona Border, Arizona, Utah, and New Mexico: (9) Little Colorado Management Unit—Little Colorado River and West Fork Little Colorado River, Arizona. (10) Virgin Management Unit—Virgin River, Nevada, Arizona, and Utah. (11) Pahranagat Management Unit— Pahranagat River, Nevada. (12) Bill Williams Management Unit— Big Sandy River, Bill Williams River, and Santa Maria Rivers (including upper Alamo Lake), Arizona.

Upper Colorado Recovery Unit in Arizona, Utah, Colorado, and New Mexico: (13) San Juan Management Unit—Los Pinos River, Colorado; San Juan River (north bank), Utah. (14) Powell Management Unit—Paria River, Utah.

Gila Recovery Unit in Arizona and New Mexico: (15) Verde Management Unit—Verde River, Arizona. (16) Roosevelt Management Unit— Salt River and Tonto Creek, Arizona. (17) Middle Gila and San Pedro Management Unit—Gila River and San Pedro River, Arizona. (18) Upper Gila

Management Unit— Gila River in Arizona and New Mexico. (19) Santa Cruz Management Unit—Santa Cruz River, Empire Gulch, and Cienega Creek, Arizona. (20) San Francisco Management Unit—San Francisco River, Arizona and New Mexico. (21) Hassayampa and Agua Fria Management Unit—Hassayampa River, Arizona.

Rio Grande Recovery Unit in New Mexico and Colorado: (22) San Luis Valley Management Unit—Conejos River and Rio Grande, Colorado. (23) Upper Rio Grande Management Unit—Coyote Creek, Rio Grande, Rio Grande del Rancho, and Rio Fernando, New Mexico. (24) Middle Rio Grande Management Unit—Rio Grande, New Mexico. Table 1 below lists all the streams included in this revised designation and whether they are considered occupied at the time of listing and whether they are currently considered occupied.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Inyo, Kern, Los Angeles, Riverside, Santa Barbara, San Bernardino, San Diego, and Ventura Counties in California; Clark, Lincoln, and Nye Counties in southern Nevada; Kane, San Juan, and Washington Counties in southern Utah; Alamosa, Conejos, Costilla, and La Plata Counties in southern Colorado; Apache, Cochise, Gila, Graham, Greenlee, La Paz, Maricopa, Mohave, Pima, Pinal, Santa Cruz, and Yavapai Counties in Arizona; and Catron, Grant, Hidalgo, Mora, Rio Arriba, Socorro, Taos, and Valencia Counties in New Mexico. Within these areas, the primary constituent elements of the physical and biological features essential to the conservation of the southwestern willow flycatcher consist of two components:

(i) Riparian vegetation. Riparian habitat along a dynamic river or lakeside, in a natural or manmade successional environment (for nesting, foraging, migration, dispersal, and shelter) that is comprised of trees and shrubs (that can include Gooddings willow, coyote willow, Geyer's willow, arroyo willow, red willow, yewleaf willow, pacific willow, boxelder, tamarisk, Russian olive, buttonbush, cottonwood, stinging nettle, alder, velvet ash, poison hemlock, blackberry, seep willow, oak, rose, sycamore, false indigo, Pacific poison ivy, grape, Virginia creeper, Siberian elm, and walnut) and some combination of: (A) Dense riparian vegetation with thickets of trees and shrubs that can range in height from about 2 meters (m) to 30 m (about 6 feet (ft) to 98 ft). Lowerstature thickets (2 to 4 m or 6 to 13 ft tall) are found at higher elevation riparian forests, and tall-stature thickets are found at middle- and lowerelevation riparian forests; (B) Areas of dense riparian foliage at least from the ground level up to approximately 4 m (13 ft) above ground or dense foliage only at the shrub or tree level as a low, dense canopy; (C) Sites for nesting that contain a dense (about 50 percent to 100 percent) tree or shrub (or both) canopy (the amount of cover provided by tree and shrub branches measured from the ground); (D) Dense patches of riparian forests that are interspersed with small openings of open water or marsh or areas with shorter and sparser vegetation that creates a variety of habitat that is not uniformly dense. Patch size may be as small as 0.1 hectare (ha) (0.25 acre (ac)) or as large as 70 ha (175 ac).

(ii) Insect prey populations. A variety of insect prey populations found within or adjacent to riparian floodplains or moist environments, which can include: flying ants, wasps, and bees (Hymenoptera); dragonflies (Odonata); flies (Diptera); true bugs (Hemiptera); beetles (Coleoptera); butterflies, moths, and caterpillars (Lepidoptera); and spittlebugs (Homoptera).

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on February 4, 2013.

Essential features in need of special management occur not only at the immediate locations where the flycatcher may be present, but at additional areas needed to reach recovery goals and areas that can provide for normal population fluctuations and habitat succession that may occur in response to natural and unpredictable events. The flycatcher may be dependent upon habitat components beyond the immediate areas where individuals of the species occur if they are important in maintaining ecological processes such as hydrologic regimes; plant germination, growth, maintenance, and regeneration (succession); sedimentation; groundwater elevations; plant health and vigor; or maintenance of prey populations.

Some of the special management actions that may be needed for essential features of flycatcher habitat are briefly summarized below: (1) Restore adequate water-related elements to improve and expand the quality, quantity, and distribution of riparian habitat. Special management may: increase efficiency of groundwater management; use urban water outfall and irrigation delivery and tail waters for vegetation improvement; maintain, improve, provide, or reestablish instream flows to expand the quality, distribution, and abundance of riparian vegetation; increase the width between levees to expand the active channel during overbank flooding; and manage regulated river flows to more closely resemble the natural hydrologic regime. (2) Retain riparian vegetation in the floodplain. Special management may include the following actions: avoid clearing channels for flood flow conveyance or plowing of flood plains; and implement projects to minimize clearing of vegetation (including exotic vegetation) to help ensure that desired native species and exotic vegetation persist until an effective riparian vegetation improvement plan can be implemented. (3) Manage biotic elements and processes. Special management may include the following actions: manage livestock grazing to increase flycatcher habitat quality and quantity by determining appropriate areas, seasons, and use consistent within the natural historical norm and tolerances; reconfigure grazing units, improve fencing, and improve monitoring and documentation of grazing practices; manage wild and feral hoofed-mammals (ungulates) (e.g., elk, horses, burros) to increase flycatcher habitat quality and quantity; and manage keystone species such as beaver to restore desired processes to increase habitat quality and quantity. (4) Protect riparian areas from recreational impacts. Special management may include actions such as managing trails, campsites, off-road vehicles, and fires to prevent habitat development and degradation in flycatcher habitat. (5) Manage exotic plant species, such as tamarisk or Russian olive, by reducing conditions that allow exotics to be successful, and restoring or reestablishing conditions that allow native plants to thrive. Throughout the range of the flycatcher, the success of exotic plants within river floodplains is largely a symptom of land and water management (for example, groundwater withdrawal, surface water diversion, dam operation, and unmanaged grazing) that has created conditions favorable to exotic plants over native plants. Special management may include the following actions: eliminate or reduce dewatering stressors such as surface water diversion and groundwater pumping to increase stream flow and groundwater elevations; reduce salinity levels by modifying agricultural practices and restoring natural hydrologic regimes and flushing flood flows; in regulated streams, restore more natural hydrologic regimes that favor germination and growth of native plant species. Improve timing of water draw down in lake bottoms to coincide with the seed dispersal and germination of native species; and restore ungulate herbivory to intensities and levels under which native riparian species are more competitive. (6) Manage fire to maintain and enhance habitat quality and quantity. Special management may include the following actions: suppress fires that occur; and reduce risk of fire by restoring elevated groundwater levels, base flows, flooding, and natural hydrologic regimes in order to prevent drying of riparian areas and more flammable exotic plant species from developing; and reduce risk of recreational fires. (7) Evaluate and conduct exotic plant species removal and native plant species management on a site-by-site basis. If habitat assessments reveal a sustained increase in exotic plant abundance, conduct an evaluation of the underlying causes and conduct vegetation improvement under measures described in the Recovery Plan (Service 2002, Appendices H and K). Remove exotics only if: underlying causes for dominance have been addressed; there is evidence that exotic species will be replaced by vegetation of higher functional value; and the action is part of an overall vegetation improvement plan. Native riparian vegetation improvement plans should include: a staggered approach to create mosaics of different aged successional tree and shrub stands; consideration of whether the sites are presently occupied by nesting flycatchers; and management of stressors that can improve the germination, growth, and maintenance of preferred vegetation. (8) Manage or reduce the occurrence, spread, and effects of biocontrol agents on flycatcher habitat. Exotic biocontrol tamarisk leaf beetle insects (leaf beetles) were brought into and released in many locations throughout the western United States. This specific U.S. Department of Agriculture program was terminated in 2010, largely because these insects are moving farther and thriving in the southwestern United States (within the flycatcher's breeding range) where it was initially believed they would not persist (APHIS 2010, p. 2). However, leaf beetles still exist within the United States, and specifically within the northern range of the flycatcher in Nevada, Arizona, and New Mexico. It is unknown to what extent these leaf beetles will continue to move throughout the Southwest. Their overall impact or benefit to the flycatcher, flycatcher habitat, and other wildlife species is also unknown, but there are predictions that the beetles could occur throughout the western United States and into northern Mexico (Tracy et al. 2008, pp. 1–3). There is concern about effects to the flycatcher in places throughout much of its range where the landscape does not support healthy native riparian vegetation (even in the absence of tamarisk). Along the Virgin River in southwestern Utah, flycatcher breeding attempts have failed concurrent with leaf beetle impacts to the vegetation (Paxton et al. 2010, p.1). Rangewide, tamarisk is a habitat component of over half of all known flycatcher territories (Durst et al. 2007, p. 15). Therefore, it would be beneficial to prevent purposeful or accidental intra- or interstate transport of leaf beetles to locations that would increase the likelihood of beetles dispersing to flycatcher habitat. Similarly, because insects can travel or be moved large distances, prevent the additional release of leaf beetles (in all their varieties) into the environment where they can eventually occur within flycatcher habitat. Where leaf beetle-related impacts may occur or are happening, consider the previous items in this list and the Recovery Plan for strategies to help improve the germination and growth of native plants (Service 2002, p. Appendix K).

Life History

Feeding Narrative

Adult: Flycatchers are diurnal invertivores. They forage in and above the canopy, along the patch edge, in openings in the territory and above water, and glean from tall trees as well as herbaceous ground cover. They eat mainly insects caught in flight, and sometimes glean insects from foliage; occasionally they eat berries

Reproduction Narrative

Adult: Nesting occurs usually from early June through the end of July, peaking in mid-June (Unitt 1987); sometimes they may lay eggs as early as late May. In the Grand Canyon, Arizona, the species breeds from early June to mid-July or perhaps early August (Brown 1988). The clutch size usually is 3 to 4 eggs (2 to 3 along Colorado River). Incubation, by the female, lasts 12 to 15 days. Young are tended by both parents and leave the nest at 12 to 15 days, usually in early to mid-July. They typically raise one brood per year. Females may produce 3.3 (mean) offspring over the estimated lifetime (1.9 mean to a maximum of 9 years). Breeding territories are about 1.5 acres. Densities may be on the order of 9-14 pairs/100 acres. They may incur a high rate of cowbird parasitism, especially in low elevation populations (e.g., Harris 1991, Brown 1988). They are sometimes polygynous.

Geographic or Habitat Restraints or Barriers

Adult: Latitudinal and elevation differences and their associated ecological effects could form an ecological barrier that inhibits gene flow between populations (USFWS 2014).

Spatial Arrangements of the Population

Adult: Metapopulations. Flycatchers are believed to exist and interact as groups of metapopulations (USFWS 2002, p. 72). A metapopulation is a group of geographically separate flycatcher breeding populations connected to each other by immigration and emigration (USFWS 2002, p. 72). Flycatcher metapopulations are most stable where many connected sites or large populations exist (USFWS 2002, p. 72).

Site Fidelity

Adult: High. Flycatchers have higher site fidelity (to a local area) than nest fidelity (to a specific nest location) and can move among sites within stream drainages and between drainages (Kenwood and Paxton 2001, pp. 29–31). Within-drainage movements are more common than between-drainage movements (Kenwood and Paxton 2001, p. 18).

Habitat Narrative

Adult: The flycatcher currently breeds in areas from near sea level to over 2,600 meters (m) (8,500 feet [ft]) (Durst et al. 2008, p. 14) in vegetation alongside rivers, streams, or other wetlands (riparian habitat). It establishes nesting territories, builds nests, and forages where mosaics of relatively dense and expansive growths of trees and shrubs are established, generally near or adjacent to surface water or underlain by saturated soil (Sogge et al. 2010, p. 4). Habitat characteristics such as dominant plant species, size and shape of habitat patch, tree canopy structure, vegetation height, and vegetation density vary widely among breeding sites. Nests are typically placed in trees where the plant growth is most dense, where trees and shrubs have vegetation near ground level, and where there is a low-density canopy. Some of the more common tree and shrub species currently known to comprise nesting habitat include Gooddings willow (Salix gooddingii), coyote willow (S. exigua), Geyer's willow (S. geyeriana), arroyo willow (S. lasiolepis), red willow (S. laevigata), yewleaf willow (S. taxifolia), boxelder (Acer negundo), tamarisk (also known as saltcedar, Tamarix ramosissima), and Russian olive (Elaeagnus angustifolia) (USFWS 2002, p. D-2). While there are exceptions, generally flycatchers are not found nesting in areas without willows, tamarisk, or both.

Dispersal/Migration

Motility/Mobility

Adult: Mobile

Migratory vs Non-migratory vs Seasonal Movements

Adult: Between August and September, the southwestern willow flycatcher migrates to wintering grounds in Mexico, Central America, and possibly northern South America.

Dispersal/Migration Narrative

Adult: Between August and September, the southwestern willow flycatcher migrates to wintering grounds in Mexico, Central America, and possibly northern South America. The Pacific lowlands of Costa Rica appear to be a key winter location for the southwestern willow flycatcher, although other countries in Central America may also be important for the subspecies (Paxton et al. 2011a, p. 608). Willow flycatchers, like most small, migratory, insect-eating birds require food-rich stopover areas in order to replenish energy reserves and continue their northward or southward migration (Finch et al. 2000, pp. 71, 78, and 79; USFWS 2002, pp. E-3, 42). Migration stopover areas are likely critically important for flycatcher productivity and survival (Sogge et al. 1997a, p. 13; Yong and Finch 1997, p. 253; USFWS 2002, pp. E-3,19).

Population Information and Trends

Population Trends:

Unknown

Species Trends:

Increasing; since 2002, the overall estimated number of flycatcher territories rangewide has increased from 986 to 1,299 (USFWS 2014).

Resiliency:

Moderate. The breeding range of the southwestern willow flycatcher is fairly broad, and encompasses about 80,000 to 1,000,000 square miles (200,000 to 2,500,000 square kilometers); this subspecies is represented by many distinct occurrences and locations (NatureServe 2015). Potential suitable habitat that is available for restoration is limited.

Representation:

Moderate. There are approximately 1,300 flycatcher territories rangewide (USFWS 2014). The current range is similar to the historical range, but the amount of suitable habitat within that range is reduced from historical levels (NatureServe 2015). Although the known status of the flycatcher has improved since its listing, declines have begun to occur across broad portions of the flycatcher's range, and more are anticipated.

Redundancy:

Moderate. Population size is estimated to be between 2,500 and 10,000 individuals (NatureServe 2015). The trend over the past 10 years or three generations is uncertain, but areas of occupancy and abundance probably have been relatively stable or slowly declining (NatureServe 2015).

Number of Populations:

~ 1,300 rangewide; in the U.S. only 6 populations have greater than 50 nesting pairs.

Population Size:

2,500 to 10,000 individuals. As of 2017: The most current estimated number of flycatcher territories rangewide is 1,299 (Durst et al. 2008, pp.12-13). (USFWS, 2017).

Additional Population-level Information:

Overall species viability is Moderate. New in 2017: The draft number of territories estimated rangewide as of the end of the 2012 breeding season was 1,629 (Durst. S., USFWS, pers. comm. 2014). The raw rangewide results (not an estimate of the entire range) from survey efforts in 2014 and 2015 are 1,074 and 1,037 territories, respectively. Again, these results are largely supported by territories within the Middle Rio Grande in NM, Upper Gila River in NM and AZ, and Gila River and San Pedro confluence in AZ. (USFWS, 2017).

Population Narrative:

The breeding range of the southwestern willow flycatcher is fairly broad, and encompasses about 80,000 to 1,000,000 square miles (200,000 to 2,500,000 square kilometers); the subspecies is represented by many distinct occurrences and locations (NatureServe 2015). The population size is estimated to be between 2,500 and 10,000 individuals (NatureServe 2015). However, in the U.S. only 6 populations have greater than 50 nesting pairs.The trend over the past 10 years or three generations is uncertain, but areas of occupancy and abundance probably have been relatively stable or slowly declining (NatureServe 2015). However, since 2002, the overall estimated number of flycatcher territories rangewide has increased from 986 to 1,299 (USFWS 2014).

Threats and Stressors

Stressor: Habitat loss and modification
Exposure: Not assessed
Response: Not assesseed
Consequence: Not assessed
Narrative: The primary cause of the flycatcher's decline is loss and modification of habitat. Its riparian nesting habitat tends to be uncommon, isolated, and widely dispersed. Industrial, agricultural, and urban developments have modified, reduced, and destroyed once-existing riparian habitat. Reductions in water flow and interruptions of natural hydrological events and cycles, as well as physical modifications to streams and native plant communities, have also directly impacted the available habitat of the southwestern willow flycatcher. Additionally, livestock grazing, recreational use, exotic species, and fire have contributed to alteration of the native riparian habitat. New in 2017: Additional specific causes of habitat alteration include dams, diversions, groundwater pumping, channelization, bank stabilization, levees, removal of riparian vegetation to reduce water loss through evapo-transpiration, drought, climate change. (USFWS, 2017).

Stressor: Nest parasitism
Exposure:
Response:
Consequence:
Narrative: Parasitism by brown-headed cowbirds (Molothrus ater) has probably occurred naturally in much of the flycatcher's range for thousands of years; however, they likely increased

in abundance with European settlement, and now result in reductions in the number of flycatcher young fledged per female.

Stressor: Genetic inbreeding
Exposure:
Response:
Consequence:
Narrative: As a result of the small population size of this species and the isolation of breeding groups, the species is vulnerable to local extirpation from stochastic events. Because the flycatcher exists in small populations, there has been concern regarding potential low genetic variation within populations, and possible inbreeding.

Stressor: Insufficient stop-over habitat for migration
Exposure:
Response:
Consequence:
Narrative: As a neotropical migrant, the flycatcher spends significantly more time migrating than it does on wintering grounds. Migration is a period of high energy demands, and migrating individuals must find suitable stopover habitat. Insufficient stopover habitat, along with destruction or degradation of existing habitat, could lead to increased mortality during migration (USFWS 2002).

Stressor: Tamarisk leaf beetle (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Introduced tamarisk leaf beetles defoliate tamarisk, also an exotic species, but one that the flycatchers use for nesting habitat. From their initial release, beetles have spread into the flycatcher's breeding range in southern NV, southern UT, northern AZ, NM, and along the AZ/CA border. Along the Virgin River in southwestern UT where nesting flycatchers and beetles occur, tamarisk was defoliated while birds were nesting, degrading habitat quality (i.e. vegetative cover, humidity), likely causing or contributing to flycatcher nesting failure (Paxton et al. 2010). The arid southwestern desert-adapted tamarisk leaf beetle released in TX has moved north into the Middle Rio Grande in NM. In 2016 the beetles were found within the largest known concentration of flycatcher breeding territories at Elephant Butte Reservoir. After beetle movement had stalled for a number of years along the lower Colorado River near Hoover Dam and Lake Mohave, beetles were found in 2016 further south at Topock Marsh and along the lower Bill Williams River (both locations where flycatcher territories occur). It is now believed that the beetle is capable of spreading and defoliating tamarisk throughout the full breeding range of the flycatcher (APHIS 2010a, p.5, Tracy et al. 2008). (USFWS, 2017). Even though APHIS has effectively terminated its beetle reintroduction program due to the beetle's unanticipated movements and potential impact to the flycatcher, there continues to be interest in moving and releasing beetles to control tamarisk. For example, in 2016, the University of CA at Santa Barbara collaborated with the State of CA, counties, and local landowners to seek transport and release of beetles to the Santa Clara River in Ventura County, CA (McMorran, R., USFWS, pers. comm. 2016). Currently leaf beetles are not known to occur within the flycatcher's breeding range in coastal CA. Portions of the Santa Clara River are designated as flycatcher critical habitat and have

previously held flycatcher territories. Progress on beetle movement and release into southern CA is awaiting environmental compliance with various regulatory agencies. (USFWS, 2017).

Stressor: Shot Hole Borer Beetles (USFWS, 2017)
Exposure:
Response:
Consequence:
Narrative: A disease complex involving polyphagous (PSHB) and kuroshio (KSHB) shot hole borer beetles and their associated fungi and pathogens is causing widespread damage to trees in riparian ecosystems throughout southern CA (Stewart 2016), and may potentially impact flycatcher habitat in the near future. The PSHB and KSHB are from Southeast Asia and believed to have come to CA from nursery plants (Stewart 2016). They create tunnels throughout trees and introduce fungal spores causing significant damage (Stewart 2016). The affected trees also become weakened and susceptible to other pathogens (Stewart 2016). The disease complex is known to attack 304 tree species (agricultural, ornamental, and native) and reproduce successfully in at least 43 tree species, including 13 natives such as riparian species (oak, willow, cottonwood, and sycamore) and desert species such as mesquite and palo verde (Stewart 2016). Neither species of shot hole borer has yet been confirmed in a CA desert ecosystem (Stewart 2016). (USFWS, 2017).

Recovery

Reclassification Criteria:
Alternative A: Increase the total known population to a minimum of 1,950 territories (equating to approximately 3,900 individuals), geographically distributed to allow proper functioning as metapopulations, so that the flycatcher is no longer in danger of extinction. For reclassification to threatened status, these prescribed numbers and distributions must be reached as a minimum, and maintained over a 5-year period.

Alternative B: Increase the total known population to a minimum of 1,500 territories (equating to approximately 3,000 individuals), geographically distributed among Management Units and Recovery Units so that the flycatcher is no longer in danger of extinction. For reclassification to threatened status, these prescribed numbers and distributions must be reached as a minimum and maintained over a 3-year period, and the habitats supporting these flycatchers must be protected from threats and loss.

Delisting Criteria:
1. Meet and maintain, at a minimum, the population levels and geographic distribution specified under reclassification to threatened Downlisting Alternative A; increase the total known population to a minimum of 1,950 territories (equating to approximately 3,900 individuals), geographically distributed to allow proper functioning as metapopulations.

2. Provide protection from threats and create/secure sufficient habitat to assure maintenance of these populations and/or habitats over time. The sites containing flycatcher breeding groups, in sufficient number and distribution to warrant downlisting, must be protected into the foreseeable future through development and implementation of conservation management agreements. Conservation management agreements may take many forms, including but not limited to the public land management planning process for Federal lands, habitat conservation

plans (under Section 10 of the ESA), conservation easements, and private land acquisition agreements, and inter-governmental conservation agreements with Tribes. The flycatcher may be considered for delisting when (a) the Service has confirmed that the agreements have been created and executed in such a way as to achieve their role in flycatcher recovery, and (b) the individual agreements for all areas within all Management Units (public, private, and Tribal) that are critical to metapopulation stability (including suitable, unoccupied habitat) have demonstrated their effectiveness for a period of at least five years prior to delisting. To achieve and maintain recovery, it is likely that a network of conservation on Federal, State, Tribal, and other public and private lands will be necessary. To ensure that the population and habitat enhancement achieved for downlisting persist over the long-term, and to preclude the need for future relisting of the flycatcher under the ESA, the management agreements must address the following: (1) Minimize the major stressors to the flycatcher and its habitat (including but not limited to floodplain and watershed management, groundwater and surface water management, and livestock management); (2) Ensure that natural ecological processes and/or active human manipulation needed to develop and maintain suitable habitat prevail in areas critical to achieving metapopulation stability; and (3) The amount of suitable breeding habitat available within each Management Unit is at least double the amount required to support the target number of flycatchers described under reclassification to threatened Downlisting Alternative A.

Recovery Actions:

- 1. Restore adequate water-related elements to improve and expand the quality, quantity, and distribution of riparian habitat. Special management may: increase efficiency of groundwater management; use urban water outfall and irrigation delivery and tail waters for vegetation improvement; maintain, improve, provide, or reestablish instream flows to expand the quality, distribution, and abundance of riparian vegetation; increase the width between levees to expand the active channel during overbank flooding; and manage regulated river flows to more closely resemble the natural hydrologic regime.
- 2. Retain riparian vegetation in the floodplain. Special management may include the following actions: avoid clearing channels for flood flow conveyance or plowing of flood plains; and implement projects to minimize clearing of vegetation (including exotic vegetation) to help ensure that desired native species and exotic vegetation persist until an effective riparian vegetation improvement plan can be implemented.
- 3. Manage biotic elements and processes. Special management may include the following actions: manage livestock grazing to increase flycatcher habitat quality and quantity by determining appropriate areas, seasons, and use consistent within the natural historical norm and tolerances; reconfigure grazing units, improve fencing, and improve monitoring and documentation of grazing practices; manage wild and feral hoofed-mammals (ungulates) (e.g., elk, horses, burros) to increase flycatcher habitat quality and quantity; and manage keystone species such as beaver to restore desired processes to increase habitat quality and quantity.
- 4. Protect riparian areas from recreational impacts. Special management may include actions such as managing trails, campsites, off-road vehicles, and fires to prevent habitat development and degradation in flycatcher habitat.
- 5. Manage exotic plant species, such as tamarisk or Russian olive, by reducing conditions that allow exotics to be successful, and restoring or reestablishing conditions that allow native plants to thrive. Throughout the range of the flycatcher, the success of exotic plants within river floodplains is largely a symptom of land and water management (for example,

groundwater withdrawal, surface water diversion, dam operation, and unmanaged grazing) that has created conditions favorable to exotic plants over native plants. Special management may include the following actions: eliminate or reduce dewatering stressors such as surface water diversion and groundwater pumping to increase stream flow and groundwater elevations; reduce salinity levels by modifying agricultural practices and restoring natural hydrologic regimes and flushing flood flows; in regulated streams, restore more natural hydrologic regimes that favor germination and growth of native plant species. Improve timing of water draw down in lake bottoms to coincide with the seed dispersal and germination of native species; and restore ungulate herbivory to intensities and levels under which native riparian species are more competitive.

- 6. Manage fire to maintain and enhance habitat quality and quantity. Special management may include the following actions: suppress fires that occur; and reduce risk of fire by restoring elevated groundwater levels, base flows, flooding, and natural hydrologic regimes in order to prevent drying of riparian areas and more flammable exotic plant species from developing; and reduce risk of recreational fires.
- 7. Evaluate and conduct exotic plant species removal and native plant species management on a site-by-site basis. If habitat assessments reveal a sustained increase in exotic plant abundance, conduct an evaluation of the underlying causes and conduct vegetation improvement under measures described in the Recovery Plan (USFWS 2002). Remove exotics only if: underlying causes for dominance have been addressed; there is evidence that exotic species will be replaced by vegetation of higher functional value; and the action is part of an overall vegetation improvement plan. Native riparian vegetation improvement plans should include: a staggered approach to create mosaics of different aged successional tree and shrub stands; consideration of whether the sites are presently occupied by nesting flycatchers; and management of stressors that can improve the germination, growth, and maintenance of preferred vegetation.
- 8. Manage or reduce the occurrence, spread, and effects of biocontrol agents on flycatcher habitat. Exotic biocontrol tamarisk leaf beetle insects (leaf beetles) were brought into and released in many locations throughout the western United States. This specific U.S. Department of Agriculture program was terminated in 2010, largely because these insects are moving farther and thriving in the southwestern United States (within the flycatcher's breeding range) where it was initially believed they would not persist. However, leaf beetles still exist within the United States, and specifically within the northern range of the flycatcher in Nevada, Arizona, and New Mexico. It is unknown to what extent these leaf beetles will continue to move throughout the Southwest. Their overall impact or benefit to the flycatcher, flycatcher habitat, and other wildlife species is also unknown, but there are predictions that the beetles could occur throughout the western United States and into northern Mexico. There is concern about effects to the flycatcher in places throughout much of its range where the landscape does not support healthy native riparian vegetation (even in the absence of tamarisk). Along the Virgin River in southwestern Utah, flycatcher breeding attempts have failed concurrent with leaf beetle impacts to the vegetation. Rangewide, tamarisk is a habitat component of over half of all known flycatcher territories. Therefore, it would be beneficial to prevent purposeful or accidental intra- or interstate transport of leaf beetles to locations that would increase the likelihood of beetles dispersing to flycatcher habitat. Similarly, because insects can travel or be moved large distances, prevent the additional release of leaf beetles (in all their varieties) into the environment where they can eventually occur within flycatcher habitat. Where leaf beetle-related impacts may occur or are happening, consider the previous items in this list and the

Recovery Plan for strategies to help improve the germination and growth of native plants (USFWS 2002).

Conservation Measures and Best Management Practices:

- See recovery measures
- Federal and state regulations, including the National Environmental Policy Act, Migratory Bird Treaty Act, Endangered Species Act, Sikes Act, Habitat Conservation Plans, Natural Community Conservation Planning Act, Safe Harbor Agreements, state laws, California Environmental Quality Act. (USFWS, 2017).

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SPECIES ACCOUNT: *Eremophila alpestris strigata* (Streaked Horned lark)

Species Taxonomic and Listing Information

Listing Status: Threatened; Pacific Region (R1) (USFWS, 2016)

Physical Description

The streaked horned lark (Eremophila alpestris strigata) is endemic to the Pacific Northwest (British Columbia, Washington, and Oregon) (Altman 2011, p. 196) and is a subspecies of the wide-ranging horned lark (Eremophila alpestris sp.). Horned larks are small, ground-dwelling birds, approximately 16 to 20 cm (6 to 8 inches) in length (Beason 1995, p. 2). Adults are pale brown, but shades of brown vary geographically among the subspecies. The male's face has a yellow wash in most subspecies. Adults have a black bib, black whisker marks, black "horns" (feather tufts that can be raised or lowered), and black tail feathers with white margins (Beason 1995, p. 2). Juveniles lack the black face pattern and are varying shades of gray, from almost white to almost black with a silver-speckled back (Beason 1995, p. 2) (USFWS, 2016).

Taxonomy

The horned lark is found throughout the northern hemisphere (Beason 1995, p. 1); it is the only true lark native to North America (Beason 1995, p. 1). Subspecies of horned larks are based primarily on differences in color, body size, and wing length. Molecular analysis has further borne out these morphological distinctions (Drovetski et al. 2005, p. 875). Western populations of horned larks are generally paler and smaller than eastern and northern populations (Beason 1995, p. 3). The streaked horned lark was first described as Otocorys alpestris strigata by Henshaw (1884, pp. 261–264, 267–268). There are four other subspecies of horned larks that occur in Washington and Oregon: pallid horned lark (E. a. alpina), dusky horned lark (E. a. merrilli), Warner horned lark (E. a. lamprochroma), and arctic horned lark (E. a. articola) (Marshall et al. 2003, p. 426; Wahl et al. 2005, p. 268). None of these other subspecies breed within the range of the streaked horned lark, but all four subspecies frequently overwinter in mixed species flocks in the Willamette Valley (Marshall et al. 2003, pp. 425–427). Drovetski et al. (2005, p. 877) evaluated the genetic distinctiveness, conservation status, and level of genetic diversity of the streaked horned lark using the complete mitochondrial ND2 gene. Samples from 32 streaked horned larks in western Washington and 66 horned larks from Alaska, alpine Washington, eastern Washington, eastern Oregon, and California were analyzed. The 30 haplotypes identified from the 98 horned larks formed three clades (taxonomic group of organisms classed together based on homologous features traced to a common ancestor): Pacific Northwest (alpine and eastern Washington, Alaska), Pacific Coast (Puget Sound and Washington coast) and coastal California, and Great Basin (Oregon) (Drovetski et al. 2005, p. 880). Analyses indicate that the streaked horned lark population is well-differentiated and isolated from all other sampled localities, including coastal California, and has "remarkably low genetic diversity" (Drovetski et al. 2005, p. 875). All 32 streaked horned lark individuals shared the same haplotype with no variation between sequences compared. All other localities had multiple haplotypes despite smaller sample sizes (Drovetski et al. 2005, pp. 879–880). The lack of mitochondrial DNA (mtDNA) diversity exhibited by streaked horned larks is consistent with a population bottleneck (Drovetski et al. 2005, p. 881). The streaked horned lark is differentiated and isolated from all other sampled localities, and although it was "…historically a part of a larger Pacific Coast lineage of horned larks, it has been evolving independently for some time and can be considered a distinct evolutionary unit" (Drovetski et al. 2005, p. 880). The streaked horned lark is recognized as a valid subspecies by the Integrated Taxonomic Information System (2012c) (USFWS, 2016).

Historical Range

The streaked horned lark's breeding range historically extended from southern British Columbia, Canada, south through the Puget lowlands and outer coast of Washington, along the lower Columbia River, through the Willamette Valley, the Oregon coast and into the Umpqua and Rogue River Valleys of southwestern Oregon (Altman 2011). The subspecies has been extirpated as a breeding species throughout much of its range, including all of its former range in British Columbia, the San Juan Islands, the northern Puget Trough, the Washington coast north of Grays Harbor County, the Oregon coast, and the Rogue and Umpqua Valleys in southwestern Oregon (Pearson and Altman 2005) (USFWS, 2016).

Current Range

The current range and distribution of the streaked horned lark can be divided into three regions: 1) the south Puget Sound in Washington; 2) the Washington coast and lower Columbia River islands (including dredge spoil deposition and industrial sites near the Columbia River in Portland, Oregon); and 3) the Willamette Valley in Oregon (USFWS, 2016). Breeding Range: Streaked horned larks currently breed on seven sites in the south Puget Sound. Four of these sites are on Joint Base Lewis McChord: 13th Division Prairie, Gray Army Airfield, McChord Field, and 91st Division Prairie. The largest population of streaked horned larks currently breeds at the Olympia Regional Airport and a small population nests at the Port of Shelton's Sanderson Field (airport) (Pearson and Altman 2005; Pearson et al. 2008). One additional breeding population has recently been documented at the Tacoma Narrows Airport (Michele Tirhi, WDFW, pers. comm., 2014); however, there is very limited population abundance information available. On the Washington coast, there are four known breeding sites in Grays Harbor and Pacific Counties: Damon Point; Midway Beach; Graveyard Spit; and Leadbetter Point (Pearson and Altman 2005). On the lower Columbia River, streaked horned larks breed on several of the sandy islands downstream of Portland, Oregon. Recent surveys have documented breeding streaked horned larks on Rice, Miller Sands Spit, Pillar Rock, Welch, Tenasillahe, Coffeepot, Whites/Browns, Wallace, Crims, and Sandy Islands in Wahkiakum and Cowlitz Counties in Washington, and Columbia and Clatsop Counties in Oregon (Pearson and Altman 2005; Anderson 2013). Larks also breed at the Rivergate Industrial Complex and the Southwest Quad at Portland International Airport; both sites are owned by the Port of Portland, and are former dredge spoil deposition fields (Moore 2011a). In the Willamette Valley, streaked horned larks breed in Benton, Clackamas, Lane, Linn, Marion, Polk, Washington, and Yamhill Counties. Larks are most abundant in the southern part of the Willamette Valley. The largest known population of larks is resident at Corvallis Municipal Airport in Benton County (Moore 2008); other resident populations occur at the Baskett Slough, William L. Finley, and Ankeny units of the Service's Willamette Valley National Wildlife Refuge Complex (Moore 2008) and on Oregon Department of Fish and Wildlife's (ODFW's) E.E. Wilson Wildlife Area (ODFW 2008). Breeding populations also occur at municipal airports in the valley (including McMinnville, Salem, and Eugene) (Moore 2008). Much of the Willamette Valley is private agricultural land, and has not been surveyed for streaked horned larks, except along public road margins. There are numerous other locations on private and municipal lands on which streaked horned larks have been observed in the Willamette Valley, particularly in the southern valley (Linn, Polk, and Benton Counties) (eBird

2013, ebird.org). In 2008, a large population of streaked horned larks colonized a wetland and prairie restoration site on M–DAC Farms, a privately owned parcel in Linn County; as the vegetation at the site matured in the following two years, the site became less suitable for larks, and the population declined (Moore and Kotaich 2010). This is likely a common pattern, as breeding streaked horned larks opportunistically shift sites as habitat becomes available among private agricultural lands in the Willamette Valley (Moore 2008). Winter Range Pearson et al. (2005b) found that most streaked horned larks winter in the Willamette Valley (72%) and on the islands in the lower Columbia River (20%); the rest spend the winter on the Washington coast (8%) or in the south Puget Sound (1%). In the winter, most of the streaked horned larks that breed in the south Puget Sound migrate south to the Willamette Valley or west to the Washington coast; streaked horned larks that breed on the Washington coast either remain on the coast or migrate south to the Willamette Valley; birds that breed on the lower Columbia River islands remain on the islands or migrate to the Washington coast; and birds that breed in the Willamette Valley remain there over the winter (Pearson et al. 2005). Streaked horned larks spend the winter in large groups of mixed subspecies of horned larks in the Willamette Valley, and in smaller flocks along the lower Columbia River and Washington Coast (Pearson et al. 2005; Pearson and Altman 2005) (USFWS, 2016).

Critical Habitat Designated

Yes; 10/13/2013.

Legal Description

On October 3, 2013, the U.S. Fish and Wildlife Service designated critical habitat for the Taylor's checkerspot butterfly (Euphydryas editha taylori) and streaked horned lark (Eremophila alpestris strigata) under the Endangered Species Act of 1973, as amended (Act). Approximately 4,629 acres (1,873 hectares) in Grays Harbor, Pacific, and Wahkiakum Counties in Washington, and in Clatsop, Columbia, Marion, Polk, and Benton Counties in Oregon, fall within the boundaries of the critical habitat designation for streaked horned lark.

Critical Habitat Designation

The two units designated as critical habitat are: Unit 3— Washington Coast and Columbia River (with 13 subunits), and Unit 4— Willamette Valley (with 3 subunits). The Washington Coast and Columbia River Unit (Unit 3) totals 2,900 ac (1,173 ha) and includes 564 ac (228 ha) of Federal ownership, 2,209 ac (894 ha) of State-owned lands, and 126 ac (51 ha) of private lands. The Willamette Valley Unit (Unit 4) totals 1,729 ac (700 ha) and is entirely composed of Federal lands. A total of 4,629 ac (1,873 ha) of critical habitat is designated for the streaked horned lark rangewide.

Unit 3: Washington Coast and Columbia River—Streaked Horned Lark On the Washington coastal sites, the streaked horned lark occurs on sandy beaches and breeds in the sparsely vegetated, low dune habitats of the upper beach. We are designating four subunits (Subunits 3–A, 3–B, 3–C, and 3–D) and a total of 2,235 ac (904 ha) as critical habitat on the Washington coast. The coastal sites are owned and managed by Federal, State, and private entities. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to reduce human disturbance during the nesting season, and the continued encroachment of invasive, nonnative plants requires special management to restore or retain the open habitat preferred by the streaked horned lark. Subunits 3–A, 3–B, 3–C, and 3–D overlap areas that are designated as critical habitat for the western snowy plover. The snowy plover nesting areas are posted and monitored during the spring and summer to keep recreational beach users away from the nesting areas; these management actions also benefit the streaked horned lark. In the lower Columbia River, we are designating nine island subunits (Subunits 3–E through 3–M) for a total of 665 ac (269 ha). The island subunits are owned by the States of Oregon and Washington. On the Columbia River island sites, only a small portion of each island is designated as critical habitat for the streaked horned lark; most of the areas mapped are used by the Corps for dredge material deposition in its channel maintenance program. Within any deposition site, only a portion is likely to be used by the streaked horned lark in any year, as the area of habitat shifts within the deposition site over time as new materials are deposited and as older deposition sites become too heavily vegetated for use by streaked horned larks. All of the island subunits are small, but are adjacent to open water, which provides the open landscape context needed by streaked horned larks. The main threats to the essential features in the critical habitat subunits designated on the Columbia River islands are invasive vegetation and direct impacts associated with deposition of dredge material onto streaked horned lark nests during the nesting season. In all subunits, the physical or biological features essential to the conservation of each subspecies may require special management considerations or protection to manage, protect, and maintain the PCEs supported by the subunits. For those threats that are common to all subunits, special management considerations or protections may be required to address direct or indirect habitat loss due to the location and timing of dredge material placement to areas that have become unsuitable for streaked horned lark nesting and wintering habitat. Subunit 3–A: Damon Point—(Grays Harbor County, Washington). This critical habitat subunit is about 481 ac (194 ha) in size; of this, 456 ac (185 ha) are owned by the State, and 24 ac (10 ha) are under private ownership. It extends from the Ocean Shores wastewater treatment plant on the western edge through the Oyhut wildlife management unit and Damon Point spit (also called Protection Island). The vast majority of this area (~95 percent) is managed by the State of Washington (WDFW, WDNR, and Washington State Parks). This subunit is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. The site has both the open landscape context and sparse, low-growing vegetation that make up the physical or biological features essential to the conservation of the subspecies. Streaked horned larks currently nest and winter on Damon Point and have also been documented nesting along the beach just west of the treatment plant. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to reduce human disturbance during the nesting season and encroachment by invasive, nonnative plants that render the habitat too dense for use by streaked horned larks. Subunit 3–B: Midway Beach—(Pacific County, Washington). This subunit is about 611 ac (247 ha) in size. The northern edge of the subunit starts at Grayland Beach State Park and extends south to the Warrenton Cannery road. The landward extent is defined by the vegetation and ownership line in the mid-dune area. This site is owned by the State of Washington (Washington State Parks and Recreation Department). This subunit is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. Both open landscape context and the sparse, low-growing vegetation that make up the physical or biological features essential to the conservation of the subspecies are present at the site, and Midway Beach is used by streaked horned larks for both nesting and wintering. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to reduce human disturbance during the nesting season and encroachment by invasive, nonnative plants that render the habitat too dense for use by streaked horned larks. Subunit 3–C: Shoalwater/Graveyard Spit—(Pacific County, Washington). This subunit is about 479 ac (194 ha);

of this, 377 ac (152 ha) are owned by the State, and 102 ac (41 ha) are under private ownership. The central portion of the subunit (182 ac; 74 ha) is within the Shoalwater Bay Indian Reservation and has been excluded under section 4(b)(2) (see Exclusions), dividing the subunit into northwest and southeast sections. Streaked horned larks have been documented off and on at this site during the breeding season since 2000. Although the site has been unoccupied for the past couple of years, singing male streaked horned larks were documented at this site during surveys in June 2012; therefore, we consider this site to be currently occupied. As with the other areas along the Washington coast, streaked horned larks use this site for both nesting and wintering. The subunit is a dynamic area and has a constantly changing sand spit that supports the essential features for nesting and wintering habitat. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to reduce human disturbance during the nesting season and encroachment by invasive, nonnative plants that render the habitat too dense for use by streaked horned larks. Subunit 3–D: Leadbetter Point— (Pacific County, Washington). This subunit contains about 665 ac (269 ha) at the northern tip of the Long Beach Peninsula. This subunit is on the Willapa National Wildlife Refuge and the Seashore Conservation Area (managed by Washington State). This site is occupied and provides the physical or biological features essential to the conservation of the subspecies. Most of the streaked horned larks at this site nest within the habitat restoration area and in ponded swales landward of the restoration area that go dry in the summer (Ritchie 2012, pers. comm.). The site has the open landscape context and sparse, low-growing vegetation that make up the physical or biological features essential to the conservation of the subspecies. The Willapa National Wildlife Refuge completed its comprehensive conservation plan in August 2011, and manages habitat at the tip of Leadbetter Spit for the western snowy plover, streaked horned lark, and other native coastal species. These management activities are compatible with streaked horned lark conservation. As with the other coastal sites, Leadbetter is used by streaked horned larks year-round. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–E: Rice Island—(Clatsop County, Oregon, and Wahkiakum County, Washington). This subunit is about 224 ac (91 ha) in size. The island is located at river mile (RM) 21, approximately 7 mi (11 km) upstream of the Astoria-Megler Bridge near the mouth of the Columbia River. Although the island is within the planning boundary of the Julia Butler Hansen National Wildlife Refuge, Rice Island is owned by the Oregon Department of State Lands. A very small portion of the subunit is in Wahkiakum County and on Washington State lands. The Corps uses this site for dredge material disposal as part of its maintenance of the Columbia River shipping channel. This subunit is occupied and provides the features essential to the conservation of the subspecies. Streaked horned larks currently nest and winter on Rice Island. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–F: Miller Sands Spit— (Clatsop County, Oregon). Miller Sands Spit is across the shipping channel from Rice Island at RM 24. The subunit is a sand spit 2 mi (1.2 km) long and about 123 ac (50 ha) in size on the northern shore of the island. The subunit is currently occupied and provides the physical or biological features essential to the conservation of the subspecies for nesting and wintering habitat. The island is owned by the Oregon Department of State Lands, but is also within the planning unit boundary for the Julia Butler Hansen National Wildlife Refuge. The Corps uses this site for dredge material disposal as part of its maintenance of the Columbia River shipping channel. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–G: Pillar Rock/Jim Crow Sands—(Clatsop County, Oregon). This island is located at about RM 27 on the Columbia River. The subunit is about 44 ac (18 ha) in size. Pillar Rock is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. Streaked horned larks nest and winter at the site. The island is owned by the Oregon Department of State Lands and is within the planning unit boundary for the Julia Butler Hansen National Wildlife Refuge. The Corps uses this site for dredge material disposal as part of its maintenance of the Columbia River shipping channel. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–H: Welch Island—(Clatsop County, Oregon). This island is at RM 34 and is owned by the Oregon Department of State Lands. The critical habitat subunit is about 43 ac (18 ha) on the northeastern shore of the island. This site is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. The Corps uses this site for dredge material disposal as part of its maintenance of the Columbia River shipping channel. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–I: Tenasillahe Island— (Columbia County, Oregon). This island is at RM 38; the subunit is on a small unnamed spit at the southern tip of Tenasillahee Island. The subunit is about 23 ac (9 ha) in size. This site is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. The site is owned by the Oregon Department of State Lands. The Corps uses this site for dredge material disposal as part of its maintenance of the Columbia River shipping channel. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–J: Whites/Brown Island— (Wahkiakum County, Washington). Whites/Brown Island is connected to the southern end of Puget Island at RM 46 and is owned by WDFW. The subunit is a small spit at the southern end of Whites/Brown Island and is about 98 ac (39 ha) in size. The site is used by the Corps for dredge material disposal as part of its maintenance of the Columbia River shipping channel. This site is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. Whites/Brown Island supports one of the largest populations of streaked horned larks in the lower Columbia River islands. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–K: Wallace Island— (Columbia County, Oregon). Wallace Island is located across the channel from Whites/Brown Island at RM 47. Streaked horned larks were detected at the site in 2012, which is about 13 ac (5 ha) in size; therefore we consider the subunit presently occupied. The area is owned by the Oregon Department of State Lands. This site is not a dredge material disposal site. This subunit currently contains the physical or biological features essential to the conservation of the species, but may require special management to maintain the low vegetative structure required by streaked horned larks. Subunit 3–L: Crims Island— (Columbia County, Oregon). This island is located upstream of Wallace Island at RM 57. The subunit is about 60 ac (24 ha) in size.

The subunit is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. The area is owned by the Oregon Department of State Lands, but is also within the planning unit boundary for the Julia Butler Hansen National Wildlife Refuge. Crims Island is an approved Corps dredge material disposal site. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 3–M: Sandy Island— (Columbia County, Oregon). This island, at RM 76, is the island farthest upstream that is known to be used by streaked horned lark for nesting. The subunit is about 37 ac (15 ha) in size on the southern end of Sandy Island and is owned by the Oregon Department of State Lands. This subunit is currently occupied and provides the physical or biological features essential to the conservation of the subspecies. The Corps uses this site for dredge material disposal as part of its maintenance of the Columbia River shipping channel. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season.

Unit 4: Willamette Valley—Streaked Horned Lark Unit 4 (Willamette Valley) includes critical habitat subunits for both the Taylor's checkerspot butterfly and streaked horned lark, all in the State of Oregon. We are designating three subunits for the streaked horned lark in the Willamette Valley, all on the Willamette Valley National Wildlife Refuge Complex. The total acreage is 1,729 ac (700 ha). All of the subunits are occupied at the time of listing and contain the physical or biological features essential to the conservation of the subspecies that may require special management considerations or protection. These subunits are managed mainly to provide forage for wintering dusky Canada geese, and this management is compatible with maintaining the essential features for the streaked horned lark. The refuge complex has incorporated management for streaked horned lark into its recently completed comprehensive conservation plan, and streaked horned lark habitat conservation is being implemented in the refuge units. Subunit 4–A: Baskett Slough National Wildlife Refuge—(Polk County, Oregon). There are two parts to this critical habitat subunit, the area of which totals 1,006 ac (407 ha). Subunit 4–A North is 181 ac (73 ha) and is in the North Morgan Reservoir area of the refuge. Subunit 4–A South is 825 ac (334 ha) and is the South Baskett Slough Agricultural area of the refuge; State Route 22 forms the southeast boundary of the south subunit. Both of the subunits are agricultural fields that are heavily grazed by dusky Canada geese in the winter. This subunit is currently occupied and contains the physical or biological features essential to the conservation of the subspecies. Baskett Slough National Wildlife Refuge has large areas of agricultural lands and restored native prairies, which provide the landscape context and vegetation structure required by streaked horned larks. The refuge manages primarily for wintering dusky Canada geese, which also provides suitable management for streaked horned larks. This subunit is consistently used by streaked horned larks in the breeding season. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 4–B: Ankeny National Wildlife Refuge—(Marion County, Oregon). This site is in the middle of the Ankeny Refuge, in the Field 6 Complex; the northeast boundary of the subunit is formed by the Sydney Ditch. The critical habitat subunit is 264 ac (107 ha). The site is composed of agricultural fields that are heavily grazed by dusky Canada geese in the winter. The subunit is currently occupied and has consistent use by streaked horned larks in the breeding season. This subunit contains all of the physical or biological features essential to the conservation of the subspecies. Ankeny National Wildlife Refuge has both agricultural lands and restored native prairies, which provide the landscape context and vegetation structure required by streaked horned larks. The refuge manages primarily for wintering dusky Canada geese, which also provides suitable management for streaked horned larks. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season. Subunit 4–C: William L. Finley National Wildlife Refuge—(Benton County, Oregon). This critical habitat subunit is on Fields 11 and 12 in the South Finley Agricultural Lands area of the refuge; Bruce Road bisects the subunit, and McFarland Road forms the southern boundary of the site. The subunit is 459 ac (186 ha) in size. This subunit is currently occupied and contains the physical or biological features essential to the conservation of the subspecies. The site is composed of agricultural fields that are heavily grazed by dusky Canada geese in the winter, and it has consistent use by streaked horned larks in the breeding season; streaked horned larks also winter at the refuge. Finley National Wildlife Refuge has large areas of agricultural lands and restored native prairies, which provide the landscape context and vegetation structure required by streaked horned larks. The refuge manages primarily for wintering dusky Canada geese, which also provides suitable management for streaked horned larks. The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to maintain the early seral vegetation required by the subspecies and to minimize nest destruction and disturbance during the breeding season.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Grays Harbor, Pacific, and Wahkiakum Counties in Washington, and Clatsop, Columbia, Marion, Polk, and Benton Counties in Oregon. Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of the streaked horned lark consist of areas having a minimum of 16 percent bare ground that have sparse, low-stature vegetation composed primarily of grasses and forbs less than 13 inches (33 centimeters) in height found in:

(i) Large (300-acre (120-hectare)), flat (0–5 percent slope) areas within a landscape context that provides visual access to open areas such as open water or fields; or

(ii) Areas smaller than described in paragraph (2)(i) of this entry, but that provide visual access to open areas such as open water or fields.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, runways, roads, and other paved areas) and the land on which they are located existing within the legal boundaries on November 4, 2013.

All areas designated as critical habitat will require some level of management to address the current and future threats to the streaked horned lark and to maintain or restore the PCEs.

Threats to the physical or biological features that are essential to the conservation of these subspecies and that may warrant special management considerations or protection include, but are not limited to: (1) Loss of habitat from conversion to other uses; (2) control of nonnative, invasive species; (3) development; (4) construction and maintenance of roads and utility corridors; and (5) habitat modifications brought on by succession of vegetation from the lack of disturbance, both small and large scale. These threats also have the potential to affect the PCEs if they are conducted within or adjacent to designated units.

The physical or biological features essential to the conservation of the streaked horned lark may require special management considerations or protection to ensure the provision of early seral conditions and landscape context of sufficient quantity and quality for long-term conservation and recovery of the subspecies. Activities such as mowing, burning, grazing, tilling, herbicide treatment, grading, beach nourishment, or placement of dredge material can be used to maintain or restore nesting and wintering habitats. Regular disturbance is necessary to create and maintain suitable habitat, but the timing of management is important. The management actions should be conducted outside of the breeding season to avoid the destruction of nests and young, or if habitat management must be done during the breeding season, it should be done in a way that minimizes destruction of nests or harassment of individuals. Nesting success is highest in locations with restricted public use or entry such as military facilities, airports, islands, wildlife refuges, or sites that are remote or difficult to access.

Life History

Feeding Narrative

Adult: Horned larks forage on the ground in low vegetation or on bare ground (Beason 1995); adults feed on a wide variety of grass and weed seeds, but feed insects to their young (Beason 1995). Larks eat a wide variety of seeds and insects (Beason 1995) and appear to select habitats based on the structure of the vegetation rather than the presence of any specific food plants (Moore 2008) (USFWS, 2016).

Reproduction Narrative

Adult: Horned larks form pairs in the spring (Beason 1995) and establish territories approximately 1.9 acres in size (range 1.5 to 2.5 acres) (Altman 1999). Horned larks create nests in shallow depressions in the ground and line them with soft vegetation (Beason 1995). Female horned larks select the nest site and construct the nest without help from the male (Beason 1995). Streaked horned larks establish their nests in areas of extensive bare ground, and nests are placed adjacent to clumps of bunchgrass (Pearson and Hopey 2004). Studies from Washington sites (the open coast, Puget lowlands and the Columbia River islands) have found strong natal fidelity to nesting sites – that is, streaked horned larks return each year to the place they were born (Pearson et al. 2008). Historically, nesting habitat was found on grasslands, estuaries, and sandy beaches in British Columbia, in dune habitats along the coast of Washington, in western Washington and western Oregon prairies, and on the sandy beaches and spits along the Columbia and Willamette Rivers. Today, the streaked horned lark nests in a broad range of habitats, including native prairies, coastal dunes, fallow and active agricultural fields, wetland mudflats, sparsely-vegetated edges of grass fields, recently planted Christmas tree farms with extensive bare ground, moderately- to heavily-grazed pastures, gravel roads or gravel shoulders of lightly-traveled roads, airports, and dredge deposition sites in the lower Columbia River (Altman 1999; Pearson and Altman 2005; Pearson and Hopey 2005; Moore 2008). Wintering streaked horned larks use habitats that are very similar to breeding habitats (Pearson et al. 2005). The nesting season for streaked horned larks begins in early April and ends mid- to late August (Pearson and Hopey 2004; Moore 2011a). Clutches range from 1 to 5 eggs, with a mean of 3 eggs (Pearson and Hopey 2004). After the first nesting attempt in April, streaked horned larks will often re-nest in late June or early July (Pearson and Hopey 2004). Young streaked horned larks leave the nest by the end of the first week after hatching, and are cared for by the parents until they are about four weeks old when they become independent (Beason 1995). Nest success studies (i.e., the proportion of nests that result in at least one fledged chick) in streaked horned larks report highly variable results. Nest success on the Puget lowlands of Washington is low, with only 28% of nests successfully fledging young (Pearson and Hopey 2004, Pearson and Hopey 2005). According to reports from sites in the Willamette Valley, Oregon, nest success has varied from 23 to 60% depending on the site (Altman 1999; Moore and Kotaich 2010). At one site in Portland, Oregon, Moore (2011) found 100% nest success (USFWS, 2016).

Habitat Narrative

Adult: Habitat used by larks is generally flat with substantial areas of bare ground and sparse low-stature vegetation primarily composed of grasses and forbs (Pearson and Hopey 2005). Suitable habitat is generally 16 to 17% bare ground and may be even more open at sites selected for nesting (Altman 1999; Pearson and Hopey 2005). Historically, nesting habitat was found on grasslands, estuaries, and sandy beaches in British Columbia, in dune habitats along the coast of Washington, in western Washington and western Oregon prairies, and on the sandy beaches and spits along the Columbia and Willamette Rivers. Today, the streaked horned lark nests in a broad range of habitats, including native prairies, coastal dunes, fallow and active agricultural fields, wetland mudflats, sparsely-vegetated edges of grass fields, recently planted Christmas tree farms with extensive bare ground, moderately- to heavily-grazed pastures, gravel roads or gravel shoulders of lightly-traveled roads, airports, and dredge deposition sites in the lower Columbia River (Altman 1999; Pearson and Altman 2005; Pearson and Hopey 2005; Moore 2008). Wintering streaked horned larks use habitats that are very similar to breeding habitats (Pearson et al. 2005) (USFWS, 2016). Vegetation height is generally less than 33cm (13 inches) (Altman 1999; Pearson and Hopey 2005). A key attribute of habitat used by larks is open landscape context. Sites used by larks are generally found in open (i.e., flat, treeless) landscapes of 300 acres or more (Converse et al. 2010). Some patches with the appropriate characteristics (i.e., bare ground, low stature vegetation) may be smaller in size if the adjacent areas provide the required open landscape context; this situation is common in agricultural habitats and on sites next to water. For example, many of the sites used by larks on the islands in the Columbia River are small (less than 100 acres), but are adjacent to open water, which provides the open landscape context needed. Streaked horned lark populations are found at many airports within the range of the subspecies, because airport maintenance requirements provide the desired open landscape context and short vegetation structure. Although streaked horned larks use a wide variety of habitats, populations are vulnerable because the habitats used are often ephemeral or subject to frequent human disturbance. Ephemeral habitats include bare ground in agricultural fields and wetland mudflats; habitats subject to frequent human disturbance include mowed fields at airports, managed road margins, agricultural crop fields, and disposal sites for dredge material (Altman 1999). Foraging Horned larks forage on the ground in low vegetation or on bare ground (Beason 1995); adults feed on a wide variety of grass and weed seeds, but feed insects to their young (Beason 1995). Larks eat a wide variety of seeds and insects (Beason 1995) and appear to select habitats based on the structure of the vegetation rather than the presence of any specific food plants (Moore 2008) (USFWS, 2016).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2016)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2016)

Dispersal

Adult: High (USFWS, 2016)

Dispersal/Migration Narrative

Adult: Pearson et al. (2005b) found that most streaked horned larks winter in the Willamette Valley (72%) and on the islands in the lower Columbia River (20%); the rest spend the winter on the Washington coast (8%) or in the south Puget Sound (1%). In the winter, most of the streaked horned larks that breed in the south Puget Sound migrate south to the Willamette Valley or west to the Washington coast; streaked horned larks that breed on the Washington coast either remain on the coast or migrate south to the Willamette Valley; birds that breed on the lower Columbia River islands remain on the islands or migrate to the Washington coast; and birds that breed in the Willamette Valley remain there over the winter (Pearson et al. 2005). Streaked horned larks spend the winter in large groups of mixed subspecies of horned larks in the Willamette Valley, and in smaller flocks along the lower Columbia River and Washington Coast (Pearson et al. 2005; Pearson and Altman 2005) (USFWS< 2016).

Additional Life History Information

Adult: Available evidence suggests that birds in the Puget lowlands are migrating south for the winter (Pearson and Altman 2005); multiple observations of banded birds throughout the winter in the Willamette Valley, Columbia River and on the Washington Coast suggest that some of these birds are staying in these regions throughout the winter (Pearson and Altman 2005).; Nonmigrant: Y; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Population Information and Trends

Population Trends:

Increasing (USFWS, 2016)

Population Growth Rate:

The breeding range has contracted over time; this subspecies no longer breeds in the northern Puget trough (San Juan Islands and other Puget Sound sites north of Tacoma), southern British Columbia (COSEWIC 2003, Environment Canada 2007), along the Washington Coast north of Grays Harbor, or in the Rogue River Valley (see Pearson and Altman 2005).No historical estimates of population size are available, but this subspecies has apparently suffered a "severe decline" (Beauchesne and Cooper 2002). It is now rare and has been extirpated from much of its range (USFWS 2003). It was originally described as very abundant in the prairies of Puget Sound region (Suckely and Cooper 1860, Dawson and Bowles 1909) and was recorded as breeding "commonly at times" in the San Juan Islands after 1946, but last breeding record there was 1962 (Rogers 2000). In the 1940s, it was was a "very common permanent resident" in the southern Willamette Valley (Gullion 1951). In western Oregon, it was noted as a common breeder in the

1930s, even "particularly abundant" in Polk and Yamhill Counties (Gabrielson and Jewett 1940). However, there may have been confusion between subspecies, and E. a. strigata may never have been that common there (Rogers 2000). The small population in British Columbia declined to extirpation over the last four decades. The last confirmed breeding record was in 1978; and the last summer sighting at Sea Island was in 1987, although a few may have persisted in the central Fraser Valley until the mid-1990s (Campbell et al. 1997, Beauchesne and Cooper 2002).Prairie habitat has declined to less than 1% of its former extent in the Willamette Valley and to less than 3% in the Puget Sound area (Altman 2000, Crawford and Hall 1997). Overall, it has been estimated that less than one percent of the native savanna and grassland remains in the range of the streaked horned lark (Oregon-Washington Partners in Flight 2000). Decline of >90% (NatureServe, 2015)

Number of Populations:

6 - 20 (NatureServe, 2015)

Population Size:

<1,600 (USFWS, 2016)

Population Narrative:

Data from the North American Breeding Bird Survey (BBS) indicate that most grassland-associated birds, including the horned lark, have declined across their ranges in the past three decades (Sauer et al. 2012). The BBS can provide population trend data only for those species with sufficient sample sizes for analyses. There is insufficient data in the BBS for a rangewide analysis of the streaked horned lark population trend (Altman 2011); however, see below for additional analysis of the BBS data for the Willamette Valley. An analysis of recent data from a variety of sources concludes that the streaked horned lark has been extirpated from the Georgia Depression (British Columbia, Canada), the Oregon coast, and the Rogue and Umpqua Valleys (Altman 2011); this analysis estimates the current rangewide population of streaked horned larks to be about 1,170 to 1,610 individuals (Altman 2011). In the south Puget Sound, approximately 150 to170 streaked horned larks breed at six sites (Altman 2011). Recent studies have found that larks have very low nest success in Washington (Pearson et al. 2008); comparisons with other ground-nesting birds in the same prairie habitats in the south Puget Sound showed that streaked horned larks had significantly lower values in all measures of reproductive success (Anderson 2010). Estimates of population growth rate (?, lambda) that include vital rates from nesting areas in the south Puget Sound, Washington coast, and Whites Island in the lower Columbia River indicate streaked horned larks have abnormally low vital rates, which are significantly lower than the vital rates of the arctic horned lark (Eremophila alpestris leucolaema) (Camfield et al. 2010). One study estimated that the population of streaked horned larks in Washington was declining by 40% per year (? = 0.61 ± 0.10 SD), apparently due to a combination of low survival and fecundity rates (Pearson et al. 2008). More recent analyses of territory mapping at four sites in the south Puget Sound found that the total number of breeding streaked horned lark territories decreased from 77 territories in 2004, to 42 territories in 2007, a decline of over 45% in three years (Camfield et al. 2011). Pearson et al. (2008) concluded that there is a high probability that the south Puget Sound population will disappear in the future given the low estimates of fecundity and adult survival along with high emigration out of the Puget Sound. On the Washington coast and Columbia River islands, there are about 120 to 140 breeding larks (Altman 2011). Data from the Washington coast and Whites Islands were included in the population growth rate study discussed above; populations at these sites appear to be declining by 40% per year (Pearson et al. 2008). Conversely, nest success appears to be very high at the Portland industrial sites (Rivergate and the Southwest Quad). In 2010, nearly all nests successfully fledged young (Moore 2011a); only 1 of 10 monitored nests lost young to predation (Moore 2011a). There are about 900 to 1,300 breeding streaked horned larks in the Willamette Valley (Altman 2011). The largest known population of streaked horned larks breeds at the Corvallis Municipal Airport (CVO); depending on the management conducted at the airport and the surrounding grass fields each year, the population has been as high as 100 breeding pairs (Moore and Kotaich 2010). Heavy snows in the southern Willamette Valley during the winter of 2013-2014 resulted in an apparent reduction of the population at CVO. Surveys during spring and early summer at CVO detected about half the number of streaked horned larks as were found in the previous year (Randy Moore, Oregon State University, Corvallis, Oregon, pers. comm., 2014). In 2007, a large (580-acre) wetland and native prairie restoration project was initiated at M–DAC Farms on a former rye grass field in Linn County (Cascade Pacific RC&D 2012). Large, semi-permanent wetlands were created at the site, and the prairie portions were burned and treated with herbicides (Moore and Kotaich 2010). These conditions created excellent quality ephemeral habitat for streaked horned larks, and the site was used by about 75 breeding pairs in 2008 (Moore and Kotaich 2010), making M–DAC the second-largest known breeding population of streaked horned larks that year. M–DAC had high use again in 2009, but as vegetation at the site matured, the number of breeding larks has declined, likely shifting to other agricultural habitats (Moore and Kotaich 2010). We do not have population trend data in Oregon that is comparable to the study in Washington by Pearson et al. (2008). However, research on breeding streaked horned larks indicates that nest success in the southern Willamette Valley is higher than in Washington (Randy Moore, Oregon State University, Corvallis, Oregon, pers. comm., 2011). The best information on trends in the Willamette Valley comes from surveys by the ODFW; the agency conducted surveys for grassland-associated birds, including the streaked horned lark, in 1996 and again in 2008 (Altman 1999; Myers and Kreager 2010). Point count surveys were conducted at 544 stations in the Willamette Valley (Myers and Kreager 2010). Over the 12-year period between the surveys, measures of relative abundance of streaked horned larks increased slightly from 1996 to 2008, according to this report. Detections at both point count stations and within regions showed moderate increases (3% and 6%, respectively) (Myers and Kreager 2010). Population numbers decreased slightly in the northern Willamette Valley and increased slightly in the middle and southern portions of the valley (Myers and Kreager 2010). Data from the BBS may provide additional insight into the trend of the streaked horned lark population in the Willamette Valley. Although the BBS does not track bird counts by subspecies, the streaked horned lark is the only subspecies of horned lark that breeds in the Oregon portion of the Northern Pacific Rainforest Bird Conservation Region (BCR). Therefore it is reasonable to assume that counts of horned larks from the breeding season in the Willamette Valley are actually counts of the streaked horned lark. The BBS data regularly detect horned larks on several routes in the Willamette Valley, and counts from these routes show that horned larks in this BCR have been declining since 1960s, with an estimated annual trend of – 4.6% (95% confidence intervals –6.9, –2.4) (Sauer et al. 2012). The U.S. Geological Survey (USGS), which manages the BBS data, recommends caution when analyzing these data due to the small sample size, high variance, and potential for observer bias in the raw BBS data. The BBS data from the Willamette Valley indicate that horned larks (as mentioned above, the BBS tracks only the full species) have been declining for decades, which is coincident with the restrictions on grass seed field burning imposed by the Oregon Department of Agriculture (Oregon Department of Environmental Quality and Oregon Department of Agriculture 2011). Prior to 1990, about

250,000 acres of grass seed fields in the Willamette Valley were burned each year. Public health and safety issues led the Oregon legislature to order gradual reductions in field burning beginning in 1991. By 2009, field burning was essentially banned in the Willamette Valley (Oregon Department of Environmental Quality and Oregon Department of Agriculture 2011). We believe that some of the observed declines in lark detections in the BBS data are attributable to the reduction of highly suitable burned habitats due to the field burning ban. Since the ban is now fully in effect, the decline in BBS observations of streaked horned larks is not expected to continue at the previously noted rate. We do not have conclusive data on population trends throughout the streaked horned lark's range, but the rapidly declining population on the south Puget Sound suggests that the range of the streaked horned lark may still be contracting (USFWS, 2016). There are currently estimated to be fewer than 1,600 streaked horned larks rangewide, and population numbers are declining (USFWS, 2016)

Threats and Stressors

Stressor: Land management/loss of natural disturbance/non-native vegetation (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Their habitat is threatened throughout their entire range from loss of natural disturbance regimes, invasion of unsuitable vegetation that alter habitat structure, and incompatible land management practices (USFWS, 2016).

Stressor: Stochastic events (USFWS, 2016)
Exposure:
Response:
Consequence: Extinction
Narrative: Large winter congregations are limited to one region, Oregon's Willamette Valley, which may put larks at risk from stochastic weather events (USFWS, 2016).

Recovery

References

USFWS 2016. Status of the Species and Critical Habitat: Eremophila alpestris strigata (Streaked Horned Lark). U.S. Fish and Wildlife Service 2600 SE 98TH Ave., Suite 100. Portland, OR 97266. Provided to FESTF from Chris Mullens 9/30/2016

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SPECIES ACCOUNT: *Falco femoralis septentrionalis* (northern aplomado falcon)

Species Taxonomic and Listing Information

Listing Status: Endangered (02/25/1986) and experimental population, non-essential (07/26/2006); Southwest Region (Region 2) (USFWS, 2016)

Physical Description

Adults characterized by rufous (rust) underparts, a gray back, a long and banded tail, and a distinctive black and white facial pattern. Aplomado falcons are smaller than peregrine falcons and larger than kestrels. (USFWS, 2016)

Taxonomy

Along with Falco femoralis septentrionalis, two other subspecies have been described: Falco femoralis pichinchae (Chapman) of western South America, and Falco femoralis femoralis (Temminck) in the remaining portions of South and Central America. The subspecies are distinguished by differences in relative dimensions, the degree of completeness of their abdominal bands (“cummerbunds”), and the darkness (or lightness) of their dorsal plumages (Table 1, Blake 1977). Falco femoralis femoralis is only slightly smaller and tends to be darker dorsally but may intergrade with F. f. septentrionalis. The abdominal band of F. f. femoralis is usually complete with only a slight mid—ventral narrowing. Falco femoralls pichinchae is larger, darker, has buffier underparts than F. f. femoralis, and has an abdominal band that is narrow or Incomplete mid—ventrally (Blake 1977). (USFWS, 1990)

Historical Range

Historic breeding range: southeastern Arizona, southern New Mexico, and southern Texas south through Mexico (Tamaulipas, Chiapas, Campeche, Tabasco, Chihuahua, Coahuila, Sinaloa, Jalisco, Guerrero, Veracruz, Yucatan, and San Luis Potosi) to Guatemala (Pacific slope of Central American cordillera). Historic winter range: Sinaloa, Chihuahua, and southern Tamaulipas south to southern Mexico; casual in Guatemala (AOU 1957). (NatureServe, 2015)

Current Range

With the goal of restoring aplomado falcons to their historical range in the United States, a reintroduction program was initiated in 1978 to release captive-bred young into the historical range in south Texas (U.S. Fish and Wildlife Service 1990, Cade et al. 1991). (USFWS, 2014)

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Feeds primarily on birds (up to rock dove size), to a lesser extent on insects (moths, beetles, cicadas, orthopterans); uncommonly on small mammals, lizards, and snakes (Terres 1980, Cade 1982). Pairs often hunt together. Birds comprise most of diet biomass in eastern Mexico, but insects also are commonly consumed. Hunts from perch or air. In eastern Mexico, this species hunted mainly within 1 km of nest site (Hector 1988). Decidedly crepuscular in hunting habits, often catching prey after sunset; not very active in middle of day. (Cade 1982). In eastern Mexico, preyed on birds mainly in the early morning, hawked insects later in the day (see Johnsgard 1990). (NatureServe, 2015)

Reproduction Narrative

Adult: Aplomado falcons do not build their own nests, but use nest sites constructed by large raptors or corvids. The northern aplomado falcon lays eggs from January-June (mainly March-May, peak in April) with a clutch size of 2-3. Both parents (mainly females) incubate eggs for about 31-32 days (Cade 1982, Evans 1982). Young can fly at 4-5 weeks, but may remain in nest area for several weeks more. Pairs remain together throughout the year (Palmer 1988). (USFWS, 2014; NatureServe, 2015)

Habitat Narrative

Adult: Open rangeland and savanna, semiarid grasslands with scattered trees and shrubs; in U.S., was found in coastal prairies along sand ridges, in woodlands along desert streams, and in desert grasslands with scattered mesquite and yucca; has been found in open pine woodland in central Mexico (Matthews and Moseley 1990, Johnsgard 1990). In the Chihuahuan Desert, aplomado falcons prefer broad, open basins and valleys with optimum visibility of the surroundings and relatively few, scattered, tall woody plants providing perch and nest sites (Hector 1981, Montoya et al. 1997, Young et al. 2004). Such settings offer maximum detectability of potential prey and protection against predators. The aplomado falcon does not typically occupy hilly or highly irregular terrain. Encroachment of thick tall grass of brush degrades habitat. Nests in old stick nests of other bird species (e.g., hawks, caracaras, ravens); in sites such as bromeliads in tropics. May sometimes nest on cliff. (USFWS, 2014; NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (NatureServe, 2015)

Immigration/Emigration

Adult: Immigrates and emigrates (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Little is known about the migratory behavior of these falcons. (USFWS, 1990)

Population Information and Trends

Population Trends:
Unknown (USFWS, 2014)

Resiliency:
Low (inferred from USFWS, 2014)

Representation:
Low (inferred from USFWS, 2014)

Redundancy:
Low (inferred from USFWS, 2014)

Number of Populations:
1 (USFWS, 2014)

Population Size:
40 - 60 (USFWS, 2014)

Population Narrative:
With the goal of restoring aplomado falcons to their historical range in the United States, a reintroduction program was initiated in 1978 to release captive-bred young into the historical range in south Texas (U.S. Fish and Wildlife Service 1990, Cade et al. 1991). A total of 927 young were reintroduced in south Texas from 1978 to 2013 (Table 1). Established pairs first bred in the wild and produced young in 1995 (Jenny et al. 2004). In recent years, there have been approximately 28 to 29 known pairs in south Texas (Hunt et al 2013; Mutch 2013, 2014). The aplomado falcon population near Brownsville, Texas, currently includes about 19 pairs and extends approximately 55 km (34.18 mi) north from the Mexican border past Laguna Atascosa National Wildlife Refuge (Hunt et al. 2013). (USFWS, 2014)

Threats and Stressors

Stressor: Habitat changes (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The overall carrying capacity for aplomado falcons has decreased markedly in the Chihuahuan Desert since the late 1800s (Hunt et al. 2013). The extent of open savanna has diminished as a result of livestock grazing and agriculture, and the abundance of wintering grassland birds important to nesting aplomado falcons has declined similarly (Macías-Duarte et al. 2004, Pool et al. 2012, 2014). Grassland birds are thought to have declined more steeply than any other avian guild in North America (Knopf 1994). A primary source of migrants to the Chihuahuan Desert is the northern prairie grassland, extending northward and westward from South Dakota to Saskatchewan and eastern Alberta. This is a region that has undergone extensive agricultural development with consequent reductions in grassland bird abundance. This may have resulted in fewer migrant birds, thereby reducing aplomado falcon carrying

capacity and productivity, even in areas where habitat conditions appear to be otherwise suitable (Hunt et al. 2013). (USFWS, 2014)

Stressor: Drought/water depletion (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The Peregrine Fund began releasing captive-bred aplomado falcons in the Chihuahuan desert grasslands of western Texas in spring 2002. Reintroduction sites were chosen according to the suitable habitat criteria described by Young et al. (2004), primarily in yucca savanna similar to occupied habitat in nearby Chihuahua, Mexico (Montoya et al, 1997, Macías-Duarte et al. 2004) (see Figure 6 above). The Chihuahua population is the only known representative of wild, desert-breeding aplomado falcons north of the equator. The 35 pairs present when Montoya began his investigations had dwindled to 25 by 2002 (Macías-Duarte et al 2004), and only 6 could be found in 2011 (Hunt at al. 2013). Factors associated with this decline have been both continuing severe drought conditions and the nearly complete conversion of parts of the study area to irrigated croplands beginning in the mid-2000s (MaciasDuarte et al. 2007). (USFWS, 2014)

Stressor: Climate change (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Changing climatic conditions are projected to create more extreme and generally drier conditions in the southwestern United States (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). The associated fauna are expected to experience lower productivity, greater stress, and reduced food resources (Parry et al. 2007, Albright et al. 2010, North American Bird Conservation Initiative 2010). This could directly impact aplomado falcons by diminishing the availability of their prey (as discussed below). Increased aridity of grasslands will make them more susceptible to negative impacts from livestock grazing (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). (USFWS, 2014)

Stressor: Prey declines (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Prey availability is a crucial component of grassland habitat suitability for aplomado falcons, and this may explain some recent distribution findings for the subspecies (Gulf South Research Corporation and La Tierra Environmental Consulting 2013, Hunt et al. 2013). In northern Chihuahua, aplomado falcon productivity and reproductive timing were both associated with avian prey abundances early in the breeding season (Macías-Duarte et al. 2004). Reproductive failure and territory abandonment may occur because of extended periods of low avian prey levels. Avian prey and aplomado falcon productivity in north-central Chihuahua were significantly greater than in an occupied area further east (Macías-Duarte et al. 2004). Researchers suggested that the former site may have been a more important migratory route for birds (Méndez-González 2000, Macías-Duarte et al. 2004). (USFWS, 2014)

Stressor: Peripheral ranges (USFWS, 2014)
Exposure:

Response:
Consequence:
Narrative: In the outer limits of species' ranges, densities often are lower and more variable (Brown et al 1995, Pulliam 1988). Birds may have stronger tendencies to continue southward if conditions are not suitable in the northern extremes of the winter range (Newton 2008, Jonzén et al. 2011, Gulf South Research Corporation and La Tierra Environmental Consulting 2013). The southwestern New Mexico and Sueco, Chihuahua, areas occupied by aplomado falcons are located in broad valleys with deep, productive soils. The associated grasslands offer greater food quality and abundance for wintering birds (Gulf South Research Corporation and La Tierra Environmental Consulting 2013). These features also likely influence the migratory pathways used by grassland birds (Méndez-González 2000, Macías-Duarte et al. 2004). (USFWS, 2014)

Stressor: Pesticides (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: One of the most severe threats to the species is pesticide contamination. Levels of DDE in membranes of 20 clutches of northern aplomado falcon eggs collected in Veracruz (1957—1966) averaged 297 ppm (range 110—530 ppm). Membranes of shell fragments collected in 1977 from 10 nests along a 550—mile transect averaged 296 ppm DDE (range 31—1280 ppm; Kiff et al. 1980). Kiff et al. (1980: 951—952) made the following observations about the pesticide problem. The average decrease (1954—1967) in eggshell thickness (25.4%) is particularly severe and is equivalent to the maximum amount of thinning reported for any population of peregrine falcons (Peakall and Kiff 1979). DDE residue levels found in both bat falcon (Falco rufigularis) and aplomado falcon eggs exceed those associated with 20% thinning in peregrine eggs (Peakall and Kiff 1979). As noted by Peakall et al (1975), thinning of over 20% is likely to result in reproductive failure, primarily from egg breakage. These findings indicate the need for a population—wide survey of the effects of pesticide contamination on aplomado falcons. Experiences with similar pesticide—sensitive species suggest that productivity of falcons in eastern Mexico is threatened by DDT—related reproductive failure. (USFWS, 1990)

Stressor: Wind turbines (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: In addition, the relatively recent potential threat posed by wind power operation may also reduce the availability of avian prey for the aplomado falcon by causing mortality from collision with moving blades (Hunt et al. 2013). Between 140,000 and 328,000 (mean = 234,000) birds are killed annually by collisions with monopole turbines in the contiguous United States (Loss et al. 2013). (USFWS, 2014)

Recovery

Reclassification Criteria:
1. A minimum self-sustaining population of 60 breeding pairs has been established in the United States (this goal may be modified after we learn more about suitable habitat within the United States). (USFWS, 2014)

2. Patches of coastal prairie and desert grassland must be maintained in (or restored to) a condition providing optimal habitat for northern aplomado falcons through application of grazing, prescribed fire, and brush control. (USFWS, 2014)

3. Use of pesticides such as DDT and dieldrin must be permanently eliminated within areas inhabited by northern aplomado falcons and their prey. (USFWS, 2014)

4. Aplomado falcons should be reestablished in suitable parts of the southwestern United States. (USFWS, 2014)

Delisting Criteria:
Delisting criteria are not available.

Recovery Actions:
- Evaluate, monitor, and minimize all threats including pesticides (and other contaminants) to extant populations. (USFWS, 1990)
- Identify, maintain, and improve habitat. (USFWS, 1990)
- Reestablish the northern aplomado falcon in the U.S. and Mexico. (USFWS, 1990)
- Conduct studies of habitat requirements, physiological ecology, and behavior of wild falcons. (USFWS, 1990)
- Enhance public support for this recovery effort through educational programs. (USFWS, 1990)
- Encourage national and international cooperation and coordination in carrying out these objectives. (USFWS, 1990)

Conservation Measures and Best Management Practices:
- The Aplomado Falcon Recovery Plan should be amended to include the development of delisting criteria. Currently, the recovery plan contains only down-listing criteria. Down-listing criteria should also be re-assessed in light of recent research findings. Both criteria should include recommendations for spatial distribution of aplomado falcon pairs within the historic range. (USFWS, 2014)
- Additional aplomado falcon reintroductions should be considered near Deming, New Mexico, in areas used successfully by nesting aplomado falcons over the past 15 years, and in south coastal Texas, in areas where habitat has recently been restored to suitability for aplomado falcons. (USFWS, 2014)
- The feasibility of supplemental feeding stations should be investigated and considered in areas of limited prey availability for reintroduced aplomado falcons. (USFWS, 2014)
- Artificial nest towers should be installed and maintained in coordination with New Mexico landowners and land managers at sites near Deming, and on the Armendaris Ranch, Bosque del Apache National Wildlife Refuge, Otero Mesa, and Lake Valley. (USFWS, 2014)
- Conservation organizations and agencies should continue to work with similar entities in Mexico to address the sharp decline of the aplomado falcon population in Chihuahua. They should consider acquisition of land or perpetual conservation easements to protect, improve, and maintain suitable aplomado falcon habitat for the Chihuahuan population. In addition, research is needed to further understand the status of aplomado falcons in coastal Mexico. (USFWS, 2014)

- The effects of wind power infrastructure and operation in aplomado falcon habitat should be evaluated and addressed. Also, the potential effects of noise on the aplomado falcon's use of land near the proposed SpaceX project in Texas should be evaluated and addressed. (USFWS, 2014)
- Research should be conducted to evaluate whether great-horned owls are becoming more abundant and widely dispersed across the aplomado falcon's range and to assess methods to address this potential predation threat. (USFWS, 2014)
- The potential threat from mercury in south Texas should continue to be monitored and addressed, if needed. (USFWS, 2014)
- The potential effects of sea-level rise on the aplomado falcon population on Matagorda Island should be evaluated and addressed. Currently, the aplomado falcons on the central Texas coast are restricted to barrier islands. Sea-level rise could reduce the barrier island habitat used by aplomado falcons. It may be unlikely that enough coastal prairie habitat would remain or could be restored to support a population, if the territorial requirements observed to date on Matagorda Island of 2,000 acres/pair are needed. (USFWS, 2014)
- The fate of young aplomado falcons fledged in coastal Texas should be studied by satellite tracking hatch-year birds. (USFWS, 2014)

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SPECIES ACCOUNT: *Fulica americana alai* (Hawaiian coot)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/13/1970; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Hawaiian coot was considered a subspecies of the American coot (Fulica americana), but is now considered a distinct species (USFWS 2011, p. 19). Adults have a black head, a slate gray body with white undertail feathers, and a prominent white frontal shield and bill; feet are lobed rather than webbed and are greenish-gray. No reliable measurements of total length or size are available; however, the Hawaiian coot is slightly smaller in body size than the American coot which averages 13 to 17 inches in total length and 15 to 30 ounces in mass (Pratt and Brisbin 2002, p. 34).

Historical Range

The Hawaiian coot historically occurred on all of the main Hawaiian Islands except Lanai and Kahoolawe. Coots have typically been most numerous on the islands of Oahu, Maui, and Kauai (USFWS 2011, p. 19). Population estimates prior to the 1950s are not available; however, estimates from the late 1950s and early 1960s indicated a population of fewer than 1,000 birds.

Current Range

Hawaiian coots currently occur in coastal plain wetlands usually below 1,320 feet (400 meters) elevation on all the main Hawaiian Islands except for Kahoolawe; however, breeding is restricted to relatively few sites. Biannual waterbird counts conducted by DOFAW suggest that the statewide Hawaiian coot population averages approximately 2,000 birds with short-term population fluctuations and long-term slightly increasing population trend (USFWS 2011, p. 21-22). While not all wetlands are surveyed, the counts are considered a fairly accurate minimum population size. About 80 percent of the population detected in the surveys occur on the islands of Kauai (Hanalei, Huleia, Opaekaa), Oahu (coastal wetlands and reservoirs such as Lake Wilson and Nuuanu Reservoir, Kahuku Point and along the windward shore), and Maui (Kanaha and Kealia Ponds, Nuu Pond) (USFWS 2011). The remaining 20 percent of the population occurs in coastal ponds and playa wetlands, including breeding populations on the islands of Hawaii, Lanai, and Molokai.

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Hawaiian coots are generalists and feed on land, grazing on grass adjacent to wetlands, or in the water. They have been observed grazing from the surface of the water, or foraging by diving to obtain food resources. Food items include seeds and leaves, snails, crustaceans, insects, tadpoles, and small fish. The species will travel long distances, including between islands, when local food sources are depleted.

Reproduction Narrative

Adult: Nests year round, but mostly March-September, apparently triggered by local habitat conditions (e.g., water level); clutch size averages 4-6; incubation lasts 23-27 days; young leave nest soon after hatching (Matthews and Moseley 1990).; Adults are aggressively territorial. Pristine habitat may support up to 24 individuals/ha in nonbreeding season (Matthews and Moseley 1990). Congregates during the summer nonbreeding period. Populations fluctuate with climatic variations (drought periods reduce the amount of suitable habitat) (Engilis and Pratt 1993).; (NatureServe, 2015)

Habitat Narrative

Adult: The species is somewhat gregarious and uses freshwater and brackish wetlands, including agricultural areas (e.g., taro fields) and aquaculture ponds. Hawaiian coot generally occur in lowland (below 1,320 feet in elevation) wetland habitats with suitable emergent plant growth interspersed with open water, especially freshwater wetlands, but also freshwater reservoirs, cane field reservoirs, sewage treatment ponds, taro loi, brackish wetlands, and limited use of saltwater habitats. However, on the island of Kauai, some birds occur in plunge pools above 4,900 feet in elevation and on the island of Hawaii, stock ponds up to 6,600 feet in elevation. The species typically forages in water less than 12 inches deep, but will dive in water up to 48 inches deep. Compared to Hawaiian moorhens, Hawaiian coots prefer to forage in more open water. Logs, rafts of vegetation, narrow dikes, mud bars, and artificial island are utilized for resting. Ephemeral wetlands support large numbers during non-breeding season. Hawaiian coots are generalists and feed on land, grazing on grass adjacent to wetlands, or in the water. They have been observed grazing from the surface of the water, or foraging by diving to obtain food resources. Food items include seeds and leaves, snails, crustaceans, insects, tadpoles, and small fish. The species will travel long distances, including between islands, when local food sources are depleted. Some important habitats are located in National Wildlife Refuges and State sanctuaries and these sites receive management attention. However, other important habitats are not protected. These mostly include wetlands facing development or those used for agriculture or aquaculture. Examples include: playa lakes on the island of Niihau; Opaekaa marsh and Lumahai wetlands on the island of Kauai; Kahuku prawn farms, Laie wetlands, Ukoa, Punahoolapa, and Waihee marshes, Haleiwa and Waialua lotus fields, and Waipio wetlands on the island of Oahu; Paialoa and Ooia playa fishponds on the island of Molokai; and Opaeula, and Loko Waka ponds on the island of Hawaii (USFWS 2011, pp. 62-75). Threats, Recovery Strategy, and Ongoing Conservation Measures The Hawaiian coot was listed as an endangered species on October 13, 1970 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978, and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. A species review has not yet been initiated pursuant to Section 4(c)(2) of the ESA which requires five-year review after listing. Critical habitat has not been designated for the Hawaiian coot (USFWS 2011). The threats to, and conservation needs of, Hawaiian waterbirds outlined above in the “Status of the Species” section for the Hawaiian moorhen apply to the Hawaiian coot. A variety of conservation measures have been implemented to protect Hawaii’s endangered waterbirds. Efforts directly benefitting the Hawaiian coot include a long-term hunting ban, protection of habitat through establishment and management of Federal and State refuges and sanctuaries, and predator control. Actions that inform conservation of the species include a biannual waterbird survey conducted by DOFAW since the mid-1950s, population monitoring, and research.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migrant

Population Information and Trends

Number of Populations:

21 - 80 (NatureServe, 2015)

Population Size:

1000 - 2500 individuals (NatureServe, 2015)

Population Narrative:

From 1976 to 1983, numbers ranged from 400 to 2,300 birds with an average of 1,300 (USFWS 1985). In the 1980s, the statewide population probably fluctuated between 2000 and 4000 birds, with 80% of the birds on Kauai, Oahu, and Maui (Engilis and Pratt 1993, Scott et al. 1988). (NatureServe, 2015). Population estimates prior to the 1950s are not available; however, estimates from the late 1950s and early 1960s indicated a population of fewer than 1,000 birds. Hawaiian coots currently occur in coastal plain wetlands usually below 1,320 feet (400 meters) elevation on all the main Hawaiian Islands except for Kahoolawe; however, breeding is restricted to relatively few sites. Biannual waterbird counts conducted by DOFAW suggest that the statewide Hawaiian coot population averages approximately 2,000 birds with short-term population fluctuations and long-term slightly increasing population trend (USFWS 2011, p. 21-22). While not all wetlands are surveyed, the counts are considered a fairly accurate minimum population size. About 80 percent of the population detected in the surveys occur on the islands of Kauai (Hanalei, Huleia, Opaekaa), Oahu (coastal wetlands and reservoirs such as Lake Wilson and Nuuanu Reservoir, Kahuku Point and along the windward shore), and Maui (Kanaha and Kealia Ponds, Nuu Pond) (USFWS 2011). The remaining 20 percent of the population occurs in coastal ponds and playa wetlands, including breeding populations on the islands of Hawaii, Lanai, and Molokai.

Threats and Stressors

Stressor: Loss or degradation of wetland habitat (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Decline has been due to loss of both natural and cultivated wetlands such as taro fields; this habitat loss has resulted from commercial and residential development, sugarcane cultivation, and encroachment of non-native wetland plants. Predation by introduced mammals (mongoose, rats, cats, dogs) may have contributed to the decline. A large portion of the population is not breeding (Scott et al. 1988). Habitat loss/degradation due to coastal development is an ongoing concern. (NatureServe, 2015)

Stressor: Climate change degradation of habitat (USFWS, 2015)

Exposure:
Response:
Consequence:
Narrative: Climate change is believed to pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2015. (USFWS, 2015).

Stressor: Alteration of hydrology (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative:

Stressor: Invasion of habitat by non-native plants (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative:

Stressor: Alien predators (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative:

Stressor: Avian Disease (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Contaminants (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Human disturbance (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Small population size/genetic diversity loss/stochastic vulnerability (USFWS, 2015).
Exposure:
Response:

Consequence:
Narrative:

Recovery

Reclassification Criteria:
To be downlisted, all core wetlands and at least 50 percent of supporting wetlands must be protected and managed in accordance with management practices outlined in the 2011 recovery plan. (USFWS, 2015).

Conservation Measures and Best Management Practices:

- Recommended action 1: Habitat and natural process management and restoration – Protect all core and at least 50 percent of supporting wetlands. Develop management plans for core and supporting wetlands. (USFWS, 2015).
- Recommended action 2: Predator / herbivore monitoring and control – Continue predator control and implement improved methods as they become available. (USFWS, 2015).
- Recommended action 3: Invasive plant monitoring and control – Remove nonnative, invasive plants and improve altered wetland hydrology as appropriate. (USFWS, 2015).
- Recommended action 4: Disease monitoring and control – Continue to monitor for botulism and if detected, implement actions to minimize the immediate threat. Research and develop new tools to prevent botulism related mortality. (USFWS, 2015).
- Recommended action 5: Surveys / inventories – Continue annual State-wide waterbird counts. These data are not analyzed for other than basic status of the species. Directed analysis of the waterbird count data could identify correlations, including use of specific wetlands, time of year, and state of the wetlands, that could improve our ability to manage for the ʻalae keʻokeʻo as well as other endangered waterbirds. (USFWS, 2015).
- Recommended action 6: Population viability monitoring and analysis – Conduct a population viability analysis to identify population numbers and time spans to serve as predictors of long term recovery for this species. (USFWS, 2015).

References

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SPECIES ACCOUNT: *Gallicolumba stairi* (Friendly ground-dove)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/24/2016; Pacific Region (R1) (USFWS, 2016b)

Physical Description

The friendly ground-dove is a medium-sized dove, approximately 10 in (26 cm) long. Males have rufous- brown upperparts with a bronze-green iridescence, the crown and nape are grey, the wings rufous with a purplish luster, and the tail is dark brown. The abdomen and belly are dark brown- olive, while the breast shield is dark pink with a white border. Females are dimorphic in Fiji and Tonga, where a brown phase (tawny underparts and no breast shield) and pale phase (similar to males but duller) occur. (USFWS, 2016)

Taxonomy

Genus Gallicolumba throughout the Pacific and Southeast Asia

Historical Range

United States population: Islands of Ofu and Olosega, Manu'a County, American Samoa (USFWS, 2014)

Current Range

United States population: Islands of Ofu and Olosega, Manu'a County, American Samoa (USFWS, 2014)

Distinct Population Segments Defined

Yes; United States population: Islands of Ofu and Olosega, Manu'a County, American Samoa (USFWS, 2014)

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: This bird spends most of its time on the ground, and feeds on seeds, fruit, buds, snails, and insects (Clunie 1999, p. 42; Craig 2009, p. 125). (USFWS, 2016)

Reproduction Narrative

Adult: The friendly ground-dove typically builds a nest of twigs several feet from the ground or in a tree fern crown, and lays one or two white eggs (Clunie 1999, p. 43). Nesting was also observed in a log less than a meter off the ground (Stirnemann 2015, in litt.). (USFWS, 2016)

Geographic or Habitat Restraints or Barriers

Adult: No information

Spatial Arrangements of the Population

Adult: No information

Environmental Specificity

Adult: No information

Tolerance Ranges/Thresholds

Adult: No information

Site Fidelity

Adult: No information

Dependency on Other Individuals or Species for Habitat

Adult: No information

Habitat Narrative

Adult: In American Samoa, the friendly ground-dove is typically found on or near steep, forested slopes, particularly those with an open understory and fine scree or exposed soil (Tulafono 2006, in litt.). Elsewhere the species is known to inhabit brushy vegetation or native forest on offshore islands, native limestone forest (Tonga), and forest habitats on large, high islands (Steadman and Freifeld 1998, p. 617; Clunie 1999, pp. 42–43; Freifeld et al. 2001, p. 79; Watling 2001, p. 118). (USFWS, 2016)

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: Low; between two islands

Immigration/Emigration

Adult: No information

Dependency on Other Individuals or Species for Dispersal

Adult: No information

Dispersal/Migration Narrative

Adult: Appear to move between Ofu and Olosega islands, ~150 m causeway, but not away from American Samoa.

Population Information and Trends

Population Trends:

No current population estimate is available as the secretive habits of this species make monitoring difficult. Monitoring surveys over the last several years do not, however, suggest any change in the relative abundance of the friendly ground-dove (Seamon 2004b, pers. comm.). (USFWS, 2014)

Species Trends:
No information

Resiliency:
No information

Representation:
No information

Redundancy:
No information

Population Growth Rate:
No information

Number of Populations:
No information

Population Size:
No information

Minimum Viable Population Size:
No information

Resistance to Disease:
No information

Adaptability:
No information

Population Narrative:
Population level information is largely unavailable because of the secretive habitats of the species make monitoring difficult. The friendly ground-dove is uncommon or rare throughout its range (Steadman and Freifeld 1998; Schuster et al. 2000; Freifeld et al. 2001; Watling 2001), except for on some small islands in Fiji (Watling 2001); however, this species is not known to be monitored except in American Samoa (DPS). In American Samoa, Engbring and Ramsey (1989) described the population on Ofu as very small, but did not attempt a population estimate; more than 10 ground-doves have been caught on Olosega between 2001 and 2004, suggesting that numbers here are greater than on Ofu, but birds may move between the two islands (Seamon 2004a, pers. comm.), which once were a single land mass and are today connected by a causeway that is roughly 150 meters (m) (492 feet (ft)) long. In Independent Samoa the species exists in very small numbers and is considered to be among the most endangered of native Samoan bird species (Watling 2001). In Tonga, the species occurs primarily on small, uninhabited islands and in one small area of a larger island. In Fiji, the species is thought to be widely distributed but uncommon on large islands and relatively common on some small islands.

Amerson et al. (1982, p. 69) estimate a total population of about 100 birds on Ofu and possibly Olosega. (USFWS, 2014; USFWS, 2016)

Threats and Stressors

Stressor: Habitat Destruction and Modification by Agriculture and Development (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: The loss or modification of lowland and coastal forests has been implicated as a limiting factor for populations of the friendly ground-dove and has likely pushed this species into more disturbed areas or forested habitat at higher elevations (Watling 2001, p. 118). Several thousand years of subsistence agriculture and more recent, larger-scale agriculture have resulted in the alteration and great reduction in area of forests at lower elevations in American Samoa (see Factor A discussion for the mao). On Ofu, the coastal forest where the ground-dove has been recorded, and which may be the preferred habitat for this species range-wide (Watling 2001, p. 118), largely has been converted to villages, grasslands, or coconut plantations (Whistler 1994, p. 127). (USFWS, 2016)

Stressor: Nest predation by rats and cats (USFWS, 2014)
Exposure: birds nest on the ground
Response: eggs, young, and adults are destroyed
Consequence: reduction in population numbers; decreased reproductive success
Narrative: Rats may play a role in limiting populations of the friendly ground-dove, although no specific data from American Samoa exist with which to test this hypothesis. Feral cats (Felis domesticus) have been observed in remote areas known to be frequented by ground-doves and may prey on friendly ground-doves and other ground-nesting species. (USFWS, 2014)

Stressor: Small population
Exposure: not enough suitable mates; population is vulnerable to catastrophic events
Response: birds inbreed and are vulnerable to stochastic extinction
Consequence: reduction in population numbers; decreased reproductive success
Narrative: Small populations are particularly sensitive to thresholds in a range of environmental and demographic parameters (Pimm et al. 1988; Mangel and Tier 1994; Meffe and Carroll 1997). This small population may be at risk of extinction because of the low number of individuals and the high frequency of catastrophic events such as hurricanes. Although severe storms are a natural disturbance with which this species has coexisted for millennia, such storms may affect habitat and food resources for birds and thus increase the threats to a population already suffering predation by nonnative mammals. For example, Hurricanes Heta (in January 2004) and Olaf (in February 2005) virtually destroyed suitable habitat at one of the areas on Olosega where this species was most frequently encountered; detections of ground-doves in other areas subsequently increased, suggesting they had moved from the area affected by the storms (Seamon 2005, pers. comm.; Tulafono 2006, pers. comm.). Inbreeding and/or reduced likelihood of locating mates are also potential threats for small populations (Thevenon and Couvet 2002; Frankham 2003). (USFWS, 2014)

Stressor: Hurricanes (USFWS, 2016)
Exposure:

Response:
Consequence:
Narrative: Hurricanes may cause the direct and indirect mortality of the friendly ground-dove, as well as modify its already limited habitat (see Factor A above). This species has likely coexisted with hurricanes for millennia in American Samoa, and if the friendly ground-dove was widely distributed in American Samoa, had ample habitat and sufficient numbers, and was not under chronic pressure from anthropogenic threats such as habitat loss and introduced predators, it might recover from hurricane-related mortality and the temporary loss or redistribution of resources in the wake of severe storms. For example, Hurricanes Heta (in January 2004) and Olaf (in February 2005) destroyed suitable habitat for the friendly ground-dove at one of the areas on Olosega where this species was most frequently encountered; detections of ground-doves in other, less storm- damaged areas subsequently increased, suggesting they had moved from the area affected by the storms (Seamon 2005, in litt.; Tulafono 2006, in litt.). (USFWS, 2016)

Stressor: Climate change (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: Although we do not have specific information on the impacts of climate change to the American Samoa DPS of the friendly ground-dove, increased ambient temperature and precipitation, increased severity of hurricanes, and sea level rise and inundation would likely exacerbate other threats to its habitat. (USFWS, 2016)

Recovery

Reclassification Criteria:
No information.

Delisting Criteria:
No information.

Recovery Actions:
- Determine population size and status of the species
- Conduct studies on basic life history characteristics of the species
- Control predators (rats, cats) at known colonies
- Determine other limiting factors and implement control measures
- Continue ongoing bans on hunting native species.

Conservation Measures and Best Management Practices:
- Report on current knowledge of the species in American Samoa and other islands within range.
- Assess the population status in Ofu/Olosega.
- Develop a regional conservation plan for the friendly ground-dove.
- Continue ongoing bans on hunting native species.
- Implement a new mark and recapture study to obtain population and survival estimates.
- Continue ongoing rat-trapping projects on Ofu.

References

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USFWS 2014. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Gallicolumba stairi (Friendly Ground-Dove).

SPECIES ACCOUNT: *Gallinula chloropus guami* (Mariana common moorhen)

Species Taxonomic and Listing Information

Listing Status: Endangered; 08/27/1984; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Mariana Island subspecies of the Common Moorhen resembles other moorhen subspecies found throughout the world. The Mariana Common Moorhen is a slate-black bird about 14 inches (35 centimeters) in length. The distinguishing physical characteristics of adult birds include a red bill and frontal shield, white undertail coverts, a white line along the flank, and long olive-green legs with large unwebbed feet. Males and females are nearly identical in appearance and are difficult to distinguish from each other (USFWS, 2016).

Taxonomy

This species was originally listed as the Mariana gallinule. Various subspecies are described from North America, Eurasia, the North Pacific, and South America (American Ornithologists' Union 1984). The Mariana subspecies is endemic to the Mariana Archipelago. The moorhen is a member of the rail family (Rallidae) and subfamily (Rallinae) within the order Gruiformes. In the past, this species had been known as Fulica chioropus or Gallinula galeata var. sandwichensis (USFWS, 1991).

Historical Range

The Mariana common moorhen was historically confined to wetland areas of Guam, Saipan, Tinian, and Pagan of the Mariana Islands (USFWS, 1991).

Current Range

The Mariana common moorhen still occurs on three islands in the Mariana Archipelago (Guam, Tinian, Saipan) (USFWS, 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Moorhens feed on both plant and animal matter in or near water. Observers have noted grass, adult insects, and insect larvae in moorhen stomachs. Moorhen are probably opportunistic feeders, so the diet varies with the particular habitat (Shallenberger 1977). Mariana common moorhen appear to be active both during the day and at night. Some evidence suggests that moorhens fly primarily at night (Guam DAWR unpubl. report) (USFWS, 1991).

Reproduction Narrative

Adult: Hydrilla verticillata is used by moorhens as a nesting substrate (USFWS, 2009). Nests have been found in all months except October, and the moorhen is believed to breed throughout the year (in Guam DAWR unpubl. report; CNMIDFW 1986 unpubl. report). Clutch size of 4 - 8 for the Mariana common moorhen has been recorded. Chicks are precocial and swim away from the nest shortly after hatching but remain close to and dependent on the parents for several weeks. Two clutches within one breeding season have been noted; observations indicate juveniles from earlier broods stay with adults and newly-hatched chicks in family groups (Guam DAWR unpubl. data) (USFWS, 1991). Incubation probably lasts 22 days (Ritter and Sweet 1993) (NatureServe, 2015).

Spatial Arrangements of the Population

Adult: Family groups (USFWS, 1991; see reproduction narrative)

Environmental Specificity

Adult: Moderate (inferred from USFWS, 1991)

Habitat Narrative

Adult: Rivers were found to be important for moorhens on Guam and their use of rivers increased during the wet season (USFWS, 2009). The moorhen is an inhabitant of emergent vegetation of freshwater marshes, ponds and placid, rivers. The key characteristics of moorhen habitat appear to be a combination of deep (greater than 60 cm) marshes with robust emergent vegetation and equal areas of cover and open water. Man-made as well as natural wetlands are used, and moorhen have been observed at commercial fish ponds, taro patches, rice paddies, sewage treatment plants, and reservoirs (Guam DAWR unpubl. data). Although the moorhen favors freshwater areas, it occasionally uses brackish water sites such as tidal channels or mangrove wetlands for limited periods of time (Guam DAWR unpubl. report) (USFWS, 1991).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS, 1991)

Dispersal

Adult: Moderate (inferred from USFWS, 2009)

Dispersal/Migration Narrative

Adult: No intra-island movement was detected for moorhens radio-tagged on Guam. The home range of birds on Guam averaged 3.1 ± 4.8 ha (SD) (USFWS, 2009). The Mariana common moorhen is a non-migratory form (USFWS, 1991).

Population Information and Trends

Population Trends:

36 - 52% decline in 1900s (NatureServe, 2015)

Species Trends:

Stable (NatureServe, 2015)

Resiliency:
Very low (inferred from USFWS, 1991)

Representation:
Very low (inferred from USFWS, 2009)

Redundancy:
Very low (inferred from USFWS, 1991)

Number of Populations:
2 (USFWS, 1991)

Population Size:
287 (USFWS, 2015)

Adaptability:
Low (inferred from USFWS, 1991)

Population Narrative:
The most recent counts of the Mariana Common Moorhen estimated 90 adult birds on Guam, 41 on Tinian, and 154 on Saipan resulting in a population estimate of 287 birds (Takano 2003; Takano and Haig 2004). (USFWS, 2015). The population structure of the Mariana common moorhen was recently examined using mitochondrial DNA from 35 individuals from Guam and Saipan. The results suggest a severe lack of genetic diversity and support the view of a single conservation unit for the Mariana common moorhen (Evans et al. 2005) (USFWS, 2009). The moorhen populations on Guam are considered to constitute one demographic unit (i.e., there is periodic gene flow between birds from all habitats), and those from the Northern Mariana Islands are considered to be a separate unit (USFWS, 1991). Population probably was reduced by at least 36 - 52% in the 1900s. USFWS (1990) categorized the status as "stable." (NatureServe, 2015).

Threats and Stressors

Stressor: Military training activities (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Department of the Navy's (DON) CNMI Joint Military Training (CJMT) proposed live-fire training will be located adjacent to Lake Hagoi and increased overflights would generate noise levels that would negatively impact Mariana Common Moorhens using Lake Hagoi and seasonal wetlands on Tinian (USFWS, 2015).

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:

Narrative: Climate change is believed to pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species (USFWS, 2015).

Stressor: Habitat degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Fena Lake experienced a loss of wetland vegetation, possibly due to eutrophication after a recent typhoon, potentially making it less desirable for Mariana common moorhens. Recent surveys indicate a decline in numbers of moorhens using the lake (A. Brooke, pers. comm. 2008). Most of the other wetlands in the Mariana Islands are also in compromised condition due to a number of factors. The condition of remaining wetlands in the Mariana Islands is generally poor for a number of reasons, including filling, dredging, altered hydrology, invasive introduced plants, introduced vertebrate predators, ungulate disturbance, fires, erosion, pollution, and even volcanic activity (Stinson 1993, Wiles and Ritter 1993). Reports indicate that many of Guam's natural wetlands are heavily invaded by the Phragmites karka reed (Ritter and Savidge 1999, Takano and Haig 2004b). Permanent wetlands on Saipan and Guam are also impacted by the presence of tilapia (Oreochromis mossambicus) which is believed to degrade habitat for wetland birds by depleting the invertebrate prey base used by these birds (Marshall and Worthington 1996, USFWS 2005) (USFWS, 2009).

Stressor: Predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Sightings of brown treesnakes (Boiga irregularis) on Saipan suggest that it may be in the process of becoming established there (Rodda and Savidge 2007). The brown treesnake was accidentally introduced to Guam around 1949 causing the extirpation or extinction of 13 of Guam's 22 native breeding birds (Rodda and Savidge 2007) and is strongly suspected of preying on moorhens (Takano and Haig 2004a). The spread of the brown treesnake to Saipan, Tinian, or Rota would likely have a negative impact the Mariana common moorhen population. Monitor lizards (Varanus indicus) were recorded in Lake Hagoi, Tinian during moorhen nest searches (USFWS 1996). The extent of predation on moorhens by monitor lizards is unknown, but monitor lizards are opportunistic and omnivorous, eating small mammals, insects, other lizards, birds, and eggs (McCoid and Witteman 1993; S. Vogt, U.S. Navy, pers. comm. 2006). In the Marianas, monitor lizard predation has been confirmed on Mariana common moorhen eggs (Gallinula chloropus guami) (USFWS, 2009).

Stressor: Disease (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The possibility of avian influenza or West Nile virus reaching the Mariana Islands from Asia or the U.S. mainland is a recent concern. The impact these two diseases may have on the Mariana common moorhen is not known at this time, but they could have deleterious impacts if they reach the Mariana Islands (USFWS, 2009).

Recovery

Reclassification Criteria:
1. A total of 240 ha (600 acres) of suitable wetland habitat on Guam, 120 ha (300 acres) on Saipan, and 30 ha (75 acres) on Tinian must be protected and managed (USFWS, 2015).

2. Population densities should be greater than 2.5 birds/ha (1 bird/acre) or 600 adult birds for Guam, 300 birds for Saipan, and 75 birds for Tinian (USFWS, 2015).

3. Population numbers and densities must be maintained for five consecutive years (USFWS, 2015).

4. There are multiple self-sustaining breeding populations, including multiple populations present on at least Kaua`i/Ni`ihau, O`ahu, Maui, and Hawai`i (USFWS, 2015).

1. Suitable wetland habitat, totaling 240 hectares (ha) (600 acres) on Guam, 120 ha (300 acres) on Saipan, and 17 ha (40 acres) on Tinian, has been protected and managed for the foraging, breeding, and sheltering needs of Mariana common moorhen (USFWS, 2018).

2. Over a minimum 15-year period, Mariana common moorhen population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance estimated through population surveys or demographic monitoring; and the average population throughout that time period is at least 600 adult birds on Guam, 300 adult birds on Saipan, and 30 adult birds on Tinian (USFWS, 2018).

3. Threats to the species, including road strikes, habitat loss, habitat degradation, and non-native predators, are managed so as to minimize mortality and meet population targets in Criterion 2 (USFWS, 2018).

In addition, any rule to downlist the Mariana common moorhen should incorporate a rule under section 4(d) of the Act granting protections regarding take (USFWS, 2018).

Delisting Criteria:
1. The area protected and managed for Mariana common moorhen, including previously suitable wetland habitat that has been restored, totals 400 ha (1000 acres) on Guam, 200 ha (500 acres) on Saipan, and 18 ha (45 acres) on Tinian (USFWS, 2018).

2. Over a minimum 30-year period, Mariana common moorhen population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance estimated through quantitative surveys or demographic monitoring; and the average population throughout that time period is at least 1000 adult birds on Guam, 500 adult birds on Saipan, and 45 adult birds on Tinian (USFWS, 2018).

3. A fourth breeding population has been established on another island. The fourth breeding population may contribute to meeting Delisting Criterion 1 (total acreage of wetlands) and 2 (minimum number of birds) (USFWS, 2018).

4. Threats to the species, including road strikes, habitat loss, habitat degradation, and non-native predators, are managed to minimize mortality and meet population targets in Criterion 2, such that populations are capable of persisting without significant human intervention (USFWS, 2018).

Recovery Actions:
- Secure and manage primary habitats (USFWS, 1991).
- Maintain and manage secondary habitats and other areas to supplement the primary areas (USFWS, 1991).
- Maximize productivity and survival of adults and young (USFWS, 1991).
- Determine biological parameters needed for development of delisting criteria (USFWS, 1991).

Conservation Measures and Best Management Practices:
- Surveys / inventories / Site / area / habitat protection – Determine which of the primary and secondary wetlands are needed on each island for recovery and develop a plan to prioritize efforts to work toward their protection and management. The rivers on Guam need to be incorporated into this determination (USFWS, 2015).
- Population viability monitoring and analysis – Work with Guam Division of Aquatic and Wildlife Resources, CNMI Division of Fish and Wildlife, and the U.S. Navy to develop and implement plans to conduct frequent and standardized surveys of the wetlands on Guam, Tinian, and Saipan (and possibly Rota) to monitor the status of the Mariana Common Moorhen throughout the Mariana Islands (USFWS, 2015).
- Alliance and partnership development – Develop cooperative agreements with private landowners for wetlands that occur on private lands and that are determined to be necessary for recovery (USFWS, 2015).
- Strategic planning / Habitat and natural process management and restoration – Develop management plans for restoring wetlands, incorporating methodology for removing nonnative invasive plants, improving hydrology where possible, removing predators effectively, and removing grazing ungulates where necessary (USFWS, 2015).
- Research recommendation implementation – Keep abreast of research on improvements in predator control and implement improved methodology (USFWS, 2015).
- Predator / herbivore monitoring and control – Conduct brown treesnake (Boiga irregularis) control at Guam wetlands. Continue brown treesnake surveillance and interdiction strategies to reduce the possibility of the brown treesnake becoming established on other islands (USFWS, 2015).
- Human interaction monitoring and management – Minimize human disturbance at primary and secondary wetlands determined essential for recovery (USFWS, 2015).
- Habitat requirements research / Population viability monitoring and analysis – Research biological parameters needed to determine delisting criteria (USFWS, 2015).
- Population viability monitoring and analysis – Conduct a population viability analysis to identify population numbers and time spans to serve as predictors of long-term recovery for this species (USFWS, 2015).

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SPECIES ACCOUNT: *Gallinula chloropus sandvicensis* (Hawaiian common gallinule)

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Hawaiian moorhen is an endemic subspecies of the common moorhen (Gallinula chloropus). It is a dark gray bird with a black head and neck, and white feathers on their flanks and on their undertail coverts. They have a distinctive red frontal shield, and their bill tip is yellow with a red base. Their legs and feet are greenish and without lobes. The Hawaiian moorhen usually measures about 13 inches in length and 11 to 16 ounces in mass, with males typically larger and heavier than the female (Bannor and Kiviat 2002, online p. 2). Both sexes are similar and have chicken-like cackles and croaks. The Hawaiian moorhen is similar to the moorhen on the mainland in appearance. In Hawaiian legend, these birds were thought to have brought fire from the gods to the Hawaiian people.

Current Range

No historical population estimates are available for the endemic Hawaiian moorhen, prior to the first biannual waterbird count by DOFAW in 1977. Because they are such secretive birds, it is difficult to conduct population surveys for this species. It is believed that they were common on the main Hawaiian Islands, except Lanai and Kahoolawe, in the 1800s but radically declined by the mid-1900s. Surveys from the 1950s through the 1960s estimated only 57 individuals (Engilis and Pratt 1993). Currently, Hawaiian moorhen inhabit the islands of Kauai and Oahu (USFWS 2011, p. 37). The State attempted a reintroduction of six Hawaiian moorhen (three females and three males) on May 18, 1983, to the island of Molokai at Kakahaia NWR. At least two birds were present in January 1984, but there have been no confirmed sightings since 1985 (USFWS 2011, p. 40).

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Hawaiian moorhen are opportunistic feeders and their diet likely varies with habitat, but includes algae, grass seeds, insects, snails, introduced fishes, crustaceans, mollusks, emergent grasses, and wetland plants (USFWS 2011, p. 44).

Reproduction Narrative

Adult: Hawaiian moorhen nest year-round but most activity occurs from March through August (USFWS 2011, p. 34). It is believed that the nesting phenology is related to water levels and late succession wetland vegetation. The Hawaiian moorhen usually lays an average of five to six eggs with the incubation period ranging from 19 to 22 days (USFWS 2011, p. 43). Re-nesting and multiple broods during one season have been observed (Byrd and Zeillemaker 1981). Platform nests are constructed in dense vegetation over water or near the waters' edge. The particular species of emergent plant used for nest construction is not as important as stem density and vegetation height (USFWS 2011, p. 43). Hawaiian moorhen are a precocial species; chicks are covered with down and are able to walk, but are dependent on parents for several weeks. The lifespan of this species is unknown; however, a common moorhen was recaptured after 10.5 years (USFWS 2011).

Habitat Narrative

Adult: Hawaiian moorhen generally occur in wetland habitats below 410 feet in elevation on the islands of Kauai and Oahu, although there have been reports from Keanae Peninsula on Maui and from the island of Hawaii. On the island of Kauai, the largest populations occur in the Hanalei and Wailua river valleys, Waiakalua Reservoir, and Wilcox Ponds (USFWS 2011, p. 40). Hawaiian moorhen also occur in the irrigation canals on the Mana Plain of western Kauai and in taro fields. On the island of Oahu, the species is widely distributed with most birds found between Haleiwa and Waimanalo; small numbers occur at Pearl Harbor and the leeward coast at Lualualei Valley.

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Population Information and Trends

Number of Populations:

6 - 20 (NatureServe, 2015)

Population Size:

Counts of `alae `ula have been stable, but remain low, with average totals of 287 birds over 10 years from 1998 to 2007. (USFWS, 2015)

Population Narrative:

Declined to an estimated 60 or fewer individuals in the 1950s and 1960s. Total population in the 1980s was estimated at about 750 (500 on Kauai, 250 on Oahu, and a small population on Molokai), but Engilis and Pratt (1993) regarded this as an underestimate due to many birds being missed in censuses. 141 occurrences, 95 current (1981-1996) and 46 historical (1954-1980). The number of distinct populations is far fewer than these numbers indicate. (NatureServe, 2015). Biannual waterbird counts indicate the statewide population of Hawaiian moorhen is stable with an average of 287 birds over 10 years (1998 to 2007), but count numbers are extremely variable between summer and winter surveys (USFWS 2011). While these surveys numbers provide a rough idea of population trends, the counts are thought to be underestimates because of the species' cryptic behavior, and an accurate population estimate is not available. Standard survey methods in these counts include visual and aural detection. Recent research conducted by DesRochers et al. (2008) in 2005 through 2007 has shown that passive surveys of cryptic waterbirds underestimate numbers of individuals present in the wetlands. Alternatively, broadcasting vocalizations of cryptic waterbirds to elicit responses increases detection. On average his research has shown that broadcasting calls increased Hawaiian moorhen detection by 30 percent on the island of Oahu and 56 percent on the island of Kauai.

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Threats and conservation needs are addressed as a combined assessment for all four species of Hawaiian waterbirds: the Hawaiian moorhen, Hawaiian coot, Hawaiian duck, and Hawaiian stilt. We are evaluating the threats and conservation needs on these four species of Hawaiian waterbirds jointly because they share common issues. The primary causes of the decline of the Hawaiian waterbirds are the loss of wetland habitat, predation by introduced animals, over-hunting in the late 1800s and early 1900s, disease, and environmental contaminants. A significant amount of Hawaii's wetlands have been lost due to human activities, including filing and draining for agriculture, houses, hotels, and golf courses. The Service estimates that 22,475 acres of wetlands existed within the coastal plains of Hawaii in the 1780s. In 1990, the Service estimated that only 15,474 acres remained; a loss of 31 percent (USFWS 2011). The majority of the wetlands that remain are degraded by altered hydrology, invasive species, human encroachment, and contaminants. In addition to wetland loss, invasion by non-native habitat-modifying plants results in alteration of wetland plant communities and degradation of wetlands. Species such as California grass (Urochloa mutica), water hyacinth (Eichornia crassipes), Indiane fleabane (Pluchea indica) and red mangrove (Rhizophora mangle) present a serious threat by outcompeting more desirable species and eliminating open water habitats. Unmanaged vegetation significantly reduces open water, shallow water, bare ground, and exposed mudflat habitat. All of these habitats are under serious threat without management to control these aggressive plant species (USFWS 2011). Introduced predators are considered a primary factor limiting Hawaiian waterbird populations. Small Indian mongoose, feral cats, and feral dogs are all presently found within wetlands and pose a serious threat to Hawaiian waterbird reproductive success. All three of these predatory Species are known to take eggs, young birds, and even adults (USFWS 2011). Both cats and dogs are of particular concern because of the close proximity of many of Hawaii's wetlands to urban areas. Other species, such as the cattle egret (Bubulcus ibis), American bullfrog (Rana catesbeiana), and rats have been observed congregating around nesting waterbirds just prior to chicks hatching (Woodside 1997, pers. comm.). Oahu National Wildlife Refuge Complex (NWRC) staff have documented predation of waterbird chicks by the cattle egret and the black-crowned night heron (Nycticorax nycticorax). A bullfrog was documented preying upon a Hawaiian moorhen chick at the Refuge (Viernes 1995, 55:37). More recently, the "Key Predators" study of 2003 to 2004 on James Campbell NWR provided the first multiple observations of Hawaiian stilt chick predation by bullfrogs, which accounted for 45 percent of chick losses over the study period (Eijzenga 2005). The most prevalent disease affecting Hawaiian waterbirds is avian botulism type C. Avian botulism is caused by a neurotoxin produced by a common bacterium (Clostridium botulinum). Normally unharmful and dormant, these spores release toxins only when certain conditions occur, including warm temperatures, high pH, low dissolved oxygen, and stagnant waters. Birds usually acquire the disease by eating invertebrates containing the toxin. Typical signs in birds include weakness, lethargy, and inability to hold up the head or to fly (Rocke and Friend 1999). Botulism can occur in any area with standing fresh or brackish water frequented by waterbirds. Avian botulism outbreaks are common in Hawaii and are a significant cause of waterbird mortality (Pratt and Brisbin 2002, p. 36). One of the first outbreaks in Hawaii occurred on the

island of Oahu at Kaelepulu pond, which is also known as Enchanted Lake, in Kailua in 1952. Since then, avian botulism outbreaks have been documented at Hanalei NWR on the island of Kauai, Aimakapa pond at Kaloko Honokohau National Historical Park on the island of Hawaii, Ohiapilo pond in Molokai, and at Kealia Pond NWR on the island of Maui (Pratt and Brisbin 2002, p. 36). At Hanalei NWR, over 300 sick or dead birds with suspected or confirmed avian botulism type C were found between December 2011 and April 2012. Of these, 82 percent were endangered species (55 percent Hawaiian duck, 19 percent Hawaiian coot, 4 percent Hawaiian moorhen, 4 percent Hawaiian stilt, and less than 1 percent Hawaiian goose) and 18 percent were native non-endangered, migratory, or feral/introduced birds. In February 2012 at the Lanai Sewage Treatment Plant, over 60 deaths were reported during an outbreak, mostly Hawaiian coot (USFWS unpublished data). The possibility of West Nile virus or avian influenza reaching the Hawaiian Islands from the U.S. continent or Asia is a recent concern. The impact these two diseases may have on the Hawaiian waterbirds is not known at this time, but they could have deleterious impacts if they reach the Hawaiian Islands. Environmental contaminants in wetlands are of concern to Hawaiian waterbirds because the general diet of these birds makes them susceptible to toxins accumulated in the food chain (Ratner 2000, p. 1-2). In 1988, a fuel spill in Pearl Harbor caused direct mortality and nest abandonment of Hawaiian waterbirds at the Honouliuli Unit of Pearl Harbor NWR (J. Leinecke 1993, pers. comm.). In 1996, an oil spill in Pearl Harbor imperiled the Hawaiian stilt as well as marine fisheries. Urban encroachment has the potential to negatively affect waterbirds’ habitats via flushing of household and industrial products into water-collecting systems (storm drains and roadside ditches) which lead to streams, wetlands, and the ocean. Preventing wetland loss, managing existing wetland habitat, and predator control at primary nesting sites are necessary actions to increase Hawaiian waterbird populations. As described in the Recovery Plan for Hawaiian Waterbirds, recovery of the Hawaiian waterbirds focuses on the following objectives: (1) increasing population numbers to a statewide baseline level; (2) establishing multiple, viable breeding populations throughout each species’ historical range; and (3) establishing a network of wetlands on the main islands that are protected and managed for waterbirds (USFWS 2011). Protection of a wetland implies that the wetland is secure from development. Management of a site implies adequate dedicated funding to implement science-based techniques to meet the life history requirements of endangered Hawaiian waterbirds. This includes a written management plan; adequate staffing, personnel with expertise in wetlands habitat management, secure water sources; managed water levels; control of invasive vegetation and fish; control of introduced predators; waterbird population monitoring; removal of mallard-Hawaiian duck hybrids; minimized human disturbance; and monitoring and control of avian diseases and environmental contaminants (USFWS 2011).

Recovery

Reclassification Criteria:
To be downlisted, all core wetlands and at least 50 percent of supporting wetlands must be protected and managed in accordance with management practices outlined in the 2011 revised recovery plan, a population viability analysis 3 (PVA) has been conducted to determine the population size necessary for long-term viability of the species. The statewide surveyed number of `alae `ula has shown a stable or increasing trend and has not declined below 2,000 birds (or an alternative target based on the PVA) for at least 5 consecutive years, and there are multiple self-sustaining breeding populations, including multiple populations present on at least Kauai/Niihau, Oahu, Maui, and Hawaii. In addition, an improved survey technique has been

developed and implemented. The downlisting goals for this species have not been met (Table 1), not all threats are being managed, and some threats may be increasing, including avian botulism (Table 2). Therefore, the `alae `ula meets the definition of endangered as it remains in danger of extinction throughout its range. (USFWS 2015)

Recovery Actions:

- The recovery strategy for the Hawaiian waterbirds relies on a combination of protection and management of core and supporting wetlands to maintain self-sustaining breeding populations. Core wetlands are defined as areas that provide habitat essential for the larger populations of Hawaiian waterbirds that comprise the bulk of the numbers prescribed for recovery. It is crucial for wetlands in these sites to be secure from conversion to non-wetland condition and to have sufficient enduring management to recover Hawaii's waterbirds. Supporting wetlands are additional areas that may not support the bulk of waterbird populations but provide habitat important for smaller waterbird populations or that provide habitat needed seasonally by segments of the waterbird populations during part of their life cycle (USFWS 2011). In addition to the overall strategy for Hawaiian waterbirds, recovery of the Hawaiian moorhen also includes reestablishing populations on at least two additional islands (Maui, Molokai, Lanai, or Hawaii) (USFWS 2005, p. 74).

Conservation Measures and Best Management Practices:

- A variety of conservation measures have been implemented to protect Hawaii's endangered waterbirds. Efforts directly benefitting the Hawaiian waterbirds include a long-term hunting ban, protection of habitat through establishment and management of federal and State refuges and sanctuaries, and predator control. Conservation partnerships with private landowners protect and preserve core and supporting wetlands. Actions that inform conservation of the species include a biannual waterbird survey conducted by DOFAW since the mid-1950s, population monitoring, and research (USFWS 2011).
- New management actions: Climate change degradation of habitat – Climate change is believed to pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs by 2015. (USFWS 2015)
- Recommendations for Future Actions: Protect all core and at least 50 percent of supporting wetlands. Develop management plans for core and supporting wetlands. Reintroduce the `alae `ula to a protected and managed site on at least two additional islands (Maui, Moloka`i, Lāna`i, Hawai`i) and monitor survival, dispersal, and reproduction. Continue predator control and implement improved methods as they become available. Remove nonnative, invasive plants and improve altered wetland hydrology as appropriate. Disease monitoring and control – Continue to monitor for botulism and if detected, implement actions to minimize the immediate threat. Research and develop new tools to prevent botulism related mortality. Continue biannual State-wide waterbird counts. These data are not analyzed for other than basic status of the species. Directed analysis of the waterbird count data could identify correlations, including use of specific wetlands, time of year, and state of the wetlands, that could improve our ability to manage for the `alae `ula as well as other endangered waterbirds. Incorporate improved survey techniques for this species into the biannual state-wide waterbird surveys. Conduct a population viability analysis to identify population numbers and time spans to serve as predictors of long term recovery for this species. (USFWS 2015)

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USFWS 2015 5-YEAR REVIEW Short Form Summary Species Reviewed: Hawaiian Common Gallinule (Gallinula chloropus sandvicensis).

SPECIES ACCOUNT: *Grus americana* (Whooping crane)

Species Taxonomic and Listing Information

Listing Status: Endangered/Experimental Population, Non-Essential; 03/11/1967, 01/22/1993, 06/26/2001, 02/03/2011; Southwest Region (R2), Southeast Region (R4) (USFWS, 2016)

Physical Description

The whooping crane occurs only in North America and is North America's tallest bird, with males approaching 1.5 m (5 ft) when standing erect. The whooping crane adult plumage is snowy white except for black primaries, black or grayish alula (specialized feathers attached to the upper leading end of the wing), sparse black bristly feathers on the carmine crown and malar region (side of the head from the bill to the angle of the jaw), and a dark gray-black wedge-shaped patch on the nape. The common name "whooping crane" probably originated from the loud, single-note vocalization given repeatedly by the birds when they are alarmed. (USFWS, 2016)

Taxonomy

The whooping crane is in the Family Gruidae, Order Gruiformes (Krajewski 1989, Meine and Archibald 1996). The closest taxonomic relatives in continental North America are 5 races of sandhill crane (G. canadensis): the lesser (G. c. canadensis); Canadian (G. c. rowani); greater (G. c. tabida); Florida (G. c. pratensis); and Mississippi (G. c. pulla) (the last also listed as endangered by the USFWS (Meine and Archibald 1996). (USFWS, 2007)

Historical Range

The historical range extended from the Arctic coast of North America south to central Mexico, and from Utah east to New Jersey, South Carolina, Georgia, and Florida; in the 19th and 20th centuries, nesting occurred principally in the region extending from central Canada to the north-central United States (see CWS and USFWS 2007). (NatureServe, 2015)

Current Range

Current distribution includes just three populations: (1) the Aransas-Wood Buffalo National Park Population that nests in Wood Buffalo National Park and adjacent areas in Canada (south-central Mackenzie and adjacent northern Alberta) and winters in coastal marshes in Texas, with significant migration stopovers in southern Saskatchewan, Nebraska, Kansas, and Oklahoma; (2) a reintroduced non-migratory Florida Population that occurs in central Florida; and (3) a reintroduced Eastern Migratory Population that migrates between Wisconsin (Necedah National Wildlife Refuge) and Florida (Chassahowitzka NWR) (CWS and USFWS 2007). (NatureServe, 2015)

Distinct Population Segments Defined

Yes: Entire U.S.A, except where listed as experimental population; Experimental populations: U.S.A. (AL, AR, GA, IL, IN, IA, KY, LA, MI, MN, MS, MO, NC, OH, SC, TN, VA, WI, WV); U.S.A. (CO, ID, FL, NM, UT, and the western half of Wyoming); and U.S.A (Southwestern Louisiana) (USFWS, 2016)

Critical Habitat Designated

Yes; 5/16/1978.

Legal Description

On May 15, 1978, the Service determined Critical Habitat for the whooping crane (Grus americana), an Endangered species, in the States of Colorado, Idaho, Kansas, Nebraska, New Mexico, Oklahoma, and Texas (43 FR 20938 - 20942). On August 17, 1978, the Service proposed eight additional areas as critical habitat in Kansas, Montana, Nebraska, North Dakota, and South Dakota (43 FR 36588 - 36590).

Critical Habitat Designation

Critical Habitat for the whooping crane (Grus americana) is determined to include the following areas:

Colorado. Areas of land, water, and airspace with the following components (1) Monte Vista National Wildlife Refuge in Alamosa and Rio Grande Counties; and (2) Alamosa National Wildlife Refuge in Alamosa and Conejos Counties.

Kansas. Areas of land, water, and airspace with the following components: (1) Quivira National Wildlife Refuge in Stafford, Reno, and Rice Counties; and (2) Cheyenne Bottoms State Waterfowl Management Area in Barton County.

Nebraska. An area of land, water, and airspace in Dawson, Buffalo, Hall, Phelps, Kearny, and Adams Counties with the following boundaries: Platte River bottoms—a strip of river bottom with a north-south width 3 miles, a south boundary paralleling Interstate 80, beginning at the junction of U.S. Highway 283 and Interstate 80 near Lexington, and extending eastward along Interstate 80 to the interchange for Shelton and Dehman, Nebr. near the Buffalo-Hall County line.

New Mexico. An area of land. water, and airspace in Socorro County with the follow- ing component: All areas at or below 4,600 feet in elevation within Bosque del Apache National Wildlife Refuge.

Oklahoma. An area of land, water, and airspace in Alfalfa County with the following component: Salt Plains National Wildlife Refuge.

Texas. An area of land, water, and airspace in Aransas, Calhoun, and Refugio Counties with the following boundaries: Beginning at the point where the north boundary of the Aransas National Wildlife Refuge intersects the shore of San Antonio Bay at Webb Point; thence, from this point along a straight line across San Antonio Bay through the westernmost tip of Mosquito Point and inland to a point of intersection with metal surfaced road; thence eastward along a straight line across Espiritu Santo Bay to the intersection of the bay shore and a road at the east end of Pringle Lake on Matagorda Island; thence south along this road to the intersection with the main Matagorda Island road; southwestward along this main road to Cedar Bayou at latitude 28°04'10? N.; thence due west across Cedar Bayou, Vinson Slough, and Isla San Jose to Gulf Intracoastal Waterway platform channel marker No. 25; thence north to the southwest corner of the proclamation boundary, just south of Blackjack Point; thence north along the proclamation boundary into St. Charles Bay to a line drawn as an eastward extension of Twelfth Street on Lamar Peninsula; thence westward along this line to intersection with Palmetto Avenue; thence northward along a straight line to the southwest corner of the Aransas National Wildlife Refuge at Texas State Highway 35 and the north shore of Cavasso Creek; thence northeast on a straight line to the corner of the Aransas National Wildlife Refuge north boundary adjacent to triangulation station "Twin"; thence along the north boundary of said refuge to the starting point at Webb Point.

Primary Constituent Elements/Physical or Biological Features

PCEs not described. All areas designated provide food, water, and other nutritional or physiological needs of the whooping crane. Cranes at Aransas feed primarily on various crustaceans and molluscs found in the tidal flats and marshes. Crayfish, frogs, small fish, and other small animals appear to be the major items taken in wetlands on spring migration. During fall migration whooping cranes seem to feed more extensively in recently harvested grain fields where insects and wasted grains seem to constitute the bulk of their diet. Generally, whooping cranes (as do most other cranes in the world) require an open expanse for nightly roosting. This habit of using sand or gravel bars in rivers and lakes for nightly roosting appears to be one of the major factors in crane habitat selection. Feeding cranes seen in migration are frequently found within short flight distances of reservoirs, lakes, and large rivers that offer bare islands for nightly roosting. Whooping cranes do not readily tolerate disturbances to themselves or their habitat. A human on foot can quickly put a whooping crane to flight at distances over one quarter of a mile. Loss of large expanses of wetlands and shooting were the major factors in causing the massive declines of whooping cranes in the late 1800's. The one common feature uniting the vast majority of confirmed sightings of this crane in migration is the proximity to wetlands that provide undisturbed roosting sites.

Based on the above text, it can be inferred that (i) small aquatic animals, (ii) sand and gravel bars, and (iii) large expanses of undisturbed wetlands are major consitutent elements required by this species.

Special Management Considerations or Protections

Critical habitat excludes existing manmade structures or settlements which are not necessary to the normal needs or survival of the species.

Life History

Feeding Narrative

Adult: Whooping cranes are omnivorous (Walkinshaw 1973), probing the soil subsurface with their bills and taking foods from the soil surface or vegetation. Summer foods include large nymphal or larval forms of insects, frogs, rodents, small birds, minnows, and berries (Allen 1956, Novakowski 1966, Bergeson et al. 2001b). Foods utilized during migration are poorly documented but include frogs, fish, plant tubers, crayfish, insects, and agricultural grains. The largest amount of time is spent feeding in harvested grain fields (Johns et al. 1997). The winter diet consists predominately of animal foods, especially blue crabs (Callinectes sapidus), clams (Tagelus plebius, Ensis minor, Rangia cuneata, Cyrtopleura costada, Phacoides pectinata, Macoma constricta), and the plant wolfberry (Lycium carolinianum) (Allen 1952, Uhler and Locke 1970, Blankinship 1976 and 1987, Hunt and Slack 1987, Chavez-Ramirez 1996). Most foraging occurs in the brackish bays, marshes, and salt flats on the edge of the mainland and on barrier islands. Occasionally, cranes fly to upland sites when attracted by fresh water to drink or by foods such as acorns, snails, crayfish and insects, and then return to the marshes to roost (Hunt 1987, Chavez-Ramirez et al. 1995). Uplands are particularly attractive when partially flooded by rainfall, burned to reduce plant cover or when food is less available in the salt flats and marshes (Bishop and Blankinship 1982). Some whooping cranes use upland sites frequently in most years, but agricultural croplands adjacent to ANWR are rarely visited. (USFWS, 2007)

Reproduction Narrative

Adult: Whooping cranes are a long-lived species. Binkley and Miller (1983) suggested a maximum life span of 22-24 years of age, however at present, 1 wild female died at age 28 and 1 male is currently 28 years old (Tom Stehn, ANWR, pers. comm.). Captive individuals live 35-40 years (Moody 1931, McNulty 1966). Eggs are normally laid in late April to mid-May, and hatching occurs about 1 month later. Pair mates for life. Both sexes, in turn, incubate 2, sometimes 1-3, eggs for 29-31 days. Whooping cranes usually produce clutches of 2 eggs laid 48-60 hours apart. Incubation begins with the first egg laid, resulting in asynchronous hatching of the eggs. Nestlings are precocial. Young are tended by both adults, fledge when no less than 10 weeks old (no earlier than mid-August), remain with parents until following year (dissociate after arrival on breeding grounds). Sexually mature at 4-6 years. Mated pairs and families establish and defend winter territories on coastal marshes in Texas. Breeding territories are very large, averaging 770 ha (Johnsgard 1991). (USFWS, 2007; NatureServe, 2015)

Geographic or Habitat Restraints or Barriers

Adult: A big problem for reintroduced whooping crane flocks may be the lack of large blocks of suitable habitat in which the species seems to prosper. (USFWS, 2007)

Environmental Specificity

Adult: Medium, with some key requirements (NatureServe, 2015)

Site Fidelity

Adult: High (USFWS, 2007)

Habitat Narrative

Adult: Nesting occurs in dense emergent vegetation (sedge, bulrush) in shallow (often slightly alkaline) ponds (Kuyt 1995), freshwater marshes, wet prairies, or along lake margins. Pothole breeding sites in Canada are separated by narrow ridges vegetated by black spruce, tamarack, and willow. The nest is a mound of marsh vegetation rising about 20-50 centimeters above the surrounding water level. Habitat during migration and winter includes marshes, shallow lakes, lagoons, salt flats, grain and stubble fields, and barrier islands (AOU 1983, Matthews and Moseley 1990). Radio-marked migrants roosted primarily in palustrine wetlands, many of which were smaller than 0.5 hectares (Howe 1989). Migration habitat includes mainly sites with good horizontal visibility, water depth of 30 centimeters or less, and minimum wetland size of 0.04 hectares for roosting (Armbruster 1990, which see for further details). A big problem for reintroduced whooping crane flocks may be the lack of large blocks of suitable habitat in which the species seems to prosper. They show considerable fidelity to their breeding territories, and normally nest in the same general vicinity each year. (USFWS, 2007; USFWS, 2012; NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory and non-migratory populations (NatureServe, 2015)

Dispersal

Adult: Medium (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: The whooping crane is a bi-annual migrant, traveling between its summer habitat in central Canada, and its wintering grounds on the Texas coast, across the Great Plains of the U.S. in the spring and fall of each year. The migratory corridor runs in an approximately straight line from the Canadian Prairie Provinces of Alberta and Saskatchewan through the Great Plains states of eastern Montana, North Dakota, South Dakota, Nebraska, Kansas, Oklahoma, and Texas. The complete corridor is approximately 2,400 miles (3,862 km) long by 220 miles (354 km) wide, a zone that encompasses 95% of known sightings of whooping cranes. Autumn migration normally begins in mid-September, with most birds arriving on the Texas wintering grounds between late October and mid-November. Whooping cranes migrate south as singles, pairs, in family groups, or as small flocks of 3 to 5 birds. They are diurnal migrants and stop daily to feed and rest. Local weather conditions influence distance and direction of travel, but whooping cranes generally are capable of reaching the autumn staging grounds in the north central portion of the Saskatchewan agricultural area on the second day of migration, where they remain for 2 – 4 weeks. The remainder of the migration from Saskatchewan to the wintering grounds is usually rapid, probably weather-induced, and may be completed in a week. Whooping cranes occupy winter areas for almost half a year. Although close association with other whooping cranes is tolerated at times on the wintering grounds, pairs and family groups typically occupy and defend relatively discrete territories. As spring approaches, “dancing” behavior (running, leaping and bowing, unison calling, and flying) increases in frequency, and is indicative of pre-migratory restlessness. Spring migration departure dates are normally between March 25 and April 15, with the last birds usually leaving by May 1. (USFWS, 2016)

Population Information and Trends

Population Trends:

Long-term trends suggest declines >90%, whereas short-term trends indicate an increase of >10% (NatureServe, 2015)

Resiliency:

Low (inferred from USFWS, 2012)

Redundancy:

Low (inferred from USFWS, 2012)

Population Growth Rate:

Slowly increasing (NatureServe, 2015)

Number of Populations:

3 (NatureServe, 2015)

Population Size:

338 individuals (NatureServe, 2015)

Minimum Viable Population Size:

Genetic analysis suggests that 90 percent of the genetic material of the species can be sustained for 100 years at a captive flock size of 153 (Jones and Lacy 2003). (USFWS, 2012)

Population Narrative:

Long-term population trends suggest declines >90%, whereas short-term trends indicate an increase of >10%. Historically, population size may have been as high as 10,000 (see CWS and USFWS 2007). A low point came in the mid-1900s when there were fewer than 50 whooping cranes in North America prior to 1968, with an all-time low of 21 as recently as 1954 (CWS and USFWS 2007). With management the total wild population is now a few hundred. Annual growth of the population during the past 65 years has averaged 4.5% per year (CWS and USFWS 2007). The total wild population in February 2006 was estimated at 338. Fewer than 250 are mature in the only self-sustaining population. The captive population contained 135 birds in February, 2006, with annual production from the Calgary Zoo, International Crane Foundation, Patuxent Wildlife Research Center, Species Survival Center, and the San Antonio Zoo. The total population of wild and captive whooping cranes in February, 2006, was 473. Three populations currently exist (see Range Extent comments). Genetic analysis suggests that 90 percent of the genetic material of the species can be sustained for 100 years at a captive flock size of 153 (Jones and Lacy 2003). (USFWS, 2012; NatureServe, 2015)

Threats and Stressors

Stressor: Construction (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: The construction of roads, buildings, power lines, towers and wind turbines have all negatively impacted the species (see section 2.3.2.5). The building of cities and towns directly destroys, as well as fragments, whooping crane migratory habitat. Large metropolitan areas such as Dallas-Ft. Worth make hundreds of square miles unsuitable for crane use, as do smaller towns located throughout the migration corridor. This loss of habitat may exacerbate the normal effects of periodic drought on whooping crane populations that do poorly in all aspects of their life cycle when conditions get drier. The occurrence and severity of drought itself may be made worse by climate change that could dry up wetlands needed by the cranes. The activities of humans continue to be the biggest threat to the species. (USFWS, 2012)

Stressor: Decreases in river flow (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Decreases in river flows have resulted in habitat degradation of riverine migration habitat for the species. Water diversions on major river systems such as the Platte River have degraded migration roost habitat. The reduced flows caused by reservoir construction and water withdrawals from the river are insufficient to scour woody vegetation from the riverbed, allowing trees to become established in the river channel. This has greatly reduced the number of

unvegetated sandbars with open visibility used by cranes for roosting. The Platte River channel has also gotten deeper so it is no longer the wide braided river that had once been so attractive to cranes, and wet meadow habitats adjacent to the river have also been reduced. (USFWS, 2012)

Stressor: Population growth/ development (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Population growth on the Texas coast resulting from an increase in development is encroaching on salt marsh habitat used by the wintering whooping cranes. If development continues, it will limit the expansion of the species winter range and very shortly preclude recovery. There are currently five housing canal-lot developers applying for permits on lands which whooping cranes have used. Threats are growing as developers build houses on lands needed for whooping crane survival and expansion, and power lines, cell towers and roads are all increasing. Currently, 60 percent of wintering whooping cranes use the ANWR and Matagorda Island NWRs. With development occurring on private lands as people move to the coast, the potential for future flock expansion may soon be limited unless there is a large effort to protect additional lands. (USFWS, 2012)

Stressor: Reductions in freshwater inflow (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Freshwater inflows starting hundreds of kilometers inland from the Guadalupe and San Antonio rivers flow into whooping crane habitat and critical habitat at and adjacent to ANWR. Inflows are needed to maintain proper salinity gradients, nutrient loadings, and sediments that produce an ecologically healthy and productive estuary (TPWD 1998). Inflows are essential to produce foods used by whooping cranes, especially blue crab populations that do well when inflows are high (Houston Advanced Research Center 2006). A simple inverse relationship exists between blue crab catch rates and mean salinity within an estuary (Longley 1994). Lower salinities in late summer also promote production of Carolina wolfberry that is an important food for whooping cranes in the fall. Inflows also lower salinities in the bays and marshes, providing drinking water for cranes that would otherwise be forced to fly inland for freshwater. Reduced fresh water inflows are reaching the bays and estuaries on and around ANWR due to diversions for agriculture and human use. Developers seek additional water rights from the Guadalupe River that conservationists allege is over-appropriated. Springs coming from the Edwards Aquifer underneath San Antonio are threatened by increased pumping. These springs can make up 80 percent of San Antonio and Guadalupe river flows during periods of drought. Inflows are already reduced over historic levels and at times are insufficient to maintain bay productivity (CWS and USFWS 2007). Due to constructed diversions, by 2040, a decrease of freshwater inflows into the crane's winter range is projected in an average year to cause an 8 percent decline in blue crab populations (Texas Department of Water Resources 1980), but could have a much larger impact in drought years (Norman Johns, NWF, Austin, Texas, pers. comm., 2004). (USFWS, 2012)

Stressor: Reduction in migration stopovers (USFWS, 2012)
Exposure:

Response:
Consequence:
Narrative: Even though they are omnivorous and do feed on agricultural crops during migration, they have not adapted to agricultural production the way sandhill cranes have because most of their life cycle is wetland-dependent. Although many important parts of their range have been protected through public ownership (refuges, parks, and wetland management areas), the cranes use migration habitat opportunistically and frequently use private lands. The frequent lack of traditional use areas in migration makes management for the species extremely difficult without being able to predict exactly what areas whooping cranes will use. The species must have a multitude of available stopover sites in order to be able to stop at short notice as darkness or wind shifts make conditions unfavorable for migration. Migration habitat is threatened by climate change with predicted reduction in rainfall for much of the corridor. Cranes may also lose habitat with their expected avoidance of areas developed for wind energy. Also, wetland loss is continuing in the migration corridor through conversion of lands for agriculture. (USFWS, 2012)

Stressor: Hunting (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: A major reason for the decline of the species in the 1800s and early 1900s was indiscriminant shooting and egg collection. Allen (1952) recorded 389 whooping cranes known to have died from gunshot or other causes from colonial times to 1948. The majority of documented mortalities (274 cranes) occurred in migration between 1870 and 1930 (Allen 1952). Considering the low reproductive potential of the species, the shooting mortality possibly exceeded annual reproduction by the early 1900s. Prior to the passage of the Migratory Bird Treaty Act in 1918, it was legal to shoot whooping cranes. Through education, whooping cranes at present are only rarely shot (Lewis et al. 1992a). Some of these shootings are strictly acts of vandalism, while most are associated with migratory bird hunting. Whooping cranes of the AWBP occasionally associate with sandhill cranes during migration. Hunting of sandhill cranes and snow geese occurs in and adjacent to areas used by migrating and wintering AWBP whooping cranes. Hunters may misidentify and shoot whooping cranes as these species. Sandhill crane hunting seasons in Canada and the United States in the migration corridor were originally seasonally timed or geographically limited to protect whooping cranes (Buller 1967, Archibald et al. 1976, Thompson and George 1987). Recent expansions of sandhill crane hunting seasons offer an increased potential for overlap with whooping crane migration periods and increased risks to whooping cranes (Konrad 1987). In some instances, large land units have been closed to sandhill crane or waterfowl hunting due to the presence of a flock or flocks of whooping cranes. Quivira NWR in Kansas is closed during most fall migrations whenever whooping cranes stopover (David Hilley, Quivira NWR, pers. comm., 2002). Tundra swan hunts recently initiated in the northern Great Plains (Montana, 1983; North Dakota, 1988; South Dakota, 1990) also present a risk of misidentification and accidental shooting of whooping cranes. (USFWS, 2012)

Stressor: Human disturbances (USFWS, 2012)
Exposure:
Response:
Consequence:

Narrative: The whooping crane is sensitive to disturbance on the breeding grounds and will not remain near human activity. Some disturbances cause the birds to leave an area; the effects of others may be more subtle. However, the egg transfer and banding programs in WBNP have demonstrated that cranes will tolerate human intrusion for short intervals. Human disturbance occurs from hunters, sport fishermen and commercial crabbers, and birders, and boaters reduce the habitat available to the species, at least on a temporary basis. The growing use of shallow-water craft including airboats and kayaks has made the crane area accessible even during periods of the lowest tides experienced mid-winter. (USFWS, 2012)

Stressor: Disease (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Little is known about the importance of diseases or parasites as mortality factors for wild whooping cranes. Although wild whooping cranes are presumably susceptible to a variety of infectious and toxicological diseases, evidence of disease-related mortality is infrequently documented. From 1976 to 1989, the USFWS necropsied or examined 25 whooping crane carcasses found dead in the field or removed from the wild because of sickness or debility. Of these, nine were diseased. Seven had avian tuberculosis (Snyder et al. 1997), a subadult crane captured in New Mexico was suffering from avian cholera (Snyder et al. 1987), and an adult died from acute lead poisoning (Brand et al. 1992, Snyder et al. 1992). The high incidence of avian tuberculosis indicates that whooping cranes may be particularly susceptible to that disease. In 2009, an unknown herpes virus was isolated from a juvenile at ANWR. Infectious bursal disease (IBD) has been known to cause mortality in whooping cranes reintroduced in Florida, and sandhill cranes captured in Nebraska in 2009 showed an antibody response to IBD and/or to a herpes virus. Eastern equine encephalitis has also been documented in the Florida flock. Human impacts on the environment and global movements are resulting in emerging disease problems of possible significance to whooping cranes. For example, West Nile virus appeared for the first time in North America in 1999 and spread rapidly. The H5N1 strain of avian influenza that surfaced in Asia in 2005 is an emerging threat to both captive and wild flocks. Aflatoxin and other molds growing on farm crops can be toxic to cranes. In addition, the toxin produced by red tide phytoplankton blooms (Karenia brevis) can be transferred through whooping crane prey items including clams. It has been known to cause bird mortality and could pose a significant threat to whooping cranes that feed heavily on clams in mid-winter. Red tide historically occurred infrequently on the Texas Coast. In recent years, it has occurred nearly annually during late summer and fall, lasting for several months. Red tide has been documented in the whooping crane area in recent years, and there have been occasional severe outbreaks along the Texas coast. In late 2011 through the time of publication, all Texas coastal waters were closed to the commercial and recreational harvesting of oysters, clams and mussels due to the presence of red tide (TPWD, Red Tide Update 2011, online). It is not known what factors are causing the increased number of outbreaks of red tide, but may be related to coastal urbanization causing changes in water quality. Coccidia, an internal parasite, have been found in a whooping crane with an injured wing captured in WBNP and in whooping crane droppings collected on the Texas wintering grounds (Forrester et al. 1978), and are common in cranes in the Florida release population (Spalding et al. 1996). Coccidia have caused deaths of several whooping crane chicks in captivity (Carpenter et al. 1980). The defense of large territories and small brood size ensures low density use of the WBNP natal area, and thereby reduces the likelihood of coccidia oocysts (spores) being ingested in quantities sufficient to cause significant disease. A variety of other

parasites have been documented in released whooping cranes in Florida, but none has been proven to cause significant disease (Spalding et al. 1996). (USFWS, 2012)

Stressor: Predation (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Adult whooping cranes generally are not susceptible to predation unless they are weakened by disease or injury, or are flightless during feather molt. However, eggs and chicks are predated (Bergeson et al. 2001a). Potential predators on the nesting grounds include black bear (Ursus americanus), wolverine (Gulo luscus), gray wolf (Canis lupus), red fox (Vulpes fulva), mink (Mustela vison), lynx (Lynx canadensis), and raven (Corvus corax). Black bears and other mammals destroy eggs, and wolves, foxes, and ravens kill chicks (Kuyt 198la, 198lb, Bergeson et al. 2001a). The overall impact of predation on AWBP recruitment remains uncertain, but Boyce et al. (2005) have correlated the 10-year crane population cycle with that of boreal forest predator cycles. Predator control is not considered an appropriate management technique within Canadian National Parks. Whooping cranes are exposed to predators during migration (Lewis et al. 1992b). In the west, two golden eagle attacks on juvenile whooping cranes were documented during migration of reintroduced birds behind an ultralight. In 2002, a bald eagle killed a whooping crane hatchling in Florida. Bobcats (Lynx rufus) and alligators (Alligator mississippiensis) are significant predators of reintroduced whooping cranes in Florida. Bobcat predation appears most severe on individuals that do not show proper roosting behaviors or use habitat with heavy cover. Predation rates are significant in Florida, but appear to be low in wild birds in Texas where more time is spent in coastal wetlands. However, bobcats and coyotes have taken cranes that are sick or injured at ANWR (Hunt et al. 1987). (USFWS, 2012)

Stressor: Climatic factors (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Whooping cranes do not do well faced with drought conditions. Production is reduced dramatically, possibly from increased predation (Kuyt 1981b). Food supplies are diminished, and newly hatched chicks are forced to travel longer distances between wetlands. Habitat becomes more limited in migration as many non-permanent wetlands go dry. Drought affecting the wintering grounds influences availability and abundance of the natural food supply by altering salinity of tidal basins and estuaries (Blankinship 1976). Blue crab and wolfberry populations are reduced, the preferred foods of the whooping crane, and winter mortality increases (Pugesek et al. 2008). The species is also threatened by extreme storm events including blizzards, hail, and lightning. A whooping crane in Florida was struck and killed by lightning in 2009, and 18 captive-raised juveniles were killed in their release pen at Chassahowitzka NWR in Florida by a lightning strike. A late-season hurricane at the ANWR could place cranes at risk due to high wind velocities and flooding; fortunately, the hurricane season ends (November 30) just after most whooping cranes arrive. Any climate change that would increase the intensity of extreme storm events over historical patterns or would cause a general drying of wetland habitat would threaten the species. Global warming and associated climate changes constitute a potential threat to whooping crane recovery. Rising temperatures could increase evaporation and dry up wetlands that whooping cranes use throughout the year. If the warmer temperatures are not counter-balanced by increased precipitation, the species would

struggle facing increased drought-like conditions. Warming temperatures that could reduce the number and severity of winter freezes at ANWR could allow black mangrove (Avicennia germinans) to spread its range northward into the crane area, an event that has been occurring over the past decade (T. Stehn, USFWS, pers. comm., 2010). The dense mangrove shrubs would reduce visibility for the cranes and would make much crane habitat unusable. Sea level rise and flooding of coastal wetlands is a major threat. Since whooping cranes mostly only use water < 20 inches deep, a projected sea level rise that could exceed 39 inches (0.99 m) by the end of the century announced by climate scientists meeting in Copenhagen in March 2009 would make the current whooping crane winter range unusable (Tom Stehn, ANWR, pers. comm., 2010). The realization that glaciers are melting more rapidly and waters are rising faster than originally predicted makes it even more important to carry out a land protection initiative for whooping cranes. Upland areas next to existing marshes need to be purchased based on forecasts of marshland changes. However, bulkheaded developments will prevent new marshes from developing. (USFWS, 2012)

Stressor: Collisions with power and electrical lines (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Collisions with power lines are a substantial cause of whooping crane mortality in migration (Brown et al. 1987, Lewis et al. 1992b). Collisions with both transmission and distribution power lines are responsible for the death or serious injury of at least 45 whooping cranes since 1956 (Stehn and Wassenich 2008). In the 1980s, two of nine radio-marked whooping cranes from AWBP died within the first 18 months of life as a result of power line collisions (Kuyt 1992). Of 27 documented mortalities in the Rocky Mountain reintroduced whooping crane population, almost 2/3 were due to collisions with power lines (40.1 percent) and wire fences (22.2 percent) (Brown et al. 1987). Twenty individuals within the Florida populations and at least four individuals in the migratory Wisconsin population have died hitting power lines. As an additional concern, power lines can cause habitat fragmentation. The Avian Power Line Interaction Committee (APLIC) composed of nine investor-owned electric utilities and the USFWS was established in 1989 to address the issue of whooping crane collisions (Lewis 1997). In 1994, APLIC provided voluntary guidelines to the industry on avoiding power line strikes (APLIC 1994). At present, the USFWS is requesting the development of avian and bat protection plans by participating companies to reduce bird strikes (Manville 2005). Tests of line marking devices, using sandhill cranes as surrogate research species, have identified techniques effective in reducing collisions by up to 61 percent (Morkill 1990; Morkill and Anderson 1991, 1993; Brown and Drewien 1995). Techniques recommended include marking lines in areas frequently used by cranes and avoiding placement of new line corridors around wetlands or other crane use areas. (USFWS, 2012)

Stressor: Renewable resources: wind energy (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Increasing interest in development of renewable energy sources as one part of addressing global climate change, in many regions of the United States, including the range of the whooping crane, has created the need for additional generation and transmission lines to move power to the grid and transport it to the population centers (i.e., areas of demand). Often

these sources of renewable energy are located in areas distant from population centers and existing electricity generation sources, and as such have limited transmission infrastructure and limited capacity within the existing infrastructure. Planning for new transmission is ongoing and directed at addressing the transmission bottleneck to further facilitate development of thousands of megawatts of wind energy facilities (i.e., thousands of wind turbines with associated habitat loss and fragmentation). Proposed extreme high voltage transmission lines (EHV; 345 to 765 kilovolts) could remove transmission capacity bottlenecks that are currently limiting further expansion of wind energy facilities. An estimated 16,000 new wind turbines may be constructed in the U.S. in the next decade, adding to the existing 15,000 turbines (Manville 2005). The development of wind farms in the whooping crane migration corridor has the potential to cause significant mortality. Cranes could be killed directly by wind turbines or from colliding with new power lines associated with wind farm development. Research and management are needed to reduce this new threat. The effects of wind energy development on whooping crane populations have not been investigated, but the effects of similar disturbances such as oil and gas development can serve as a surrogate in many instances and suggest that the effects will not be neutral or beneficial. Like oil and gas development, wind energy development involves loss of habitat due to the installation of roads, turbine pads, substations, maintenance/operation facilities, and generation interconnect lines; these features also serve as sources of habitat fragmentation. It is likely that migrating whooping cranes coming upon wind farms will be less likely to stop due to the presence of the tall turbines since whooping cranes are known to avoid tall structures such as buildings. (USFWS, 2012)

Stressor: Other vertical structures (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: Collisions with other objects including fences, aircraft, vehicles and possibly wind turbines and communications towers are a threat to the species. Whooping cranes, particularly in the western population reintroduced at Grays Lake, Idaho were documented either colliding with or getting entangled in fences as they tried to walk through them. Fences crossing wetlands are particularly hazardous as whooping cranes may be coming in to land and simply not see the thin fence wire. Human settlement including roads and buildings has resulted in the fragmentation of whooping crane habitat, particularly in migration. This has reduced the total amount of habitat available to the species. When given a choice, whooping cranes will avoid roads and buildings. Whooping cranes prefer to avoid humans. However, whooping cranes reintroduced in the eastern U.S. that are less wary of people have been documented feeding on roadsides and being killed by vehicle collisions. Guy wires associated with telecommunication towers (radio, television, cellular, and microwave) present another potential collision obstacle to cranes. Although a whooping crane has not yet been documented hitting a tower, particularly worrisome is the use of support guy wires that are thin and thus difficult for whooping cranes to see. Visible markers should be placed on guy wires to reduce the risk of avian collisions. Whooping crane collisions with aircraft rarely occur because of the small number of whooping cranes, but are a growing threat. One whooping crane was killed in June 1982 during a KC-135 tanker takeoff from Minot Air Force Base, North Dakota (Harrison 1983). Feather remains were identified by the Smithsonian Institute. A crane over North Dakota may have been hit by a plane in April 2007; the bird suffered massive internal injuries from collision with a blunt object, but the exact cause of death was never determined. In October 2007, a recently released, naïve DAR

bird was struck and killed by a jet aircraft at the Dane County airport in Madison, Wisconsin (WCEP 2007). (USFWS, 2012)

Stressor: Chemical spills (USFWS, 2012)
Exposure:
Response:
Consequence:
Narrative: The release of chemicals at ANWR associated with ship traffic on the Intracoastal Waterway and oil and gas development including platforms and pipelines could cause a disaster, killing a large number of cranes outright or degrading their habitat (Robertson et al. 1993). Many barges carrying toxic chemicals travel the Gulf Intracoastal Waterway (GIWW) daily through the core of whooping crane winter habitat. The U.S. Coast Guard has the lead responsibility for spill response and containment. The USFWS has response plans for the Gulf of Mexico (USFWS 1979) and specifically for Aransas (Robertson et al. 1993). However, it is impossible to provide full protection for the cranes as long as chemicals are transported on the GIWW through the heart of the winter range. When a spill occurs, high winds would greatly reduce the effectiveness of containment booms for products floating on the surface. Gaseous materials leaked could directly kill all cranes downwind. Spills of hazardous chemicals may limit human approach to only those personnel wearing special protective suits and breathing apparatus. An event occurring at night or in bad weather (the most probable times) would slow response. The cranes are exposed to gas and oil development in migration, including waste oil pits and tar sands development in Canada. In the fall of 2006, a crane family group was seen in Nebraska with what appeared to be oil-stained feathers on the lower half of their bodies. It looked like they had walked into an oil waste pit. The huge oil waste pits connected with tar sands oil extraction in Canada located in the migration corridor is another risk to the whooping cranes. There is no evidence that pesticide contamination has ever been a significant threat to whooping cranes. Whooping crane egg and tissue specimens examined for pesticide residues have shown concentrations well below those encountered in most other migratory birds (Robinson et al. 1965, Lamont and Reichel 1970, Anderson and Kreitzer 1971, Lewis et al. 1992b). Eggshell thickness, a measure of contaminant exposure, has been measured in eggs taken from the wild and those in captivity from the 1970s to the present; no evidence of shell thinning has been detected. However, knowledge of potential indirect or sub-lethal effects of pesticides on whooping cranes is inadequate and poorly understood. The baseline contaminant impacts research comes from research on other birds including sandhill cranes, but has never been done on whooping cranes. Whooping cranes on the winter range are exposed to contaminants associated with runoff from agricultural and industrial activities. Nearby Lavaca Bay was closed for multiple years to the harvesting of fish and crabs because of industrial pollution including high levels of mercury (Lewis et al. 1992b). (USFWS, 2012)

Recovery

Reclassification Criteria:
1. Establish and maintain self-sustaining populations of whooping cranes in the wild that are genetically stable and resilient to stochastic environmental events. (USFWS, 2007)

2. Maintain a genetically stable captive population to ensure against extinction of the species. (USFWS, 2007)

Delisting Criteria:
Delisting criteria are not available.

Recovery Actions:
- Continue to build the AWBP and protect and manage its habitat to minimize the probability that a catastrophic event will eradicate this population. (USFWS, 2007)
- Attain breeder pair and productivity goals at 4 captive facilities in the United States and 1 in Canada to produce the birds required for reintroductions. Continue research to improve production of captive flocks. (USFWS, 2007)
- Establish 2 additional self-sustaining wild populations. Continue research to identify appropriate reintroduction sites and improve reintroduction techniques. Protect and manage habitat of reintroduced populations. (USFWS, 2007)
- Continue to use genetic information and advances in conservation biology to conserve flock genetics, and determine Ne and revise criteria as warranted. (USFWS, 2007)
- Maintain an outreach program. (USFWS, 2007)

Conservation Measures and Best Management Practices:
- Determine peak flock size, number of nests, number of fledged chicks, and number of chicks that reach ANWR during each of the next 5 years on aerial surveys. Document spring to fall, and winter mortality. (USFWS, 2012)
- Enhance foraging opportunities on 5,000 acres/year at ANWR by prescribed burns. (USFWS, 2012)
- Obtain additional funding and purchase easements and fee title lands for 40,000 acres of occupied winter habitat, potential habitat and upland buffer in the next 5 years with a 10-year goal of 100,000 acres. (USFWS, 2012)
- Obtain additional funding to restore, enhance and/or maintain 40,000 acres of occupied and potential habitat, including upland buffer, in the next 5 years. Use Cooperative Agreements with non-government organizations and Private Lands Agreements with landowners. (USFWS, 2012)
- Map and characterize the invasion of black mangrove into the crane range at ANWR, coordinate with National Marine Fisheries Service (NMFS), and implement a control program if feasible. (USFWS, 2012)
- Consider expansion of designated Critical Habitat. (USFWS, 2012)
- Minimize and mitigate for impacts to whooping cranes and crane habitat from development projects through ESA, Section 7 consultations, or Section 10 incidental take permits (Habitat Conservation Plans or HCPs). (USFWS, 2012)
- Continue to work to ensure freshwater inflows reach the crane wintering grounds. Assemble data to describe flow levels needed to provide the resources needed for a healthy whooping crane population. (USFWS, 2012)
- Continue education and public relations programs such as community based conservation initiatives, working with news media, doing public presentations, and working with schools. (USFWS, 2012)
- Carry out cooperative tracking project during migration periods. Update annually and post-on-line the GIS corridor database and map. (USFWS, 2012)
- Capture, health check, radio and track 50 whooping cranes. Determine habitat use in migration and detect causes of mortality. (USFWS, 2012)
- Collaborate with the wind industry to write an HCP to minimize and mitigate wind farms impacts. (USFWS, 2012)
- Work with APLIC to write an HCP to minimize and mitigate whooping crane collisions with power lines. (USFWS, 2012)

- Annually carry out the State-Federal contingency plan for protecting cranes in migration. Minimize shooting mortalities related to migratory bird hunting. (USFWS, 2012)
- Maintain and expand to 50 breeder pairs the captive breeding flocks by supporting captive breeding facilities. (USFWS, 2012)
- Complete genomic mapping of the captive flock and compare with genetic material sampled from the AWBP. (USFWS, 2012)
- Initiate research to determine how to get whooping cranes to breed at an earlier age in captivity. (USFWS, 2012)

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SPECIES ACCOUNT: *Grus canadensis pulla* (Mississippi sandhill crane)

Species Taxonomic and Listing Information

Listing Status: Endangered; 06/04/1973; Southeast Region (Region 4) (USFWS, 2016)

Physical Description

Mississippi sandhill cranes resemble great blue herons (Ardea herodias). A major distinguishing characteristic is that cranes are completely gray. Great blue herons usually have white on their heads and dark colored underparts. When standing erect, cranes are about 4 feet tall. Male and female cranes are similar in appearance. All cranes have long necks, and adult cranes possess a bald red forehead. The species vocalizations are loud and clattering. Cranes are also unique in that they require separate nesting, foraging, and roosting habitats (U.S. Fish and Wildlife Service 1991). (USFWS, 2016)

Taxonomy

Six sandhill crane subspecies are currently recognized. Three subspecies, lesser (G. c. canadensis), Canadian (G. c. rowani), and greater (G. c. tabida) sandhill cranes are northern migratory forms that generally nest in northern North America and the Soviet Union and in the winter migrate to the southern United States and in Mexico. In the southeastern United States, migratory sandhill cranes, mainly greater sandhill cranes, are found in the winter from Texas through Florida. In winter, a small number of migratory sandhill cranes inhabit southeastern Mississippi and infrequently they have been observed in the company of Mississippi sandhill cranes. The Florida and Mississippi races are nonmigratory and nest in the souteastern United States. The Cuban sandhill crane, also nonmigratory, nests in Cuba (Johnsgard 1983). (USFWS, 1991)

Historical Range

Small populations formerly occurred in widely scattered areas along the coastal plain of Louisiana, Mississippi, Alabama, and Florida; may have bred in savannas just east of the Pascagoula River in Mississippi in the early 1900s (Matthews and Moseley 1990). (NatureServe, 2015)

Current Range

Currently restricted to an area in southern Jackson County, Mississippi, extending from the Pascagoula River west to the Jackson County line, south to Simmons Bayou, north to latitude about 4 miles north of Vancleave; part of this area is within the Mississippi Sandhill Crane NWR; main winter roost is in the marshes of Bluff Creek, Bayou Castelle, and Paige Bayou (Matthews and Moseley 1990). (NatureServe, 2015)

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 8/8/1977.

Legal Description

On August 8, 1977, the Director, U.S. Fish and Wildlife Service determined Critical Habitat for the Mississippi sandhill crane (Grus canadensis pulla) (42 FR 39985 - 39988) pursuant to Section 7 of the Endangered Species Act of 1973. In accordance with Section 7, all Federal agencies will be required to insure that actions authorized, funded, or carried out by them do not adversely affect this Critical Habitat.

Critical Habitat Designation

Mississippi. Areas of land, water, and airspace in Jackson County, with the following components (St. Stephens Base Meridian): T6S 6W Sec. 31: T6S R7W E1/2 of E1/2 Sec. 34, Sec. 35 - 36, S1/2 Sec. 38: T6S R8W Sec. 27, those portions of Sec. 26 - 31 south of Seaman Road, Sec. 32 - 44; T7S R6W N1/2 of N1/2 Sec. 3, Sec. 6; T7S R7W Sec. 2 - 11, Sec. 13 - 16, Sec. 20 - 22, W1/2 Sec. 23, W1/2 of E1/2 Sec. 23, NE1/4 of NE1/4 Sec. 23, N1/2 of N1/2 Sec. 24, that portion of the SW1/4 of SW1/4 Sec. 30 south of the Louisville and Nashville Railroad. W1/2 of W1/2 Sec. 31, W1/2 Sec. 37, that portion of the E1/2 Sec. 37 north of U.S. Inrerstate Highway 10; : T7S R8W Sec. 1 - 3, that portion of Sec. 4 north of U.S. Interstate Highway 10, Sec. 5 - 6, those portions of Sec. 7 - 8 north of U.S. Interstate highway 10, Sec. 10 - 12, W1/2 of W1/2 Sec. 14, Sec. 15, that portion of Sec. 25 south of the Louisville and Nashville Railroad, that portion of the SE1/4 of Sec. 26 south of the Louisville and Nashville Railroad and southeast of Davis Bayou, N1/2 of NE1/4 Sec. 35, Sec. 36.

Primary Constituent Elements/Physical or Biological Features

Primary constituent elements are not described in the 1977 Final Rule (42 FR 39985 - 39988).

Special Management Considerations or Protections

Not available

Life History

Feeding Narrative

Adult: Prey probably includes adult and larval insects, earthworms, crayfish, small reptiles, amphibians, especially frogs, and perhaps small birds and mammals. During the fall, winter, and early spring, most of the cranes feed on small corn and chufa (Cyperus esculentus) fields, pastures, and pecan orchards found within several miles of the nesting range. Picks food items from ground surface or probes into substrate. (USFWS, 1991; NatureServe, 2015)

Reproduction Narrative

Adult: The Mississippi sandhill crane normally nests as far as possible from sources of disturbance. The ideal nesting habitat can be characterized as an open area of grasses and sedges with perennial shallow water. This species defends breeding territory of 36-202 ha during mating (Matthews and Moseley 1990). The age when wild Mississippi sandhill cranes attain sexual maturity is unknown. J. Valentine (pers. comm.) has data that shows some Mississippi cranes first lay eggs between the ages of 3 and 6 years. S. Nesbitt (pers. comm.) said some male Florida cranes become sexually active when 2 years old but females mature a year or so later. Mated cranes defend nesting territories. Incubation begins as soon as the first egg is laid and the average incubation period is about 32 days (Bennett and Bennett 1990). Clutches on the MSCNWR have averaged 1.70 eggs (n = 125). First clutches generally hatch from May 1 through May 20. Sandhill crane sex ratios are generally reported to be 1:1 males and females. Steve Nesbitt (Florida Freshwater Fish and Game Commission, Gainesville, FL, pers. comm.,

1991) reported Florida cranes can attain ages of about 20 years. (USFWS, 1991; NatureServe, 2015)

Environmental Specificity

Adult: Medium, with some key requirements (USFWS, 1991)

Site Fidelity

Adult: Nest site fidelity is high (USFWS, 1991)

Habitat Narrative

Adult: The Mississippi sandhill crane is found in open savannas, swamp edges, young pine plantations, and wetlands along edges of pine forests. Associated trees and shrubs include longleaf pine, slash pine, bald cypress, gallberry, wax myrtle, black gum, sweet bay, and yaupon (Matthews and Moseley 1990). Nesting territories tend to be occupied year after year. The ideal nesting habitat can be characterized as an open area of grasses and sedges with perennial shallow water. The opening is surrounded by trees and shrubs and is large enough for the cranes to see potential predators and allow flight. Areas of water, grasslands, pastures, or open pine forests are often close to the nests. The marshes in the Bluff Creek, Bayou Castelle, and Paige Bayou areas provide the main winter roosts. Marshes have fresh to slightly brackish water and the vegetation is mainly sawgrass and needlerush. Artificial freshwater ponds, on and off the Refuge, are also used as roosting habitats. Other known roosts include savannas, open forests, pastures, and moist clearings in the foraging areas. During the breeding season, paired cranes roost near the nest. (USFWS, 1991; NatureServe, 2015)

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Not available.

Population Information and Trends

Population Trends:

Short-term trends suggest a relatively stable population (NatureServe, 2015)

Resiliency:

Low (inferred from USFWS, 1991)

Representation:

Low (inferred from USFWS, 1991)

Redundancy:

Low (inferred from USFWS, 1991)

Population Growth Rate:

Stable (USFWS, 1991)

Number of Populations:

1 (NatureServe, 2015)

Population Size:

100 - 150 individuals (NatureServe, 2015)

Population Narrative:

Short-term trends suggest a relatively stable population. There was only one interbreeding population in 2000 (S. G. Hereford, pers. comm.). In 2000, population estimated at 110-120 individuals (S. G. Hereford, pers. comm.). Total population was estimated at about 100 in the late 1920s, 40 in 1983, and 60 in 1989 (plus 28 in captive flock). As of 1 October 1993, 207 captive-reared cranes had been released, and the total wild population was 130 (Franson and Hereford 1994). (NatureServe, 2015)

Threats and Stressors

Stressor: Human activities (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Wild flock has been slow to increase due to abnormally high mortality of nestlings and first-year birds (End. Sp. Tech. Bull. 18:13). Prior decline was the result of habitat degradation and fragmentation related to conversion of habitat to slash pine plantations; disturbance associated with highways crossing habitat; and commercial and residential development (Matthews and Moseley 1990). Death due to lead poisoning has been reported (Franson and Hereford 1994). Disappears from areas of heavy human use. (NatureServe, 2015)

Stressor: Habitat loss (USFWS, 1991)
Exposure:
Response:
Consequence:
Narrative: As already noted, the human population in southeastern Mississippi, especially along the coast, has increased dramatically. Construction of roads and power lines and commercial and residential development have accompanied the increased human population. In the mid-1950's, timber companies acquired or leased lands for pine tree production. Slash pine was planted on thousands of acres during the 1950's and 1960's. To encourage tree growth in wet situations, savannas were drained and in some areas seedlings were bedded and furrowed. Access roads and fire breaks were constructed. Wild fires were suppressed. The pine plantations formed dense stands that precluded nesting and feeding by cranes. Eight paved roads and highways transect or border the Mississippi sandhill crane's range. The adverse effects have been: (1) direct loss of lands; (2) noise, vibration, and visual disturbance; (3) pollution; (4) eased public access to the cranes; (5) development along the highway route; and (6) direct mortality. (USFWS, 1991)

Stressor: Direct mortality (USFWS, 1991)
Exposure:
Response:
Consequence:

Narrative: Reports of shootings in the 1960's and 1970's were sporadic, but this mortality probably exceeded recruitment to the population. Between July 1966 and June 1967, three reliable reports of shootings were received and one crane was shot in October 1974. During 1983, two cranes were found shot. These killings exceeded the annual recruitment rate. In 1978, a crane was killed either by a vehicle or an airplane near the end of the Gulf Park Estates Airport. In 1982, a captive-released crane was struck and killed by a car on Interstate Highway 10 and another crane was killed on the Gautier-Vancleave Road. A released crane was found dead on the Refuge in January 1981. Death may have been accidental or caused by an interspecific conflict. A dead crane was found below a power line in 1989. Aside from one or two captive-released cranes known to have been killed by free-running dogs, and predation by a bobcat when the birds were being held in a pen, predation on living adult cranes has not been documented. However, predation is a natural phenomena and dead cranes that have been found may have been killed by predators. Flooding, caused by heavy rainfall, has killed eggs and chicks (Mcllhenny 1938). In April 1980, heavy rainfall may have inundated two nests with eggs. Flash floods regularly occur and nests in low lying areas have been flooded. Hurricanes come ashore along the Mississippi Coast about once every 3 to 5 years. Crane mortality caused by the winds and rains associated with hurricanes has not been documented but loss of birds, eggs, and nests are certainly possible. Conversely, spring and summer droughts are common. Lack of drinking water could cause chick mortality. (USFWS, 1991)

Stressor: Pollution, disease, and parasites (USFWS, 1991)
Exposure:
Response:
Consequence:
Narrative: The area is subjected to the usual pollutants associated with major highways. Until fairly recently, fire ant eradication with Mirex was common. A crane found dead in 1974 contained 0.14 parts per million (ppm) of Mirex in the breast muscle and 0.22 ppm in the brain. Roadsides are often treated with herbicides. Since 1981, eighteen cranes have been necropsied by the National Wildlife Health Research Center (NWHRC, Madison, Wisconsin). Six of these 6irds were diagnosed as having biliary hyperplasia and five of the six with biliary hyperplasia had adenocarcinomas. In four cases, the tumors could have caused death. Similar tumors are very rare among wild birds and tumors have not been documented among the PWRC cranes. The most commonly identified causes of tumors include: (1) infectious agents such as viruses or parasites, (2) xenobiotic or naturally occurring toxins, and (3) genetic predisposition. Although the causative agent has not been established, because both tumors and biliary hyperplasia have been found in each case, a toxin may be indicated (Couvillion et a!., 1991). The susceptibility of the Mississippi sandhill crane to the toxins may be increased by the loss of genetic variability. A captive-released crane, struck by a vehicle, had a nematode infestation in the proventriculus and small intestine. Another released crane that died in 1982 had a severe infestation (probably Cappillaria sp.) of the tongue. The lesions may have prevented the crane from feeding. Another emaciated wild crane died after being found. An unknown type of hepatitis was diagnosed as the cause of death. (USFWS, 1991)

Stressor: Genetic viability and the captive population (USFWS, 1991)
Exposure:
Response:
Consequence:

Narrative: Poor hatching success and some debilities in captive chicks may have resulted from a lowered level of genetic heterozygosity. In 1988, four of six wild chicks that hatched died within 24 hours after hatching. One other chick pipped the shell but failed to fully hatch. Also, two of 9 chicks that hatched in 1989 died within 24 hours after hatching. Whether the 1988 chick survival problems were caused by an unusual drought, human interference, loss of genetic heterozygosity, or other factors is unknown. Recent information (October 1990) provided by H. Dessauer (Louisiana State University Medical Center, New Orleans, Louisiana) suggests that there has been a loss of heterozygosity in the Mississippi sandhill crane population (Table 9). The genotype of the Mississippi sandhill crane has been studied by blood electrophoresis of 31 proteins (Table 10, G. Gee, unpubl. data, November 1990, Patuxent Wildlife Research Center, Laurel, Maryland). Non-migratory sandhill crane populations along the Gulf Coast have been isolated by human activities. Because of the distances involved, maintenance of genetic diversity by natural intergradation is improbable. In an effort to maintain the remaining genetic variability of Mississippi sandhill cranes, maximum outbreeding techniques are being used with birds in the captive population. Restoring natural intergradation with the Florida and/or Georgia populations is being studied. (USFWS, 1991)

Recovery

Reclassification Criteria:
Reclassification criteria are not available.

Delisting Criteria:
Delisting criteria are not available.

Recovery Actions:
- Maximize the quality and quantity of nesting habitat on and near the Refuge. (USFWS, 1991)
- Increase natural recruitment in the wild population. (USFWS, 1991)
- Increase the genetic viability of the subspecies. (USFWS, 1991)
- Minimize human disturbance, especially to nesting cranes. (USFWS, 1991)
- Stop human predation. (USFWS, 1991)
- Continue to restore, improve, and maintain feeding and roosting habitats. (USFWS, 1991)
- Limit or negate crane contact with potential toxins. (USFWS, 1991)

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U.S. Fish and Wildlife Service. 1977. Endangered and Threatened Wildlife and Plants

Determination of Critical Habitat for Mississippi Sandhill Crane. Final rule. 42 FR 39985 - 39988 (August 8, 1977).

NatureServe. 2015. NatureServe Explorer: an encyclopedia of life [web application]. Accessed July 2016

SPECIES ACCOUNT: *Gymnogyps californianus* (California condor)

Species Taxonomic and Listing Information

Listing Status: Endangered/Experimental Population, Non-Essential; 03/11/1967, 10/16/1996; California/Nevada Region (R8) (USFWS, 2016)

Physical Description

One of the largest flying birds in the world, the California condor is a large, soaring vulture. Predominantly black, with the exception of white underwing linings, it has a naked (featherless) head and neck with skin mottle gray to shades of yellow, red, and orange. Adults weigh as much as 10 kilograms (22 pounds) and have a wingspan of up to 2.9 meters (9.5 feet). The sexes are indistinguishable from each other (USFWS 1996).

Taxonomy

The California condor was originally classified in the same genus as its closest living relative, the Andean condor (Vultur gryphus), but due to the Andean condor's slightly different markings, slightly longer wings, and tendency to kill small animals for food, the California condor has now been placed in its own monotypic genus. The California condor is a member of the family Cathartidae, or New World vultures, a family of seven species, including the closely related Andean condor and the sympatric turkey vulture (Cathartes aura). This family has traditionally been placed in the Order Falconiformes, but more recently there has been a proposal to reassign it, along with other New World vultures, to order Accipitriformes, which includes hawks, eagles, ospreys (Pandion haliaetus), and the secretary bird (Sagittarius serpentarius) (USFWS 2013).

Historical Range

The fossil record of the genus Gymnogyps dates back about 100,000 years to the Middle Pleistocene Epoch, where the fossil records reveal that the species once ranged over much of the southern United States, south to Nuevo Leon, Mexico; east to Florida; and as far away as upstate New York. There is evidence indicating that California condors nested in west Texas, Arizona, and New Mexico during the late Pleistocene. The disappearance of the California condor from much of this range occurred about 10,000 to 11,000 years ago, coinciding with the late Pleistocene extinction of the North American megafauna (USFWS 1996). By the time of the arrival of European man in western North America, California condors occurred only in a narrow Pacific coastal strip from British Columbia, Canada, to Baja California Norte, Mexico. California condors were observed until the mid-1800s in the northern portion of the Pacific Coast region (Columbia River Gorge), and until the early 1930s in the southern extreme (northern Baja California). Prior to 1987, California condors used a wishbone-shaped area encompassing six counties just north of Los Angeles, California (USFWS 1996).

Current Range

Following the implementation of reintroduction projects in 1992 in California; in 1996 in Arizona; and in 2002 in Baja California, free-flying (noncaptive) birds have been reintroduced back into portions of the species' historical range. Populations of California condors now exist in central and southern California; northern Arizona and southern Utah; southeastern Nevada; and northern Baja California (USFWS 2013).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 9/22/1977.

Legal Description

On September 22, 1977, the Director, U.S. Fish and Wildlife Service issued a rulemaking which determined critical habitat for the California Condor (Gymnogyps californianus) pursuant to Section 7 of the Endangered Species Act Of 1973 (42 FR 47840 - 47845). In accordance with section 7, all Federal agencies will be required to insure that actions authorized, funded, or carried out by them do not adversely affect these Critical Habitats.

Critical Habitat Designation

California. Sespe-Piru Condor Area: an area of land, water, and airspace to an elevation of not less than 3,000 feet above the terrain, in Ventura and Los Angeles Counties, with the following components (San Bernardino Meridian): Sespe Condor Sanctuary, as delineated by Public Land Order 696 (January 1951): T4N R20W Sec. 2, 5-10. NY6 Sec. 11: T4N R21W Sec. 1-3, 10-12. N1/4 Sec. 13, N1/4 Sec. 14, N1/4 Sec. 15; T5N R18W Sec. 4-9, 18, 19, 30, 31, N1/2, Sec. 3, N1/2 Sec. 17; T5N R21W Sec. 1-4, 9-16, 21-28, 33-36; T6N R18W Sec. 7-11, 14-23, 26-35; T6N R19W Sec. 7-36; T6N R20W Sec. 8-36; T6N R21W Sec. 13-36; T6N R22W Sec. 3-26, 35, 36; T6N H23W Sec. 1-3, 10-14, 24, N1/2 Sec. 23; T7N R22W Sec. 31; T7N R23W Sec. 34- 36.

Matilija condor Area: an area of land, water, and airspace to an elevation of not less than 3,000 feet above the terrain, in Ventura and Santa Barbara Counties, with the followine components (San Bernardino Meridian): T5N R24W W1/2 Sec. 3, Sec. 4-11, 14, 15, N1/2 Sec. 16, N1/4 Sec. 17; T5N R25W E1/2 Sec. 1, NE1/4 Sec. 12; T51/2N R24W Sec. 31-34; T6N R24W S1/2 Sec. 32, S1/2Sec. 33, S1/2 Sec. 34.

Sisquoc-San Rafael Condor Area: An area of land, water, and airspace to an elevation of not less than 3,000 feet above the terrain, Santa Barbara County, with the following components (San Bernardino Meridian): T6N R26W Sec. 5, 6; T6N R27W Sec. 1, 2; T7N R26W Sec. 6-8. 17-20, 29-32; T7N B27W Sec. 1-14. 23-26, 35, 36; T7N R28W Sec. 1, 2, 11, 12; T6N R26W Sec. 19-22, 27-34; T8N R27W Sec. 19-36.

Hi Mountain-Beartrap Condor Areas: Areas of land, water, and airspace to an elevation of not less than 3,000 feet above the terrain in San Luls Obispo County, with the following components (Mt. Diablo Meridian): T30S R16E Sec. 13, 14, 23-26, SE1/4 Sec. 11, S1/2 Sec. 12; T30S R17E Sec. 17-20, 29, 30; T31S R14E Sec. 1, 2, 11, 12, E1/2 Sec. 3, E1/2 Sec. 10, N1/2 Sec. 14, N1/2 Sec. 13; T31S R15E W1/2 Sec. 6, W1/2 Sec. 7, NW1/4 Sec. 18.

Mt. Pinos Condor Area: An area of land, water, and airspace in Ventura and Kern Counties, with the following components (San Bernardino Meridian): T8N R21W W1/2 Sec. 5, Sec. 6 N1/2 Sec. 7, NW1/4 Sec. 8; T8N R22W Sec. 1, 2, E1/2 Sec. 3, NE1/4 Sec. 10, N1/2 Sec. 11, N1/2 Sec. 12; T9N R21W Sec. 31, 32, W1/2 Sec. 33; T9N R22W E1/2 Sec. 35, Sec. 36.

Blue Ridge Condor Area: An area of land, water, and-airspace in Tulare County, with the following components (Mt. Diablo Meridian): T19S R29E Sec. 5-9, 15-22, 27-30.

Tejon Ranch: An area of land, water, and airspace in Kern County, with the following components (San Bernardino Meridian): R16W T10N, R17W T10N, R17W T11N, R18W T9N, R18W T10N, R19W T10N.

Kern County rangelands: An area of land, water, and airspace in Kern County between California State Highway 65 and the western boundary of Squoia National Forest, with the following components (Mt. Diablo Meridian): R29E T25S, R29E T26S, R30E T25S, R30E T26S.

Tulare County Rangelands: An area of land, water, and airspace in Tulare County between California State Highway 65, State Highway 198, and the western boundary of Sequoia National Forest, with the following components (Mt. Diablo Meridian): R28E T18S (all sections); R28E T19S (all sections); R28E T20S (all sections); R28E T21S Sec. 1-18; R29E T20S (all sections); R29E T21S Sec. 1-18.

Primary Constituent Elements/Physical or Biological Features

PCEs not described. The Sespe-Piru, Matilija, Sisquoc-San Rafael, and Hi Mountain-Beartrap Condor areas are considered critical for nesting and related year-long activity.

The Mt. Pinos and Blue Ridge Condor areas are considered critical for roosting.

The Tejon Ranch, Kern County rangelands, and Tulare county rangelands are considered critical for feeding and related activities. The Tejon Ranch is very important because it contains the only significant feeding habitat remaining in close proximity to the Sespe-Piru Condor nesting area.

Special Management Considerations or Protections

Not available

Life History

Feeding Narrative

Adult: Condors maintain wide-ranging foraging patterns throughout the year. Condors at interior locations feed on mule deer (Odocoileus hemionus), tule elk (Cervus canadensis), pronghorn antelope (Antilocapra americana), feral hogs (Sus scrofa), domestic ungulates, and smaller mammals; the diet of birds on the coast includes whales (Order Cetacea), sea lions (Zalophus californianus), and other marine species. Condors use sight, rather than smell, to locate food, or follow other scavenging birds. Condors are opportunistic scavengers that may feed individually or in large numbers at a carcass. Supplemental feeding is also performed to trap and closely monitor California condor wild populations, test blood samples, and inoculate for West Nile Virus throughout the year for all wild populations (USFWS 2013).Currently, California condors forage predominantly in open terrain of foothill grassland and oak savanna habitats, and at coastal sites in central California (birds released from Big Sur and Pinnacles National Park), but have also been observed feeding in more wooded areas, though this is less common (USFWS 2013).

Reproduction Narrative

Adult: The California condor is a monogamous species, initiating courtship and nest site selection in winter (November through March) and laying a clutch of a single egg between late

January and early April. California condors are primarily a cavity-nesting species; they typically nest on steep rock formations or in the burned out hollows of old-growth conifers (coast redwood [Sequoia sempervirens] and giant sequoia trees [Sequoiadendron giganteum]). Less typical nest sites include cliff ledges, cupped broken tops of old-growth conifers, and—in several instances—nests of other species. Pairs lay a single egg clutch; following an incubation period of approximately 56 days, the offspring hatch, fledge at 5.5 to 7 months of age, and attain independence the following year. However, young birds typically do not reach sexual maturity until 6 to 8 years of age (on rare occasion, 5 years). Both parents are involved in incubation, hatching, and feeding/caring for young. Condor pairs nest every other year (on rare occasion, a pair may nest the following year if that year's nestling fledges early) (USFWS 2013).

Geographic or Habitat Restraints or Barriers

Adult: Mountainous country, low to moderate elevation (USFWS 2013).

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Narrow/specialist

Site Fidelity

Adult: High

Habitat Narrative

Adult: California condors inhabit areas in mountainous country in low to moderate elevations with available nesting/roosting habitat (standing snag/hollow tree, cliff face, and cavity); suitable foraging habitat (grasslands, oak savannas, mountain plateaus, ridges, and canyons); and a prey base of small-to-large mammals as carrion. Individuals show high site fidelity, but are spatially clumped by the geographic distribution of suitable habitat. They typically inhabit vegetation communities including aerial, cliff, grassland/herbaceous, savanna, shrubland/chaparral, conifer, hardwood, and mixed woodland (USFWS 2013, NatureServe 2015).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: High

Immigration/Emigration

Adult: Unlikely

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: California condors have relatively heavy wing-loading (mass per wing area) and have a difficult time becoming and remaining airborne over flat terrain. Over such terrain, condors are almost exclusively dependent on the uplift provided by thermal cells, a less consistent motive force than breezes blowing over hilly terrain. As a result, condors exhibit high mobility and can disperse great distances over a short amount of time, but remain within their home range. In good weather, it is common for birds to cover great distances over the course of a day; in extreme cases, from 225 km (141 mi.) to more than 643 km (400 mi). However, breeding pairs tend to forage most frequently within 70 km (43 mi) of a nest, and occasionally as far away as 180 km (112 mi); nonbreeders forage more widely (NatureServe 2015, USFWS 2013).

Additional Life History Information

Adult: In good weather, it is common for birds to cover great distances over the course of a day; in extreme cases, from 225 kilometers (km) (141 miles [mi.]) to more than 643 km (400 mi.). However, breeding pairs tend to forage most frequently within 70 km (43 mi.) of a nest, and occasionally as far away as 180 km (112 mi.); nonbreeders forage more widely (NatureServe 2015; USFWS 2013). California condors have been reintroduced to a variety of habitats, including coastal mountains, old-growth forests, desert cliffs, and temperate montane shrublands and grasslands. Within these habitats they can have enormous home ranges (Meretsky and Snyder 1992, p. 321; Hunt et al. 2007, pp. 84–87; Romo et al. 2012, pp. 43–47; Rivers et al. 2014a, pp. 496–498) and often use different portions of their range for nesting and foraging (Meretsky and Snyder 1992, p. 329; Snyder and Snyder 2000, pp. 140–147; D'Elia et al. 2015, p. 96). Home range size varied among release sites (95 percent confidence intervals for southern California: 173,295–282,760 acres (ac) (70,130–114,429 hectares (ha)); Pinnacles National Park: 86,825–174,266 ac (35,137–70,523 ha); and Big Sur: 42,613–90,495 ac (17,245–36,622 ha)), probably as a result of geography, food availability (Rivers et al. 2014a, pp. 496–497, 500), years since the release program started, and flock size (Bakker et al. 2017, p. 100). (USFWS, 2019).

Population Information and Trends

Population Trends:

Wild-fledged population is increasing.

Species Trends:

Increasing

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Growth Rate:

Gradually increasing (with the help of captive breeding programs).

Number of Populations:

Three populations (California, Arizona, and Baja California).

Population Size:

As of 2012: 235 in the wild, and 169 in captivity. Of the wild birds, 129 are in California, 78 in Arizona, and 28 in Baja, California (USFWS 2013). As of December 2017, 2017, there were 290 California condors in the wild, divided among the four release areas: Central California (90 condors); southern California (80 condors); northern Arizona and southern Utah (82 condors); and the Sierra de San Pedro Ma´rtir release site in Baja California (38 condors) (USFWS 2018, p. 1). There were also 173 California condors in captivity (USFWS 2018, p. 1) distributed among release sites, zoos, and four captive-breeding facilities. Breeding facilities include the Peregrine Fund's World Center for Birds of Prey, the Oregon Zoo's Jonsson Center for Wildlife Conservation, the Los Angeles Zoo, and the San Diego Zoo's Safari Park. (USFWS, 2019).

Minimum Viable Population Size:

Unknown

Resistance to Disease:

Low

Adaptability:

Low

Additional Population-level Information:

The captive breeding program produces an average of 60 California condor eggs per year with a 74 percent hatch rate, resulting in 45 new hatchlings on average each year. The current program appears to be reaching capacity, and may not be able to oversee the release and management (track, feed, capture, treat, and release) of additional birds under the current management strategies in place (USFWS 2013).

Population Narrative:

As of 2012, there were 235 California condors in the wild and 169 in captivity. Wild condors are spread across three known wild populations of California condors in California (129 wild birds), Arizona (78 wild birds), and Baja California (28 wild birds). Wild-fledged populations are increasing in number, with an overall increase in species level trends. However, given the species' dependence on limited key resources, the unlikelihood of immigration/emigration, and the limited genetic diversity, the species shows a low resilience to withstand stochastic events, has a low representation to adapt to changing environmental conditions across the landscape, a low redundancy to withstand catastrophic events, and a low resistance to disease.California condor populations are slowly but steadily increasing with the support of captive breeding programs. The captive breeding program produces an average of 60 California condor eggs per year with a 74 percent hatch rate, resulting in 45 new hatchlings on average each year. The current program appears to be reaching capacity, and may not be able to oversee the release and management (track, feed, capture, treat, and release) of additional birds under the current management strategies in place (USFWS 2013).

Threats and Stressors

Stressor: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range
Exposure: Indirect/direct
Response: Individuals avoiding otherwise suitable nesting, roosting, and foraging sites; a decline in carrion availability; and an increase in lethal collisions with wind turbines and collisions/electrocutions from power lines.
Consequence: Degradation of habitat; reduction of quality/quantity of nesting, roosting, and foraging habitat; reduction in population numbers; decreased reproductive success; increased genetic effects of population bottleneck; higher susceptibility to mortality/extirpation.
Narrative: The loss and modification of California condor foraging, roosting, and nesting habitat is a threat to the continued recovery of the species. Human development (i.e., land conversion) and encroachment leads to individuals avoiding otherwise suitable nesting, roosting, and foraging sites; a decline in carrion availability; and an increase in lethal collisions with wind turbines and collisions/electrocutions from power lines (USFWS 2013).

Stressor: Predation
Exposure: Direct
Response: Increased incidence of mortality in all life stages.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Mortality data suggest that condors—especially newly released captive-bred individuals—are susceptible to predation by terrestrial mammals such as black bears, coyotes, mountain lions, bobcat, ravens, and golden eagles at food caches, or as eggs/nestlings when left unattended in the nest (USFWS 2013).

Stressor: Disease
Exposure: Direct
Response: Increased incidence of disease and mortality.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Captive and wild California condor populations are both at risk of diseases such as West Nile Virus and Highly Pathogenic Avian Influenza (HP H5N1) (USFWS 2013).

Stressor: Inadequacy of Existing Regulatory Mechanisms
Exposure: Indirect
Response: Lack of lead-free hunting regulation enforcement.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Education and enforcement regarding the use of lead ammunition for big game hunting or varmint control are critical to successfully reduce (or eliminate) lead-related condor mortalities. Unfortunately, enforcement of lead-free hunting regulations is problematic due to budget constraints, the resulting lack of enforcement personnel to enforce the law, and the difficulty of determining whether lead ammunition was used to harvest an animal (USFWS 2013).

Stressor: Lead Poisoning
Exposure: Indirect/direct

Response: Behavioral and physiological effects of lead poisoning.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Lead ingestion as a result of ingestion of spent ammunition in carcasses and offal (gut piles) by California condors, and the subsequent behavioral and physiological effects of lead poisoning—including both mortality and morbidity events—is the single most significant threat to the species (USFWS 2013).

Stressor: Shooting
Exposure: Direct
Response: Lethal mortality and nonlethal injuries.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Lethal and nonlethal gun and bow shooting continues to pose a threat to free-flying California condors (USFWS 2013).

Stressor: Microtrash Ingestion
Exposure: Direct
Response: Digestive tract impaction, evisceration, internal lesions, and death.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Breeding California condors sometimes ingest small manmade materials (microtrash) and feed these items to your nestlings, which in large quantities can lead to digestive tract impaction, evisceration, internal lesions, and death (USFWS 2013).

Stressor: Organochlorides
Exposure: Indirect/direct
Response: Increased incidence of eggshell thinning, weight loss, and reproductive failure.
Consequence: Reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Especially along the central California coastline, California condors that feed on marine carrion (sea lions) are at risk of increased rates of exposure to DDT and DDE, which leads to eggshell thinning, weight loss, and reproductive failure (USFWS 2013).

Stressor: Habituation
Exposure: Indirect/direct
Response: Increased habitation to landing on radio towers, telephone poles, houses, and other structures; increased risk of injury to individual birds while being fed by or approaching humans, or allowing humans to approach them; reduced reliance on natural foraging behaviors.
Consequence: Increased exposure to threats as a result of high-risk behaviors, reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, and higher susceptibility to mortality/extirpation.
Narrative: Wild-flying and captive bred individuals risk becoming habituated to landing on radio towers, telephone poles, houses, and other structures; and to being fed by humans, and approaching or allowing humans to approach them. Such habituation increases the risk of injury to individual birds and a possible reduced reliance on natural foraging behaviors (USFWS 2013).

Stressor: Climate Change

Exposure: Indirect
Response: Changes in the prevailing winds that condors rely on for soaring; a reduction in carrion prey base as a result of the effects of climate change on ranchers and ungulates; increased frequency of wildfires and resulting loss of roosts or direct mortality; and a reduction in water sources necessary for drinking and bathing.
Consequence: Reduction of prey base, reduction of water resource availability, increased stress levels, reduction in population numbers, decreased reproductive success, increased genetic effects of population bottleneck, higher susceptibility to mortality/extirpation.
Narrative: The effects of climate change on California condors include changes in the prevailing winds that they rely on for soaring; a reduction in carrion prey base as a result of the effects of climate change on ranchers and ungulates; increased frequency of wildfires and resulting loss of roosts or direct mortality; and a reduction in water sources necessary for drinking and bathing (USFWS 2013).

Recovery

Reclassification Criteria:
Maintenance of at least two noncaptive (wild) populations and one captive population. In addition to the minimum criterion, there are five conditions that must be met, for each population:

(1) must each number at least 150 individuals;

(2) must each contain at least 15 breeding pairs;

(3) must be reproductively self-sustaining, with a positive rate of population growth.

Furthermore, the noncaptive (wild) populations:

(4) must be spatially disjunct and noninteracting; and

(5) must contain individuals descended from each of the 14 founders (USFWS 2013).

Delisting Criteria:
Not specified in the Recovery Plan (USFWS 1996, USFWS 2013).

Recovery Actions:
- Develop a 5-year needs assessment to assess the need for resources to implement recommended organizational changes, and for a state-based non-lead outreach and education effort.
- Continue development of specific workgroups as part of a larger California Condor Recovery Team with narrowly drawn, time-limited responsibilities, to address significant pending issues, including: a. Developing programmatic responses to contaminants in the environment, including lead, DDT/DDE, and microtrash; b. Planning for additional release sites if found feasible and desirable; c. Managing program growth and recordkeeping that results from the continued captive breeding, release, and management of condors in the wild; d. Developing consistent and structured health, veterinary, and animal management protocols and standards.

- Develop and publish a Federal Register notice that corrects the 1987 and subsequent listing of the nonexperimental California condor population to reflect the actual listed range.
- Additional specific management and research recommendations include ongoing management of captive breeding efforts through various partnerships; field restoration activities aimed at managing population growth; data analysis and management of existing databases and studbooks to manage essential condor population information; public outreach and education for hunters, hunting and shooting organizations, landowners, and the general public; and further research into the effectiveness of the lead ban in California, analysis of condor flight patterns, further development of alternatives to telemetry-based detection and avoidance systems in the California condor's range, additional modeling of feeding behavior based on GPS telemetry information, evaluation of the efficacy of the current protocol for treating lead-exposed condors, evaluation of the importance of West Nile Virus vaccines, facilitation of independent self-sustaining condor populations, evaluation of the availability of sufficient carrion and other potential food sources, and better understanding of the effects of habitat loss in the California condor's ranges.

Conservation Measures and Best Management Practices:

-

Additional Threshold Information:

-
-

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SPECIES ACCOUNT: *Gymnomyza samoensis* (Ma'oma'o)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/24/2016; Pacific Region (R1) (USFWS, 2016)

Physical Description

The maomao bird is an approximately 28 cm (11.0 inch), large, very dark looking honeyeater (Watling 2001, p. 174). The maomao is uniformly olive-black with a brown suffusion, except for an olive stripe beneath the eye (Watling 2001, p. 174). The bill is slender, down-curved and black, and the feet are black (Watling 2001, p. 174). Butler and Sirnemann (2013) report that male maomao have blue eyes and are larger while females are smaller with brown eyes. Juveniles have a shorter beak than adults and eye color changes two months post-fledging (Butler and Sirnemann 2013, p. 25). The maomao is a very vocal species making a variety of loud distinctive calls with bouts of calling lasting up to a minute (Watling 2001, p. 174). Calls differ between sexes (Butler and Sirnemann 2013, p. 25). (USFWS, 2014)

Taxonomy

The genus refers to birds in the honeyeater family Meliphagidae, which are restricted to a few Gymnomyza islands in the southwestern Pacific Ocean. The maomao is one of three honeyeaters in the genus (Mayr 1945). BirdLife International recognizes the maomao as a species under the authority of Sibley and Monroe (1990) (BirdLife International 2013). We have carefully reviewed the available taxonomic information (BirdLife International 2013; Watling 2001) and have concluded the species is a valid taxon. (USFWS, 2014)

Historical Range

The maomao was once found throughout Savaii and Upolu in forests from coast to mountain tops (MNRE 2006, p. 2). It is endemic to the islands of Savaii and Upolu, Samoa, and Tutuila Island, American Samoa (Watling 2001, p. 174; Engbring 1989, p. 68). (USFWS, 2014)

Current Range

The maomao is currently only found on the islands of Savaii and Upolu in Samoa (Watling 2001, p. 74; MNRE 2006, p. 2; USFWS 1982, p. 72; Engbring 1989, p. 68). (USFWS, 2014)

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: The maomao diet consists of primarily the nectar of flowers as well as invertebrates and fruit (MNRE 2006, p. 11). Nectar is an important food source, especially during the breeding season, and the maomao will defend nectar patches (Butler and Sirnemann 2013, p. 30). The maomao eat invertebrates by probing dead material and moss, and by gleaning leaf budburst (Butler and Sirnemann 2013, p. 30). Females forage for invertebrates under dead leaves on the forest floor to feed their fledging (Butler and Sirnemann 2013, p. 30). Fledglings solicit food from the female by begging continually from the forest floor (Butler and Sirnemann 2013, p. 28). (USFWS, 2014)

Reproduction Narrative

Adult: The mao have an extended breeding season that can occur over 9 to 10 months, although peak egg-laying appears to occur from late May to October. One egg is produced per clutch. The nest consists of young branches of various trees and contains little lining (Butler and Stirnemann 2013, p. 25). Nests are oval, cup-shaped, approximately 5.5 in (14 cm) by 3.1 in (8 cm), and are constructed in the junction of branches. Incubation lasts 19 days, and chicks fledge 22 to 24 days after hatching. Juveniles are dependent on adults for approximately 8 to 10 weeks post-fledging. The female is almost exclusively responsible for incubation and feeding the chick, and both adults defend the nest. The mao will re-nest if the first nest fails, but not if the first nesting attempt produces a chick. Pairs are highly territorial with high site fidelity. The mao's extended breeding season, extended parental care period (100 to 120 days), and limited re- nesting attempts suggest a maximum annual reproductive capacity of one chick; notably low in comparison with other honeyeaters (Stirnemann et al. 2015a, p. 8). (USFWS, 2016)

Geographic or Habitat Restraints or Barriers

Adult: Found in the high canopy layer of large trees (USFWS, 2014)

Environmental Specificity

Adult: Medium, with some key requirements (USFWS, 2014)

Habitat Narrative

Adult: The maomao are primarily restricted to mature well-developed, moist, mossy forests at upper elevations (Watling 2001, p. 175; Enbring 1989, p. 68). They use the mid- to upper-canopy levels of the forest and will also forage along forest edges and brushy forest openings (Engbring 1989, p. 68). The maomao have also been recorded as visiting coconut trees near the coast (Watling 2001, p. 175).Butler and Sirnemann (2013, p. 30) found that the maomao only occur in areas with a canopy layer of trees, and do not occur in logged areas with no large tree canopy cover. However, maomao were observed in modified habitat such as areas with plantations where large trees were present (Butler and Sirnemann 2013, p. 30). The study found that the maomao were primarily found in the high canopy layer, but also spent considerable time foraging on the trunks of trees and feeding on nectar on the ground and in low bushes (Butler and Sirnemann 2013, p. 30). The maomao selected territories with high tree species diversity and with appropriate nectar sources and an appropriately large tree for the male to sing from. Trees near a commonly used singing tree are selected for nesting (Butler and Sirnemann 2013, p. 30). No particular tree species is used for nesting but all nests are built more than five meters above the ground (Butler and Sirnemann 2013, p. 30). (USFWS, 2014)

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available.

Population Information and Trends

Population Trends:
Declining (USFWS, 2014)

Resiliency:
Low (inferred from USFWS, 2014)

Representation:
Low (inferred from USFWS, 2014)

Redundancy:
Low (inferred from USFWS, 2014)

Population Size:
1000 (USFWS, 2016)

Population Narrative:
The population is believed to have declined due to habitat loss from cyclones between the 1980s and 1990s (MNRE 2006, p. 2, 4). A general decline in distribution and numbers has resulted in small, increasingly fragmented populations estimated to comprise fewer than 1,000 mature individuals (MNRE 2006, p. 4; Tipamaa 2007, in litt., cited in Birdlife International 2012; Stirnemann 2015, in litt.). (USFWS, 2014; USFWS, 2016)

Threats and Stressors

Stressor: Loss of mature forests (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The loss of forested habitat is the primary threat to the maomao (MNRE 2006, p. 5). There is very little mature forest left in Samoa (Watling 2001, p. 175), as forested land area in Samoa declined by 18 percent from 1987 to 1999 (Butler and Sirnemann 2013, p. 22). Habitat quality has also degraded with the loss of closed forest space (MNRE 2006, p. 5; Butler and Sirnemann 2013, p. 22). An analysis in 1999 identified 32 percent of the total forest cover as open forest (less than 40 percent tree cover) and less than 0.05 percent as closed forest, largely as a result of damage from Cyclones Ofa and Val (Butler and Sirnemann 2013, p. 22). An additional 24 percent of the forest cover is classified as secondary re-growth forest. As a result, the montane forest in Samoa is now extremely open and patchy with fewer food resources for birds, including the maomao (Butler and Sirnemann 2013, p. 22). (USFWS, 2014)

Stressor: Non-native weeds (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The montane forests are also increasingly vulnerable to invasion by nonnative weeds (Butler and Sirnemann 2013, p. 22), which adversely affect native forests through competition for light, nutrients, and water; chemical inhibition; and prevention of reproduction. (USFWS, 2014). The following list provides a brief description of the nonnative plants that have the greatest negative impacts to the native forest habitat for the mao in American Samoa (Space and Flynn

2000, pp. 23–24; Craig 2009, pp. 94, 96–98; ASCC 2010, p. 15): Adenanthera pavonina (red bean tree, coral bean tree, lopa), native to India and Malaysia, is a medium-sized tree up to 50 ft (15 m) high that invades intact forests as well as disturbed sites, and can quickly form large stands (GISD 2006). In American Samoa, it is invasive in secondary forests, but also has the ability to become more widely established on Tutuila and the Manua Islands (Space and Flynn 2000, p. 4). It is considered to have negative impacts on the native forests in American Samoa because the trees produce large quantities of seed, grow on a variety of soils, and can overtop many native trees and eventually form monotypic stands (Space and Flynn 2002, p. 5). (USFWS, 2015). Castilla elastica (Mexican rubber tree, pulu mamoe), native to tropical America, is a medium-sized tree 15 to 30 ft (5 to 10 m) high that can invade intact forest where it reproduces prolifically and can crowd out native species (NPSA 2012, in litt.). It has displaced significant areas of lowland forest in Samoa, and is now considered to be an important threat to native forests in American Samoa (Atkinson and Medeiros 2006, p. 18). (USFWS, 2015). Cinnamomum verum (cinnamon, tinamoni), native to south Asia, is a fastgrowing, medium-sized tree up to 30 ft (9 m) high with aromatic bark and leaves. It forms dense root mats that inhibit establishment of other plants, and can shade out other tree species and thus create monotypic stands. On Tutuila, it is actively spreading in the ridge forests of Mt. Matafao, Matuu, and Maloata (Space and Flynn 2000, p. 4; NPSA 2012, in litt.). (USFWS, 2015). The shrub Clidemia hirta (Koster's curse), native to the New World from Mexico to Argentina, grows to be 6.6 ft (2 m) in height, forms a dense understory, shades out native plants, and prevents their regeneration (Wagner et al. 1985, p. 41; Smith 1989, p. 64). On Tau, it has become a serious problem in the unique summit scrub community (Whistler 1992, p. 22). (USFWS, 2015). Falcataria moluccana (albizia, tamaligi), native to Moluccas, New Guinea, New Britain, and the Solomon Islands, is a tree that can reach 131 ft (40 m) in height and has a widespreading canopy. It grows rapidly and outcompetes slow-growing native trees by reducing light availability, and its abundant, high-nutrient litter alters soil chemistry (GISD 2008). Its shallow root system may lead to soil instability and landslides (Atkinson and Medeiros 2006, p. 17). (USFWS, 2015). Funtumia elastica (African rubber tree, pulu vao), is a medium-sized tree up to 100 ft (30 m) tall native to tropical Africa (U.S. Department of Agriculture—Agricultural Research Service (USDA) 2006). This tree is invasive because of its ''parachute seeds'' that can disperse long distances and germinate in sunny or shady conditions (Whistler 2002, p. 122). Funtumia has become a dominant subcanopy and understory tree in the western half of Upolu where it can form monotypic forests (Pearsall and Whistler 1991, p. 30). It is also established and becoming dominant on eastern Savaii (Whistler 2002, p. 122). This species has the potential to become a major problem in American Samoa due to its proximity and the volume of traffic with Samoa (Space and Flynn 2000, p. 12). (USFWS, 2015). Leucaena leucocephala (wild tamarind, lusina, fua pepe), a shrub native to the neotropics, is a nitrogenfixer and an aggressive competitor that often forms the dominant element of the vegetation (Geesink et al. 1999, pp. 679– 680). It crowds out native species and resprouts vigorously after cutting, and seeds can remain viable for 10 to 20 years (Craig 2009, p. 98). (USFWS, 2015). Merremia peltata (Merremia, fue lautetele), is an indigenous, sprawling, or high-climbing vine that can invade areas following disturbances such as land-clearing and hurricanes. This fastgrowing vine can smother plantation and forest trees (Craig 2009, p. 98). (USFWS, 2015). Mikania micrantha (mile-a-minute vine, fue saina), native to tropical America, is a scrambling or climbing herbaceous vine, that retards forest regeneration with its smothering growth (Whistler 1994, p. 42). This sun-loving, shade-intolerant vine is a major pest of plantations and forests on all major American Samoa islands (Space and Flynn 2000, p. 5; Craig 2009, p. 94). (USFWS, 2015). Psidium cattleianum (strawberry guava, kuava) is a tall shrub or small tree that forms dense stands in which few other plants can grow, displacing native vegetation through competition. The fruit is eaten by feral pigs and birds that disperse the seeds throughout the forest (Smith 1985, p. 200; Wagner et al. 1985, p. 24). It is thought to have been cultivated in American Samoa for more than 40 years and has become naturalized in lowland rainforest on western Tutuila. (USFWS, 2015). Spathodea campanulata (African tulip, faapasi), native to tropical Africa, is a large tree up to 80 ft (24 m) or more in height with showy red-orange tuliplike flowers and pods containing hundreds of wind-dispersed seeds (Pacific Islands Ecosystems at Risk (PIER) 2013). It is particularly invasive in low- to mid-elevation forests, and can spread in open agricultural land, waste areas, and intact native forest, forming dense stands that shade out other vegetation (GISD 2010). (USFWS, 2015).

Stressor: Reduced breeding and foraging habitat (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Loss of forest is likely to affect the maomao by reducing breeding and foraging habitat, increasing forest fragmentation, and increasing the abundance and diversity of invasive species (Butler and Sirnemann 2013, p. 22). (USFWS, 2014)

Stressor: Logging, agriculture, and cyclones (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The decline of closed forest habitat has been a result of logging on Savii, agricultural clearing on the edges of National Parks and Reserves (MNRE 2006, p. 5), and damage caused by Cyclones Ofa and Val in the 1990s (MNRE 2006, p. 4). (USFWS, 2014)

Stressor: Predation (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Nest predation by rats (Rattus spp.) is an important threat to many island birds including the maomao (Atkinson 1977, 1985; Butler and Sirnemann 2013, p. 29). Other potential predators include the barn owl (Tyto alba) and wattled honeyeater (Foulehaio carunculatus) (Butler and Sirnemann 2013, p. 31). Juveniles spending time on the forest floor risk predation by feral cats (Felis catus) (Butler and Sirnemann 2013, p. 31). Butler and Sirnemann (2013, p. 22) captured footage of one nest predation by a black rat (Rattus rattus) on a maomao egg. Plantation habitats have larger rat populations than native forest habitats, and Butler and Sirnemann (2013, p. 31) observed lower nest success nearer plantations. When artificial nests were used to determine what factors influence nest predation, researchers found that nests within 50 meters of a plantation are 40 percent more likely to be predated than nests in forested areas farther from plantations (Butler and Sirnemann 2013, p. 31). (USFWS, 2014)

Stressor: Small population size (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: The small size of the maomao population, perhaps not more than a few hundred birds, could be a threat to this species. Small populations are more susceptible to stochastic,

genetic, environmental, and demographic events that can lead to extinction (Soule 1987; Lande 1988; Pimm et al. 1988; Mangel and Tier 1994; Meffe and Carroll 1997). (USFWS, 2014)

Stressor: Catastrophic events (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Catastrophic events such as storms are a major threat to the continued persistence of the species (MNRE 2006, p. 8). Although severe storms are a natural disturbance with which the maomao has coexisted for millennia, such storms affect habitat and food resources for the birds and exacerbate the threats to the small populations. Two storms in the 1990s, Cyclones Ofa (1990) and Val (1991), destroyed much of the forested habitat in Samoa, reducing forest canopy cover by 73 percent (MNRE 2006, p. 5, 7). In addition, Cyclone Evan struck Samoa in 2012 causing severe widespread forest damage. In Upolu, 80-90 percent of the Reserves and National Parks were highly devastated by downed trees and defoliation (Butler and Sirnemann 2013, p. 41). Secondary forests were seriously impacted by the storm; and most trees in the known maomao locations were stripped of their leaves, fruits, and flowers (Butler and Sirnemann 2013, p. 41). Researchers reported that rat numbers increased as a result as well. (USFWS, 2014)

Stressor: Inbreeding and loss of genetic diversity (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Inbreeding and/or the reduced likelihood of locating mates are also potential threats to the maomao (Thevenon and Couvet 2002). Small populations are particularly vulnerable to reduced reproductive vigor caused by inbreeding depression, and they may suffer a loss of genetic variability over time due to random genetic drift, resulting in decreased evolutionary potential and ability to cope with environmental change (Lande 1988; Pimm et al. 1988; Center for Conservation Biology 1994; Mangel and Tier 1994). (USFWS, 2014)

Stressor: Habitat Destruction and Modification by Nonnative Ungulates (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: Feral pigs (Sus scrofa) cause multiple negative impacts to island ecosystems, including the destruction of vegetation, spread of invasive nonnative plant species, and increased soil erosion. In addition, feral cattle (Bos taurus) consume tree seedlings and browse saplings, and combined with undergrowth disturbance, prevent forest regeneration, subsequently opening the forest to invasion by nonnative species (Cuddihy 1984, p. 16). Feral pigs are known to cause deleterious impacts to ecosystem processes and functions throughout their worldwide distribution (Aplet et al. 1991, p. 56; Anderson and Stone 1993, p. 201; Campbell and Long 2009, p. 2,319). Feral pigs are extremely destructive and have both direct and indirect impacts on native plant communities. Pigs are a major vector for the establishment and spread of invasive, nonnative plant species by dispersing plant seeds on their hooves and fur, and in their feces (Diong 1982, pp. 169–170, 196–197), which also serve to fertilize disturbed soil (Siemann et al. 2009, p. 547). In addition, pig rooting and wallowing contributes to erosion by clearing vegetation and creating large areas of disturbed soil, especially on slopes (Smith 1985, pp. 190, 192, 196, 200, 204, 230–231; Stone 1985, pp. 254– 255, 262–264; Tomich 1986, pp. 120– 126;

Cuddihy and Stone 1990, pp. 64– 65; Aplet et al. 1991, p. 56; Loope et al. 1991, pp. 18–19; Gagne and Cuddihy 1999, p. 52; Nogueira-Filho et al. 2009, p. 3,681; CNMI–SWARS 2010, p. 15; Dunkell et al. 2011, pp. 175–177; Kessler 2011, pp. 320, 323). Erosion resulting from rooting and trampling by pigs impacts native plant communities by contributing to watershed degradation and alteration of plant nutrient status, and increasing the likelihood of landslides (Vitousek et al. 2009, pp. 3,074–3,086; Chan-Halbrendt et al. 2010, p. 251; Kessler 2011, pp. 320–324). In the Hawaiian Islands, pigs have been described as the most pervasive and disruptive nonnative influence on the unique native forests, and are widely recognized as one of the greatest current threats to Hawaii's forest ecosystems (Aplet et al. 1991, p.56; Anderson and Stone 1993, p. 195). Significant numbers of feral cattle were present in an upland site where their trampling had kept open grassy areas within forested flats, and where mao had previously been observed (Atherton and Jeffries 2012, pp. 103– 105). Trampling in forested areas damages understory vegetation and is likely to reduce foraging opportunities for mao as well as provide vectors for invasion by nonnative plants. (USFWS, 2016)

Recovery

Reclassification Criteria:
Not available.

Delisting Criteria:
Not available.

Recovery Actions:
- Not available.

Conservation Measures and Best Management Practices:
- Develop and implement a plan to translocate birds to American Samoa. (USFWS, 2014)
- Conserve key forested areas on Upolu and Savaii. (USFWS, 2014)
- Determine if the Savaii uplands are a potential rat-free habitat for the maomao. (USFWS, 2014)
- Monitor existing populations and breeding sites. (USFWS, 2014)
- Continue to conduct studies on basic life history characteristics of the species. (USFWS, 2014)
- Control predators (rats, cats) in occupied habitats and potential translocation sites. (USFWS, 2014)
- Evaluate the development of a captive management program. (USFWS, 2014)
- Determine other limiting factors and implement control measures. (USFWS, 2014)
- In 2004, the American Samoa Invasive Species Team (ASIST) was established as an inter-agency team of nine local government and Federal agencies. The mission of ASIST is to reduce the rate of invasion and impact of invasive species in American Samoa with the goals of promoting education and awareness on invasive species and preventing, controlling, and eradicating invasive species. (USFWS, 2015).
- In 1996, the National Park of American Samoa (NPSA) initiated a feral pig control program that includes fencing and removal of pigs using snares in the Tutuila Island and Tau Island Units. Two fences have been constructed and several hundred pigs have been removed since 2007 (Togia 2015, in litt.). The program is ongoing and includes monitoring feral pig activity twice per year and additional removal actions as needed (Togia 2015, in litt.). (USFWS, 2015).
- Other conservation programs: Samoan government mao recovery plan, Mt. Vaea Ecological Restoration Project, Two Samoas Environmental Collaboration Initiative. (USFWS, 2015).

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USFWS. 2016. Endangered and Threatened Wildlife and Plants

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SPECIES ACCOUNT: *Hemignathus affinis* (Maui nukupuu (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed for delisting

Physical Description

The Maui nukupu`u is a medium-sized, approximately 23 gram (0.78 ounce), Hawaiian honeycreeper with an extraordinarily thin, curved bill, slightly longer than the bird's head. The lower mandible is half the length of the upper mandible and follows its curvature. Adult males are olive green with a yellow head, throat, and breast, whereas adult females and immatures have an olive-green head and yellow or yellowish gray under-parts. Females and first- and second-year males are nearly identical and have a noticeably pale superciliary line. Maui nukupu`u differ from Kaua`i nukupu`u (H. l. hanapepe) by their smaller size, yellowish rather than whitish vent, and grayish-green rather than yellowish-green back (USFWS, 2006).

Taxonomy

Belongs in the family Fringillidae, subfamily Drepanidinae. The Maui nukupu`u is one of three subspecies. The Maui and Kaua`i subspecies may still survive, but H. l. lucidus of O`ahu is extinct. Evidence is mounting that the Kaua`i, O`ahu, and Maui forms of nukupu`u are distinct species (Pratt 2005; R. Fleischer, unpubl. data). The Maui nukupu`u was described by Rothschild (1893 to 1900) (USFWS, 2006). The scientific name of the species was officially listed as Hemignathus affinis effective May 17, 2016. (USFWS, 2016).

Historical Range

Historical records indicate the species inhabited forests on the northwestern slope of Haleakala. Historically, the Maui nukupu`u is known only from Maui, but subfossil bones of a probable Maui nukupu`u from Moloka`i show that the species formerly inhabited that island (James and Olson 1991) (USFWS, 2006).

Current Range

Sightings since the 1967 rediscovery of the Maui nukupu`u have been in Kipahulu Valley and the northeast slope of Haleakala (USFWS, 2006). The large areas on East Maui (approximately 50,000 hectares; USFWS 1984, USFWS 2006) with suitable habitat, and many sites that are remote and only rarely visited by qualified observers, increase the potential that a small population of nukupu`u still exists in Hawai`i (USFWS, 2010). As of the 2018 5-Year review, none have been observed at the Hanawi Natural Area Reserve, Kipahulu Valley on northern Haleakala, or on East Maui. (USFWS, 2018).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Maui nukupu`u tap and probe bark, lichen, and branches to extract insects, and thus their foraging behaviors resemble those of `akiapola`au. Diet of the Maui nukupu`u was reported by Perkins (1903) to be small weevils and larvae of coleoptera (beetles) and Lepidoptera (butterflies and moths). Apparently they seldom forage for larvae and adults of longhorn beetles (Cerambycidae) and thereby compete little with Maui parrotbills. There is scant evidence that Maui nukupu`u take nectar from flowers (USFWS, 2006). This species exhibits a diurnal phenology (NatureServe, 2015).

Reproduction Narrative

Adult: Nothing is known of its breeding biology, which likely was similar to its closest relative, the `akiapola`au (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: 3,600 - 6,720 ft. elevation (USFWS, 2006)

Spatial Arrangements of the Population

Adult: Mixed species flocks (USFWS, 2006)

Habitat Narrative

Adult: The first historical records, at the turn of the last century, indicate that the Maui nukupu`u inhabited mixed koa/`ohi`a (Acacia koa/Metrosideros polymorpha) forest from 1,220 meters (4,000 feet) to timberline (Perkins 1903, Banko 1984b, Hawai`i Natural Heritage Program Database). Sightings since the 1967 rediscovery of the Maui nukupu`u have been in mixed shrub montane wet forest (Jacobi 1985) at 1,100 to 2,100 meters (3,600 to 6,720 feet), though most have been above 1,700 meters (5,500 feet; Banko 1984b). Maui nukupu`u often join mixed species foraging flocks (Perkins 1903) (USFWS, 2006).

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available

Population Information and Trends

Population Trends:

Possibly extinct (USFWS, 2006); > 90% decline (NatureServe, 2015)

Species Trends:

Rediscovered in 1967 (USFWS, 2006; see current range/distribution); declining (NatureServe, 2015)

Resiliency:

Very low (inferred from USFWS, 2006; see current range/distribution)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

0 - 1 (NatureServe, 2015)

Population Size:

28 estimated in 1980 (NatureServe, 2015)

Population Narrative:

Although it is possible the Maui subspecies may be extinct (Pratt and Pyle 2000), the relatively recent sightings of nukupu`u on Haleakala and extensive habitat area that still exists for nukupu`u led Reynolds and Snetsinger (2001) to conclude that the nukupu`u is still extant on Maui. Further targeted surveys will be required to confirm the status of this species (USFWS, 2006). The Hawai`i Rare Bird Search confirmed the existence of at least one nukupu`u on East Maui in 1995 and 1996 (USFWS, 2010). At most, a single population exists. Total population in 1980 was estimated at 28 (Scott et al. 1986). This species has experienced a long term population decline of > 90% and USFWS (1990) categorized the status as "declining." (NatureServe, 2015).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Habitat loss and degradation by agriculture, urbanization, cattle grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006). Feral pigs, and goats to a lesser degree, have had a long-term damaging effect upon native forests in the remaining nukupu`u range by consuming and damaging understory vegetation, creating openings on the forest floor for weeds, transporting weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Predation by alien mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by alien mosquitoes have also been primary threats to this species (USFWS 2006) (USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic

stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006) (USFWS, 2010).

Stressor: Climate change (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Climate change may also pose a threat to nukupu`u. However, current climate change models do not allow specific predictions as to what those effects, and their extent, would be for this species (USFWS, 2010).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2010).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:
The taxon may be delisted when the downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2010).

Recovery Actions:
- Monitor changes in the distribution and abundance of forest birds, which describes systematic surveys to monitor changes in the distribution and abundance of forest birds, to help evaluate the effects of management actions, and to provide necessary information for developing measures of population stability for future listing actions (USFWS, 2006).
- Public awareness and information, which describes important outreach and information activities (USFWS, 2006).
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the

detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2010).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Given the low survey effort for this species and the difficulty of detecting forest birds in remote mountainous habitats in Hawai`i, we recommend the species' biological status be "unknown" instead of "presumed extinct." This determination is based on reexamination of data from the 1994-1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001), Hawaiian Forest Bird Survey data (Scott et al. 1986), and searches for this and other rare species by John Sincock from 1968-1973 (USFWS 1983). The species was confirmed to still exist as recently as 1995, and additional targeted searches are needed to confirm either that the nukupu`u still exists or that it has disappeared and is likely to be extinct (USFWS, 2010). As of the 2018 5-Year review, the recommendation was reversed to list the species as "presumed extinct" rather than "unknown" due to the amount of survey work conducted to confirm historic sightings to date. (USFWS, 2018).
- As described in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006), one of the most important recovery actions for the nukupu`u is to intensively and systematically search areas of forest habitat where the species occurred historically. Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 2006, pp. 16, 30, 32, 37, and 39) that do not cover all areas where extremely rare Hawaiian forest birds are most likely to persist. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare and/or likely extinct Hawaiian forest birds will be detected or rediscovered. Therefore, we recommend that an intensive search for nukupu`u be conducted on Maui and Kaua`i using similar methodologies as those employed during the 1994-1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001). In addition, we recommend that autonomous recording units, or ARUs (Fitzpatrick 2002), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2010).

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U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office Honolulu, Hawai`i

USFWS 2010. Kaua`i nukupu`u (Hemignathus lucidus hanapepe) and Maui nukupu`u (Hemignathus lucidus affinis) 5-Year Review Summary and Evaluation. U.S. Fish and Wildlife Service Pacific Islands Fish and Wildlife Office Honolulu, Hawai`i.

SPECIES ACCOUNT: *Hemignathus hanapepe (=H.lucidus)* (Kauai nukupu`u (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016). 5-year review of 2019 recommended delisting as presumed extinct. (USFWS, 2019); proposed for delisting

Physical Description

Yellow-green forest bird with a long decurved upper mandible, and a short decurved lower mandible (Pratt et al. 2001). Males with upperparts yellowish green; head, throat, and breast bright orangish yellow; belly white, lores black (Pratt et al. 2001). Females and young males with upperparts greenish gray and underparts whitish (Pratt et al. 2001) (NatureServe, 2015). Kaua`i nukupu`u (H. l. affinis) differ from Maui nukupu`u by their larger size and subtle differences in plumage (USFWS, 2006). Added in 2019: The nukupuʻu is a medium-sized, approximately 23-gram (0.78-ounce), Hawaiian honeycreeper (family Fringillidae, subfamily Drepanidinae) with an extraordinarily thin, curved bill, slightly longer than the bird's head. (USFWS, 2019)

Taxonomy

The Kaua`i nukupu`u is a longbilled Hawaiian honeycreeper (family Fringillidae, subfamily Drepanidinae). The Kaua`i nukupu`u is one of two subspecies of nukupu`u that may still survive (the other is the Maui nukupu`u). Evidence is mounting that the Kaua`i, O`ahu, and Maui forms of nukupu`u are distinct species (Pratt 2005; R. Fleischer, unpubl. data). The Maui and Kaua`i subspecies may still survive, but H. l. lucidus of O`ahu is extinct (USFWS, 2006). In older literature, each of the subspecies (lucidus, affinis, and hanapepe) was treated as a separate species in the genus Heterorhynchus, in which hemignathus munroi (= H. wilsoni) ('akiapola'au) also was included (Berger 1981). Olson and James (1994) presented evidence indicating that H. lucidus and H. munroi (= H. wilsoni) do not constitute a superspecies (NatureServe, 2015). The scientific name of the species was officially listed as Hemignathus hanapepe effective May 17, 2016. (USFWS, 2016).

Historical Range

Since 1960, the nukupu`u has been reported infrequently from Koke`e and the Alaka`I (USFWS, 2006).

Current Range

Small range in the Alakai Swamp area (Kokee area and both sides of Waimea Canyon) on the island of Kauai, Hawaiian Islands (NatureServe, 2015). At the time of the 1994 - 1996 Hawai`i Rare Bird Search, Reynolds and Snetsinger (2001) search results on Kaua`i to be inconclusive (USFWS, 2010). New in 2019: Although skilled observers reported three unconfirmed sightings of Kauaʻi nukupuʻu in 1995 (Reynolds and Snetsinger 2001, p. 142), extensive person-hours spent searching within the historical range failed to detect any individuals. At the time of the unconfirmed sightings in 1995, the population of Kauaʻi nukupuʻu was estimated to be fewer than 10 birds. Extensive time, however, has been spent by qualified observers in the historical range of Kauaʻi nukupuʻu, searching for puaiohi (Myadestes palmeri), ʻakekeʻe (Loxops caeruleirostris), ʻakikiki (Oreomystis bairdi), and Kauaʻi ʻakialoa (Akialoa stejnegeri). Hawaiʻi Forest Bird Surveys were conducted in 1981, 1989, 1994, 2000, 2005, 2007, 2008, 2012, and

2018 (Paxton et al. 2016, L. Crampton pers. comm. 2018). The Kauaʻi Forest Bird Recovery Project (KFBRP) conducted occupancy surveys for puaiohi in Kokeʻe State Park, Hono O Na Pali Natural Area Reserve, Na Pali Kona Forest Reserve and the Alakaʻi Wilderness Preserve, from 2011 to 2013 (Crampton et al. 2017) and spent over 1,500 person-hours per year from 2015 to 2018 searching for ʻakekeʻe and ʻakikiki nests. Hawaiʻi Forest Bird Surveys in 2012 and 2018, occupancy surveys, and nest searches did not yield any detections of Kauaʻi nukupuʻu. The KFBRP conducted mist netting in various locations within the historical range for Kauaʻi ʻakialoa from 2006 through 2009 and from 2011 through 2018 and no Kauaʻi nukupuʻu were caught or encountered (L. Crampton pers. comm. 2018). (USFWS, 2019).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are insectivores. It is a bark-picker; rarely takes nectar (Pratt et al. 1987). Searches for spiders, caterpillars, and weevils in bark of tree trunks and branches (Berger 1981, Shallenberger 1984). Takes some nectar from understory flowers (Ehrlich et al. 1992) (NatureServe, 2015).

Reproduction Narrative

Adult: Not available.

Geographic or Habitat Restraints or Barriers

Adult: 2,000 - 4,000 ft. elevation (USFWS, 2006)

Spatial Arrangements of the Population

Adult: Inter and intraspecies flocks (NatureServe, 2015)

Habitat Narrative

Adult: Mountain forest, especially ohia and koa (AOU 1983). Possibly formerly more common in the lower elevation koa forests that have been nearly eliminated by cattle ranching (Reynolds et al. 1995). May flock with creepers, Maui parrotbill, and po'ouli (NatureServe, 2015). Historical records from the turn of the last century indicate that the Kaua`i nukupu`u was found in a small area of diverse montane mesic and wet forest at elevations of 610 to 1,220 meters (2,000 to 4,000 feet) on the southwestern slope of Kaua`i Island (Banko 1984b). All subsequent sightings, many of them doubtful, have been from the same habitat (Pratt and Pyle 2000) (USFWS, 2006).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:
Decline of > 90% (NatureServe, 2015)

Species Trends:
Possibly extinct (NatureServe, 2015)

Resiliency:
Very low (inferred from USFWS, 2010; see current range/distribution)

Representation:
Very low (inferred from NatureServe, 2015)

Redundancy:
Very low (inferred from NatureServe, 2015)

Number of Populations:
0 - 1 (NatureServe, 2015)

Population Size:
1 - 50 individuals (NatureServe, 2015)

Adaptability:
Very low (inferred from NatureServe, 2015)

Population Narrative:
This species has experienced a long term decline of > 90%. Total population in 1980 was estimated at 28 (Scott et al. 1986). Historically (late 1800s) scarce to numerous; not seen for a long period until 1967; an adult male was seen in 1994 (Reynolds et al. 1995). Likely extinct, no known extant occurrences. Last verified report in 1988 for Maui and Kauai subspecies. At most, a single population exists (NatureServe, 2015).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Habitat loss and degradation by agriculture, urbanization, cattle grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006). Feral pigs, and goats to a lesser degree, have had a long-term damaging effect upon native forests in the remaining nukupu`u range by consuming and damaging understory vegetation, creating openings on the forest floor for weeds, transporting weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Predation by alien mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by alien mosquitoes have also been primary threats to this species (USFWS 2006) (USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006) (USFWS, 2010).

Stressor: Climate change (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Climate change may also pose a threat to nukupu`u. However, current climate change models do not allow specific predictions as to what those effects, and their extent, would be for this species (USFWS, 2010).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2010).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:

The taxon may be delisted when the downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2010).

Recovery Actions:

- Monitor changes in the distribution and abundance of forest birds, which describes systematic surveys to monitor changes in the distribution and abundance of forest birds, to help evaluate the effects of management actions, and to provide necessary information for developing measures of population stability for future listing actions (USFWS, 2006).
- Public awareness and information, which describes important outreach and information activities (USFWS, 2006).
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2010).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:

- Given the low survey effort for this species and the difficulty of detecting forest birds in remote mountainous habitats in Hawai`i, we recommend the species' biological status be "unknown" instead of "presumed extinct." This determination is based on reexamination of data from the 1994-1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001), Hawaiian Forest Bird Survey data (Scott et al. 1986), and searches for this and other rare species by John Sincock from 1968-1973 (USFWS 1983). The species was confirmed to still exist as recently as 1995, and additional targeted searches are needed to confirm either that the nukupu`u still exists or that it has disappeared and is likely to be extinct (USFWS, 2010).
- As described in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006), one of the most important recovery actions for the nukupu`u is to intensively and systematically search areas of forest habitat where the species occurred historically. Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 2006, pp. 16, 30, 32, 37, and 39) that do not cover all areas where extremely rare Hawaiian forest birds are most likely to persist. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare and/or likely extinct Hawaiian forest birds will be detected or rediscovered. Therefore, we recommend that an intensive search for nukupu`u be conducted on Maui and Kaua`i using similar methodologies as those employed during the 1994-1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001). In addition, we recommend that autonomous recording units, or ARUs (Fitzpatrick 2002), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2010).

- 2019 recommendations for future actions: Captive propagation for reintroduction and genetic storage – There are instances where rare Hawaiian birds have been rediscovered after they were presumed extinct or have been found in larger populations than expected (Reynolds and Snetsinger 2001, p. 142). Should Kauaʻi nukupuʻu be rediscovered we recommend that the Rare Bird Discovery Protocol in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006, pp. 3-17 – 3-21) be followed with regard to decisions of whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ. (USFWS, 2019).

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SPECIES ACCOUNT: *Hemignathus wilsoni (=H. munroi)* (?Akiapola?au (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

A 14-cm-long yellow-green bird with a decurved upper mandible and a straight lower mandible. Adult male is olive-green above, yellow below, with yellow superciliaries and cheeks and black lores; adult female is smaller and of duller color, with only the throat and upper breast yellow; adult males have greater exposed culmen, gonys, wing chord, tail, and tarsus lengths than do females; individuals in forst prebasic molt or older can be identified as to sex by culmen length, that of males being greater than 23.4 mm; upper mandible is long, thin, and decurved, lower mandible is half as long and straight; overall length about 13-14 cm (H. D. Pratt et al. 1987, Hawaii Audubon Society 1993, T. K. Pratt et al. 1994). Juvenal plumage is mottled, replaced by a first basic plumage characterized by yellowish-gray or yellowish-green underparts and often by retained wing bars (Pratt et al. 1994, 2001) (NatureServe, 2015).

Taxonomy

The species was described by Rothschild (1893 to 1900), who named it Heterorhynchus wilsoni. The `akiapola`au was later grouped with the `amakihi and renamed Hemignathus munroi (Pratt 1979, American Ornithologists Union 1983). The `akiapola`au is closely related to the nukupu`u (H. lucidus, Olson and James 1994) (USFWS, 2010). The scientific name of the species was officially listed as Hemignathus wilsoni effective May 17, 2016. (USFWS, 2016).

Historical Range

The `akiapola`au is endemic to Hawai`i island and is presently unknown from the fossil record (James and Olson 1991). The `akiapola`au was much more common and widespread historically than it is today, being found virtually island-wide in native forest (Pratt et al. 2001) (USFWS, 2010).

Current Range

Small, fragmented populations occur at three windward locations (Hamakua, Upper Waiakea kipuka, and Kulani-Keauhou) in montane mesic and wet forest, and one location in montane mesic forest of central Kau District including Kapapala (1340-1700 m) (NatureServe, 2015). The `akiapola`au is recently extirpated from subalpine Mauna Kea and probably the North and South Kona districts (USFWS, 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are insectivores. Uses bill to extract insect larvae from trunks and branches of large trees; partial to koa trees, moves creeperlike over branches (Pratt et al. 1987). This species exhibits a diurnal phenology (NatureServe, 2015). Moth larvae are the most common food item in `akiapola`au fecal samples, followed by spiders and longhorned beetle larvae (Ralph and Fancy 1996). The foraging behavior of `akiapola`au is very specialized compared with that of other forest birds, and foraging sites and food may be limiting. Lichen-covered and dead branches are preferred as foraging substrates. This species rarely takes nectar from flowers, but it recently has been discovered to drink sap from small wells it drills in the bark of `ohi`a trees (USFWS, 2006).

Reproduction Narrative

Adult: May breed throughout much of the year; nesting apparently occurs primarily between January and June; individual birds may nest infrequently (Matthews and Moseley 1990, Banko and Williams 1993, Ralph and Fancy 1994) (NatureServe, 2015). The aspect of `akiapola`au life history most important to conservation is the low intrinsic rate of reproduction, which puts a premium on success of nesting events and on adult survival. Usually only one young is fledged, followed by an extended period (more than 4 to 5 months) of juvenile dependency, so that only a single brood is typically produced per year. Clutch size is either one or, rarely, two eggs (Banko and Williams 1993). The majority of nests have been found in the leafy, terminal branches of tall `ohi`a (Metrosideros polymorpha) trees (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Rarely occurs < 4,500 ft. elevation (USFWS, 2010); 1,340 - 2,700 m elevation (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: Small groups, mixed species flocks (NatureServe, 2015)

Habitat Narrative

Adult: Inhabits native dry, mesic, and wet forests at 1340 - 2700 m, usually 1500 - 2000 m (Pratt et al. 2001). Now inhabits closed Koa/Ohia Montane Mesic forest, where densities are highest (5-10 birds/km2) (Pratt et al. 2001). Observed in old, mixed-species plantations of non-native trees adjacent to Koa/Ohia forest at Piha, Hamakua. On Mauna Loa, a series of lava flows have broken the habitat into a landscape mosaic of seral forests. At the lower elevational limit, habitat includes Ohia and Koa/Ohia montane wet forests, habitat it historically occupied much more extensively in the south Hilo and Puna districts from 500 - 1500 m (Pratt et al. 2001). Koa forest at higher elevations where mosquitoes are absent or occur only seasonally are critical (Fancy et al. 1996). Often in groups of three (family groups?). Commonly joins mixed species flocks (NatureServe, 2015). The highest akiapolaau densities reported are in upper elevation koa (Acacia koa) forest plantations (Pejchar et al. 2005) (USFWS, 2015). Despite the availability of apparently suitable habitat, `akiapola`au are absent from most areas below 4,500 feet (1,350 meters) (USFWS, 2010). Essentially all recent observations of `akiapola`au have been in montane mesic and wet forest dominated by koa and `ohi`a or in subalpine dry forest dominated by mamane and naio (USFWS, 2006).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 2006)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (inferred from USFWS, 2006)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015). Home range size varies from approximately 5 to 40 hectares (12 to 100 acres) (USFWS, 2006).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Hakalau Forest NWR: increasing; Kau: stable; central Hawaii: decreasing (USFWS, 2015)

Number of Populations:

2 (USFWS, 2015)

Population Size:

~1,900 (USFWS, 2015)

Resistance to Disease:

Low (USFWS, 2015)

Population Narrative:

This species has experienced a long term decline of > 90%. Relatively abundant in the late 1800s. Population in the late 1970s to early 1980s was estimated at about 1500, with 900 at Hamakau, 500 at Kau, 50 at Mauna Kea, and 20 at Kona (Scott et al. 1986). Surveys of 1990-1995 yielded an estimated total population of 1163 +/- 54 (90% CI) (Fancy et al. 1996) (NatureServe, 2015). The total population of akiapolaau is approximately 1,900 birds in 2 populations (Gorresen et al. 2009). Density is increasing in Hakalau Forest National Wildlife Refuge (NWR) and stable in upper Kau, but is likely decreasing in central windward Hawaii. The species is extirpated from subalpine Mauna Kea and probably Kona districts (Gorresen et al. 2009). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009) (USFWS, 2015).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:

Consequence:
Narrative: According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. In Hawaii, the threshold temperature for transmission of avian malaria has been estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak P. relictum prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Benning et al. 2002). Benning et al. (2002) used GIS simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by some climate models (e.g., IPCC 2013; ICAP 2010), would result in 100 years in a nearly 100 percent decrease in the land area for akiapolaau where malaria transmission currently is only periodic (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Destruction and degradation of forest habitat from development, logging, and ranching has greatly reduced the range of the `akiapola`au, and has been particularly severe in mesic and dry forest areas. Dry, high-elevation mamane-naio forest habitat on the slopes of Mauna Kea has been severely degraded by decades of browsing by feral goats and sheep. Widespread loss and alteration of forest habitats also has led to fragmentation of the remaining suitable forest. The dispersal behavior of `akiapola`au is poorly known, but habitat fragmentation may isolate the remaining populations, decrease the effective population size, and hinder recolonization of formerly occupied areas (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Most Hawaiian forest birds are susceptible to introduced mosquito-borne diseases, and the `akiapola`au may be limited to its current high-elevation distribution by these diseases (Scott et al. 1986, van Riper et al. 1986, Atkinson et al. 1995). Despite the availability of apparently suitable habitat, `akiapola`au are absent from most areas below 4,500 feet (1,350 meters) as, where mosquitoes are common. Predation of nests and adults by rats, cats, mongoose, and owls is suspected to have a significant impact on many native Hawaiian bird species (Atkinson 1977), but the significance of predation in limiting the `akiapola`au is not clear. Predation, especially on adults, may affect `akiapola`au more than other native birds because the low reproductive rate of this species increases the demographic value of breeding adults (Ralph and Fancy 1996) (USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The `akiapola`au is threatened with extinction because of its small total population size and restricted distribution. These characteristics make the species vulnerable to a variety of natural processes, including reduced reproductive vigor caused by inbreeding depression, loss of

genetic variability and evolutionary potential over time due to random genetic drift, stochastic fluctuations in population size and sex ratio, and natural disasters such as hurricanes and fires (USFWS, 2010).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species, and viable populations exist in Hamakua, Kulani/Kilauea/Keauhou, Ka`u, south Kona, and mamane forest on Mauna Kea (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery area is protected and managed to achieve criteria 1 and 2 above (USFWS, 2010).

4. The threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:
All four of the criteria above have been met for a 30-year period (USFWS, 2010).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories – Continued monitoring of akiapolaau is important to determine species response to management actions and effects of climate change (USFWS, 2015).

- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. We encourage continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).
- Habitat and natural process management and restoration – o Continued habitat management in areas where the species currently exists (USFWS 2006). o Hawaiian forest birds susceptible to avian disease may become extinct following a drastic reduction in disease free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Akiapolaau forage primarily on koa and utilize koa plantations for foraging (Pejchar et al. 2005). Acquisition and management of transmission free high-elevation habitat is crucial to the preservation and restoration of native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, we recommend securing deforested and pasture lands on Hawaii at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for akiapolaau and other Hawaiian forest birds (USFWS, 2015).
- Captive propagation protocol development – Recovery of akiapolaau may be achieved most effectively through in situ management techniques such as habitat management. However, captive propagation technology may need to be developed for akiapolaau in case it is needed to help reestablish wild populations in the future (USFWS, 2015).

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SPECIES ACCOUNT: *Himantopus mexicanus knudseni* (Hawaiian stilt)

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed reclassification as threatened

Physical Description

Hawaiian stilts are slender wading birds, black above (except for the forehead), white below, and with distinctive long, pink legs. Sexes are distinguished by the color of the back feathers (brownish female, black male) as well as by voice, which is lower in females. Downy chicks are well camouflaged, tan with black speckling. Immature birds have a brownish back and white patches on their cheeks (Hawaii Audubon Society 2005, p. 49). The total length of adult Hawaiian stilt is about 16 inches with the mass of males and females averaging 199 ± 13.8 grams (n=42) and 206.2 ± 21.7 g (n=43), respectively (Robinson et al. 1999, p. 16).

Taxonomy

The Hawaiian stilt is part of a superspecies complex of stilts (Family: Himantopus), and is considered a distinct subspecies of the black-necked stilt (Himantopus mexicanus) (USFWS 2011, p. 45).

Current Range

Hawaiian stilt were historically known from all of the major Hawaiian Islands, except Lanai and Kahoolawe (USFWS 2011, p. 46). Hawaiian stilt are now found on all of the main Hawaiian Islands except Kahoolawe. No historical estimate of Hawaiian stilt population size is available, but by the early 1940s, the statewide population was estimated to be between 200 and 1,000 birds (USFWS 2011, p. 46). However, these population estimates did not account for the Hawaiian stilt present on Niihau and are therefore considered underestimates. DOFAW has conducted biannual waterbird surveys since the 1950s. Though Hawaiian stilt census data show high year-to-year variability in the number of stilts observed (USFWS 2011, p. 47), long-term census data indicate that statewide populations have been relatively stable or slightly increasing. Currently, this trend has continued and the statewide Hawaiian stilt population is considered to be stable to increasing with an average of approximately 1,500 birds over the 10 year period of 1998 to 2007 (USFWS 2011, p. 47). Because Hawaiian stilts readily disperse between islands they are considered a homogenous meta-population (USFWS 2011, p. 50).

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Hawaiian stilt are opportunistic feeders. They eat a wide variety of invertebrates and other aquatic organisms available in shallow water and mudflats. Specific organisms taken include water boatmen (Corixidae), beetles (Coleoptera), possibly brine fly (Ephydra riparia) larvae, polychaete worms, small crabs, Mozambique tilapia (Tilapia mossambica), western mosquito fish (Gambusia affinis), and tadpoles (Bufo spp.) (USFWS 2011, p. 59). Ephemeral ponds provide an immediate and short term food supply with the emergence of invertebrates (USFWS 2011, p. 60).

Reproduction Narrative

Adult: Hawaiian stilts prefer to nest on freshly exposed mudflats interspersed with low growing vegetation (USFWS 2011, p. 57). Nesting has also been documented on low relief islands (natural and man-made) in fresh or brackish ponds, man-made floating nest structures, floating wooden platforms, and cleared level areas near foraging habitats. The nest itself is a simple scrape on the ground. They have also been observed using grass stems and rocks for nesting material (Coleman 1981). Hawaiian stilts are territorial with average inter-nest distances varying from 53 to 262 feet and are semi-colonial (USFWS 2011, p. 57). The nesting season normally extends from mid-February through August (Robinson et al. 1999). Peak nesting varies among years and re-nesting can occur after loss of a clutch (Robinson et al. 1999). Hawaiian stilt usually lay three to four eggs that are incubated for approximately 24 days (Coleman 1981; Chang 1990). Chicks are precocial, leaving the nest within 24 hours of hatching. Adults with three-day old chicks have been observed to move 0.3 of a mile from the nest site (Reed and Oring 1993). Young may remain with both parents for several months after hatching (Coleman 1981). Little is known about the lifespan or survivorship of the species, however, several banded wild Hawaiian stilts survived 15 to 17 years (USFWS 2011, p. 59).

Habitat Narrative

Adult: Hawaiian stilts use a variety of aquatic habitats but are limited by water depth and vegetation cover. Hawaiian stilts are known to use ephemeral lakes, anchaline ponds, prawn farm ponds, marshlands and tidal flats. Foraging habitat for Hawaiian stilt is early successional marshland or other aquatic habitat with a water depth less than 9 inches and perennial vegetation that is limited and low-growing. Native low-growing wetland plants associated with stilt nesting areas include water hyssop (Bacopa monnieri), sea purslane (Sesuvium portulacastrum), and the sedges makaloa (Cyperus laevigatus) and kaluha (Bolboschoenus maritimus). They use taro (Colocasia esculenta) ponds in the early stages of planting and do not frequent closed canopy taro patches (USFWS 2011, p. 59). Hawaiian stilt are opportunistic feeders. They eat a wide variety of invertebrates and other aquatic organisms available in shallow water and mudflats. Specific organisms taken include water boatmen (Corixidae), beetles (Coleoptera), possibly brine fly (Ephydra riparia) larvae, polychaete worms, small crabs, Mozambique tilapia (Tilapia mossambica), western mosquito fish (Gambusia affinis), and tadpoles (Bufo spp.) (USFWS 2011, p. 59). Ephemeral ponds provide an immediate and short term food supply with the emergence of invertebrates (USFWS 2011, p. 60).

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Apparently many migrate between Kauai and ephemeral wetland breeding areas on Niihau; general pattern may be of arrival on Niihau after winter rains, departure for Kauai in late summer (unless wetland remain wet) (Telfer, in Engilis and Pratt 1993).; Nonmigrant: Y; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Population Information and Trends

Population Trends:

Stable or slightly increasing

Number of Populations:

6 - 20 (NatureServe, 2015)

Population Size:

1000 - 2500 individuals (NatureServe, 2015)

Population Narrative:

Declined to about 300 in the 1940s. Counts from 1977 to 1983 yielded an average of about 900 individuals per count. Currently, the total population is probably between 1500 and 1800 birds and is relatively stable (though has steadily increased since 1982 on Oahu and Maui, due to active management) (Pratt et al. 1987, Engilis and Pratt 1993, Matthews and Moseley 1990, Morrison et al. 2001). 137 occurrences, 112 current (1981-1996) and 25 historical (1954-1977). Number of distinct populations is far fewer than these numbers indicate. (NatureServe, 2015). No historical estimate of Hawaiian stilt population size is available, but by the early 1940s, the statewide population was estimated to be between 200 and 1,000 birds (USFWS 2011, p. 46). However, these population estimates did not account for the Hawaiian stilt present on Niihau and are therefore considered underestimates. DOFAW has conducted biannual waterbird surveys since the 1950s. Though Hawaiian stilt census data show high year-to-year variability in the number of stilts observed (USFWS 2011, p. 47), long-term census data indicate that statewide populations have been relatively stable or slightly increasing. Currently, this trend has continued and the statewide Hawaiian stilt population is considered to be stable to increasing with an average of approximately 1,500 birds over the 10 year period of 1998 to 2007 (USFWS 2011, p. 47). Because Hawaiian stilts readily disperse between islands they are considered a homogenous meta-population (USFWS 2011, p. 50).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: The Hawaiian stilt was listed as an endangered species on October 13, 1970 (USFWS 1970), pursuant to the Endangered Species Preservation Act of 1966. The original recovery plan was approved in 1978, and revised in 1985. The first draft of the second revision was released on May 1999, followed by the second draft of the second revision in May 2005. A species review has not yet been initiated pursuant to Section 4(c)(2) of the ESA which requires a five-year review after listing. Critical habitat has not been designated for the Hawaiian stilt (USFWS 2011). The threats to, and conservation needs of, Hawaiian waterbirds outlined above in the “Status of the Species” section for the Hawaiian moorhen apply to the Hawaiian stilt. A variety of conservation measures have been implemented to protect Hawaii’s endangered waterbirds. Efforts directly benefitting the Hawaiian stilt include a long-term hunting ban, protection of habitat through establishment and management of Federal and State refuges and sanctuaries, and predator control. Actions that inform conservation of the species include a biannual waterbird survey conducted by DOFAW since the mid-1950s, population monitoring, and research.

Recovery

Conservation Measures and Best Management Practices:

- A variety of conservation measures have been implemented to protect Hawaii's endangered waterbirds. Efforts directly benefitting the Hawaiian stilt include a long-term hunting ban, protection of habitat through establishment and management of Federal and State refuges and sanctuaries, and predator control. Actions that inform conservation of the species include a biannual waterbird survey conducted by DOFAW since the mid-1950s, population monitoring, and research.

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SPECIES ACCOUNT: *Lanius ludovicianus mearnsi* (San Clemente loggerhead shrike)

Species Taxonomic and Listing Information

Listing Status: Endangered; August 11, 1977 (42 FR 40682).

Physical Description

The San Clemente loggerhead shrike (Lanius ludovicianus mearnsi) is a medium-sized (45 to 50 grams [1.56 to 1.76 ounces]) predatory passerine bird found only on San Clemente Island, California. It has a maxillary "tooth" on its bill to enable predation on insects, lizards, and mice. It is slightly color-dimorphic, with vivid black, white, and grey plumage, and prominent black/white patches on wings and tails that are flashed in display flights. Bird measurements average the following: 224 millimeters (mm) (8.8 inches [in.]) in length, 97.6 mm (3.78 in.) in wing length, 100.3 mm (3.95 in.) in tail length, 27.6 mm (1.09 in.) in bill length, and 13.2 mm (0.52 in.) in middle toe length (USFWS 1984; USFWS 2009).

Taxonomy

The San Clemente loggerhead shrike is one of nine recognized subspecies of loggerhead shrike. In 1903, scientists recognized the distinctiveness of the L. l. mearnsi population of loggerhead shrikes and assigned sub specific rank based on smaller body size and a larger bill. This finding was later supported by other scientists, who further differentiated the subspecies as having a shorter wing and tail, and darker plumage. A recent study has incorporated measurements from museum skins and live-trapped shrikes, which reinforce the sub specific ranking and indicate a smaller foot than other shrike subspecies (USFWS 1984). A 2004 study confirmed the genetic distinctiveness of the San Clemente Island subspecies by examining mitochondrial control region sequences and nuclear microsatellites of those shrikes occupying San Clemente Island, Santa Catalina Island, northern Channel Islands, and the nearby mainland. The study concluded that loggerhead shrikes should not be managed as a single taxonomic entity, and Channel Island loggerhead shrikes comprise three distinct genetic clusters which use San Clemente Island, Santa Catalina Island, and the northern Channel Islands/mainland (USFWS 2009).

Historical Range

The San Clemente loggerhead shrike is a nonmigratory island endemic; it historically occupied most of the 14,500 hectares (ha) (35,830 acres [ac.]) on San Clemente Island, one island in the chain of the Channel Islands archipelago, 80 kilometers (49.7 miles) from the California coastline. It has the smallest distribution of any subspecies of shrike, occurring only on San Clemente Island (USFWS 2009). Early accounts imply that San Clemente Island supported a considerable and widely dispersed shrike population. An account from 1897 claimed "...two or three shrikes could be seen in an hour walk," and a decade later others commented on the sizable population. During a 1915 spring collecting excursion, one scientist located three active shrike nests within a few kilometers (couple of miles) of each other, and also suggested the presence of auxiliary breeding shrikes, "...no matter which birds we shot, there always seemed to be other that came to take their place." A marked contrast is offered by the documentation of shrike abundance on the island since the mid-1960s, which describe the species as an uncommon resident, and estimates fewer than 50 individuals (USFWS 1984).

Current Range

The current range of the species is the same as the historic range of the species, because it is only known from San Clemente Island, California. The distribution and population size has fluctuated widely over the last century. A study from 1999 described, during what is now known as the population low, that "62.5 percent of breeding pairs nested in only one major canyon …This represents a decrease in central breeding range of approximately 87 percent (from 7,200 to 960 ha [17,792 to 2,372 ac.])." Since then, shrikes have nested in other areas throughout the island, including the eastern side, western side, and the shore bombardment area, with 12 new territories (never before observed occupied) in 2006 (USFWS 2009). New in 2019: The San Clemente loggerhead shrike is distributed primarily within the southern 2/3 of San Clemente Island along canyons that support canyon woodland and maritime desert scrub vegetation. (USFWS, 2019).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Shrikes are highly efficient, search-type predators. They forage from a variety of elevated perches (1 to 14 meters (m) [3.2 to 46 feet (ft.)] above the ground) and prey on a diversity of food items (USFWS 1984). San Clemente loggerhead shrikes consume available arthropods such as Hymenoptera, Lepidoptera, Homoptera, and Orthoptera, and reptiles such as lizards. Some small mammals such as mice (Mus spp.), and small birds such as wrens (Troglodytidae) and warblers (Parulidae), are also used as prey (USFWS 2009). There is a large American kestrel (Falco sparverius) population on San Clemente Island, and direct interaction between shrikes and kestrels is a common occurrence. Competition between the two seems especially pronounced with regard to perch and food preferences, to the extent that shrike behavior is notably impaired. The degree of niche overlap and the relative competitiveness of the kestrel and shrike have yet to be determined in relation to the decline of the bird (USFWS 1984). Activity rates are moderate, and growth rates are relatively fast; this bird reaches maturity in 1 year (USFWS 2009). The San Clemente Island loggerhead shrike captures prey after a short sally from a perch or aerial chase. It may impale prey on a plant spine or barbed wire, which may facility feeding or storage. Mainland shrikes successfully feed an average of five times per hour during the nonbreeding period, and approximately twice that rate throughout the breeding season (USFWS 1984). These birds are territorial throughout the year (NatureServe 2015).

Reproduction Narrative

Adult: San Clemente loggerhead shrikes are generally seasonally monogamous, but exceptions have been documented (USFWS 2000). Although little is known regarding the reproductive biology of this species, much of information for mainland shrikes is probably applicable (USFWS 1984).Sexual maturity is reached at 1 year of age; pair formation is usually accomplished during January or February, but has been reported as early as November. Shrikes may nest in February, but March and April constitute the prime nesting period. Sexual dimorphism does not occur among loggerhead shrikes, and both sexes participate in nest site selection, nest construction, and care and feeding of young. Whereas incubation among mainland shrikes is apparently performed by females only, both sexes of San Clemente Island loggerhead shrike incubate. The size of individually defended areas varies considerably in relation to the quality of the habitat; the range for breeding territories is 4.5 to 16 ha (11 to 39.5 ac.) (USFWS 1984).Nests had been constructed in ten species of trees and shrubs (mostly cherries or plums [Prunus sp.] and sumac [Rhus sp.]), and on two artificial structures (buildings). Eggs are incubated for 15 to 18 days (USFWS 2009). There is geographic variation in the number of broods raised annually by a pair of loggerhead shrikes. Renesting after a failed first nest appears to be relatively common at all latitudes, particularly for nests that fail early in the nesting season. The species is sometimes double-brooded; pairs with successful first nests may also initiate second nests. Double-broodedness is likely related to latitude, and to weather conditions in a given year. Southern birds may attempt to rear as many as three broods in a year (USFWS 2000). Clutch size is between four and six eggs. Parental care is high; young fledge approximately 2.5 to 3 weeks post-hatch. Adults feed fledglings for another 3 to 4 weeks. Adult shrikes can live up to 11 years (USFWS 2009).

Geographic or Habitat Restraints or Barriers

Adult: Endemic to San Clemente Island, California.

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Narrow/specialist.

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High

Dependency on Other Individuals or Species for Habitat

Adult: Requires an adequate supply of invertebrate and small vertebrate prey (USFWS 1984).

Habitat Narrative

Adult: The San Clemente loggerhead shrike occurs in open country with scattered trees and shrubs on San Clemente Island in the Channel Island archipelago. They commonly disperse throughout the upper mesas during the fall and winter, but apparently use only the island canyons for nesting activities. Current shrike breeding seems confined to a zone from the China Point region (southwestern corner) around to the southeastern Pyramid Point area, northward no further than Burns' or Stone Canyons, approximately midway on the eastern side of the island. This area encompasses roughly one-half of the pre-1920 breeding habitat (USFWS 1984).San Clemente loggerhead shrikes nest in tall shrubs (at least 2.1 m [7 ft.] high) or small trees in open areas in forest or in open country (NatureServe 2015). They require an adequate supply of invertebrate and small vertebrate prey, open foraging areas, a selection of elevated perches, and sufficient roosting and nesting cover (USFWS 1984). In 2006, nests had been constructed in ten species of trees and shrubs (mostly cherry or plum [Prunus spp.] and sumac [Rhus spp.]) (USFWS 2009).As a maritime volcanic island, San Clemente Island had unique maritime sage scrub, coastal salt marsh, and island grassland flora and fauna endemic only to that locale. Much of the original vegetation (diversity, structure, and function) has been lost due to habitat conversion caused largely by grazing. Habitat conversion altered the shrub and tree components where shrikes nest, and dramatically changed the San Clemente Island ecosystem (USFWS 2009).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Low

Immigration/Emigration

Adult: No

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: Because the San Clemente loggerhead shrike is endemic to San Clemente Island, motility and dispersal of the San Clemente loggerhead shrike is confined to an area of 100 to 250 square kilometers (less than about 40 to 100 square miles) (NatureServe 2015). Loggerhead shrikes are nonmigratory, but they occupy both breeding and winter territories tenaciously. The only discernible pattern of movement is associated with the establishment of these separate seasonal territories. The size of individually defended areas varies considerably in relation to the quality of the environment. Breeding territories range between 4.5 and 16 ha (11 and 39.5 ac.) (USFWS 1984).

Additional Life History Information

Adult: Breeding territories range between 4.5 and 16 ha (11 and 39.5 ac.). Loggerhead shrikes occupy both breeding and winter territories tenaciously. The size of individually defended areas varies considerably in relation to the quality of the environment. The only discernible pattern of movement is associated with the establishment of these separate seasonal territories (USFWS 1984).

Population Information and Trends

Population Trends:

Increasing (NatureServe 2015)

Species Trends:

Increasing; short-term trend of greater than 10 percent increase in the past decade, associated with release of captive-bred individuals (NatureServe 2015).

Resiliency:

Moderate

Representation:

Low

Redundancy:

Low

Population Growth Rate:

Greater than 10 percent increase in past decade (NatureServe 2015).

Number of Populations:

One (NatureServe 2015)

Population Size:

Approximately 46 pairs of adults and 100 juveniles (192 to 206 individuals) (USFWS 2009). New in 2019: The aggressive recovery effort implemented by the Navy has contributed to expanded distribution and abundance of shrikes on San Clemente Island, and by the time our last status review was finalized (2009), the San Clemente loggerhead shrike potential breeding population had increased from 14, detected in 1998, to approximately 179 adult shrikes in 2009 (Stahl et. al 2010, p. 20) (Figure 1). However, between 2009 and 2016, the potential breeding population declined approximately 65 percent to 63 adult shrikes (Stahl et. al 2017, p. 20). (USFWS, 2019).

Resistance to Disease:

Moderate; this subspecies is not known to be subject to disease; however, other subspecies of shrike are affected by West Nile Virus, and all captive bred individuals are vaccinated for the disease (USFWS 2009).

Adaptability:

Low

Additional Population-level Information:

The status of the San Clemente loggerhead shrike has greatly improved during the past decade. Although still an extremely small population, the number of individuals has increased from 14 individuals in 1998 to approximately 46 pairs of adults and 100 juveniles in the wild in 2006 to 2009 (192 to 206 individuals). Captive breeding augmentation (a total of 255 captive reared shrikes have been released between 1999 and 2005) of the wild population shows great promise to gradually increase the subspecies number to a stable level (USFWS 2009).

Population Narrative:

The San Clemente loggerhead shrike population is increasing. The status of the San Clemente loggerhead shrike has greatly improved over the past decade. Although still an extremely small population, the number of individuals has increased from 14 individuals in 1998 to approximately 46 pairs of adults and 100 juveniles in the wild in 2006 to 2009 (192 to 206 individuals). Captive breeding augmentation (a total of 255 captive reared shrikes have been released between 1999 and 2005) of the wild population shows great promise to gradually increase the subspecies number to a stable level. Current goals are to maintain 55 to 65 individuals for captive breeding, annually incorporate (through rotation) wild pedigree stock into the flock, and produce sufficient shrikes in captivity to release up to three adult pairs (and broods produced in captivity) and 15 to 25 juveniles (USFWS 2009). This subspecies is not known to be subject to disease; however, other subspecies of shrike are affected by West Nile Virus, and all captive bred individuals are vaccinated for the disease (USFWS 2009).

Threats and Stressors

Stressor: Habitat degradation
Exposure: Nonnative herbivorous or omnivorous species, including domesticated grazing livestock.
Response: Loss and alteration of native vegetation, soil impaction, erosion, and soil chemistry.
Consequence: Altered island ecology, loss of suitable habitat for nesting, population decline.
Narrative: The final listing rule identified habitat degradation by nonnative herbivores as a primary threat to the subspecies; the recovery plan was more specific, and indicated that goats were the primary threat at the time. Starting in 1862, San Clemente Island was used for domestic sheep (Ovis aries), goat (Capra aegagrus hircus), and pig (Sus domesticus) ranching. It was grazed heavily for more than 150 years, causing loss of native ground cover, shrubs, and trees; and contributing to soil compaction, erosion, alteration of soil chemistry, and loss of native habitat. This was the primary threat which caused the listing of the San Clemente loggerhead shrike. Nonnative grazers were eradicated from the island by the early 1990s but only 16 percent of the island is suitable for nesting by San Clemente loggerhead shrikes (USFWS 2009). Sheep, goats, and pigs were eradicated from the island by the early 1990s. Approximately 29,000 goats were removed from San Clemente Island between 1972 and 1991. Cessation of the defoliation of native vegetation and soil compaction caused by human-introduced grazing animals has stopped direct habitat degradation. Although canyon shrub/woodland and maritime desert scrub cholla habitat (including the appropriate nesting substrate) is beginning to recover in many areas affected by overgrazing, nesting habitat on San Clemente Island remains very limited owing to the absence in many areas of trees and shrubs suitable for nesting. At present, only feral cats and rodents remain as invasive vertebrates. Rodents subtly affect habitat components; being omnivores, they will consume plant material. Predator populations and their control are addressed as a part of the Predator Management Program enacted by the Navy (USFWS 2009).

Stressor: Predation by nonnative and natural predators
Exposure: Introduced black rats and feral cats, and natural predators such as native raptors (Buteo sp.) and foxes (Urocyon sp.).
Response: Predation
Consequence: Injury or mortality.
Narrative: Predation by introduced black rats and feral cats, and natural predators, continue to be a threat to the low extant populations of shrike on San Clemente Island, and is considered to be the greatest cause of annual mortality. In 2006, predation was strongly suspected to have resulted in 45 percent of nest failures. With the removal of nonnative grazers in the 1990s, habitat conversion across the San Clemente Island ecosystem (to more suitable shrub and tree nesting habitat) may also correlate with increased exposure to predation risk as the species range expands and there is not only greater cover for shrikes but for predators as well (USFWS 2009).Efforts to negate predation by nonnative vertebrate species have continued, and are treated by the Navy’s Integrated Natural Resource Management Plan (INRMP), which provides

practicable means to reduce and eliminate feral cats, black rats, and other nonnative rodents (USFWS 2009).

Stressor: Inadequacy of existing regulatory mechanisms
Exposure: See narrative.
Response: See narrative.
Consequence: See narrative.
Narrative: Due to San Clemente being a federal installation, few opportunities occur for a state or local government nexus, and California Environmental Quality Act is not mandated. The Endangered Species Act (ESA) is the primary federal law that provides protection for the San Clemente loggerhead shrike. As the federal nexus, the National Environmental Policy Act (NEPA) provides some protection for listed species that may be affected by activities undertaken, authorized, or funded by federal agencies. However, NEPA does not require that adverse impacts be fully mitigated, only that impacts be assessed and the analysis disclosed to the public (USFWS 2009).

Stressor: Military bombing and training
Exposure: Vehicles, military bombing and training, shore bombardment, covert training, grenade and small arms practice, and other support.
Response: Increased risk to disturbance or harm.
Consequence: Injury or mortality.
Narrative: Human activities related to military readiness and training continue on the island, and are managed and directed by the U.S. Navy. Activities such as shore bombardment in the shore bombardment area, covert training, grenade and small arms practice, and other support activities continue in specified training areas on the island to augment military readiness and national security. Shrikes that live in close proximity to training areas are at increased risk to disturbance or harm from training activities. Several shrikes have also been accidentally hit and killed by vehicles during travel on San Clemente Island gravel roads. The U.S. Navy has worked closely with the U.S. Fish and Wildlife to promote protection and population resurgence of the San Clemente Island loggerhead shrike, and through adaptive management regularly alter training activities and flight patterns of helicopters if shrike breeding areas are nearby. Implementation of the U.S. Navy's Loggerhead Shrike Recovery Program has resulted in expanded distribution of the species on the island, with a greater percentage of the population now distant from potential training conflicts. Negative impacts to land and resources have been successfully ameliorated by implementation of the INRMP, and rigorous monitoring which results in changing human management practices (USFWS 2009).

Stressor: Fire from military activities
Exposure: Shore bombardment, fire, and nonnative plants.
Response: Habitat destruction and modification.
Consequence: Mortality and increased risk of extinction.
Narrative: Fire was not considered a severe threat to the subspecies in the listing rule; however, the understanding of fire in maritime island scrub habitat and grasslands has changed since the listing of the subspecies in 1977. Although fire is a natural component for regeneration and maintenance of many habitats, endemic vegetation on San Clemente Island was never fire-dependent, due to maritime-related humidity and adaptations of specific indigenous plants. Shore bombardment can result in uncontrolled fire on San Clemente Island. Additionally, invasive plants have exacerbated fire danger to maritime scrub plant communities by creating micro-

climates that increase the risk of conflagrations during more times of the year. Intense fires can destroy not only surface fuels but also the woody vegetation used for nesting by shrikes. Habitat destruction by loss of native ecosystems, and destruction of the soil and soil seed banks, could make the shrike more vulnerable to extinction. Threats to the habitat from fire may make the shrike even more vulnerable to extinction if uncontrolled fire destroys available nesting habitat (USFWS 2009).

Stressor: Small population size
Exposure: Current population is increasing but small.
Response: Vulnerable to natural catastrophes and stochastic events such as floods, fires, or drought; and to inbreeding depression and genetic drift.
Consequence: Increased likelihood of extinction, and dependency on captive breeding and population augmentation.
Narrative: The current population of San Clemente Island shrikes is increasing, but small. Small populations are more vulnerable to natural catastrophes and stochastic events that can substantially reduce or eliminate small populations and increase the likelihood of extinction. Additionally, genetic effects may further influence population demography via inbreeding depression and genetic drift. Small population size makes it difficult for the San Clemente loggerhead shrike to persist without captive breeding and population augmentation (USFWS 2009).

Stressor: Drought
Exposure: Drought
Response: May impact habitat and predatory/prey relationship.
Consequence: May impact the shrike population, and cause mortality and population decline.
Narrative: Few studies have assessed the biological impact of summer or seasonal droughts on predator and prey dynamics. Periodic and successive droughts are an underestimated ecological stress and selection factor, depending on species-specific ability to withstand these effects. The current extended drought in southern California may have effects on shrike demography, including impacts to habitat and available prey. Drought on San Clemente Island has not been studied specifically in relation to the shrike or its prey, but has been addressed as having deleterious impacts for the San Clemente sage sparrow (USFWS 2009).

Stressor: Climate change
Exposure: Current climate.
Response: Expediting alterations of the naturalized condition in which the species have evolved, potential for favorable conditions for invasive species to out-compete the endemics, and increased fire risk.
Consequence: Unknown
Narrative: In an ecological context, current models and scientific thought suggest that southern California likely will be adversely affected by global climate change through prolonged seasonal droughts, and rainfall coming at unusual periods and in unusual amounts. Effects related to climate change are not now known to be directly causing impacts on site-specific adaptations of species and endemic terrestrial biodiversity on San Clemente Island due to a lack of island-specific climate change related research, but are being experienced in other locations where they are studied (USFWS 2009).Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying. Predictions of climatic conditions for smaller sub-regions

such as California and the Channel Islands remain uncertain. It is unknown at this time if climate change in California will result in warmer trend with localized drying, higher precipitation events, and more frequent El Niño or La Niña events. Although climate change is an important issue with potential effects to listed species and their habitat, adequate information to make predictions regarding its effects to the San Clemente Island loggerhead shrike is lacking (USFWS 2009).

Recovery

Reclassification Criteria:
Downlisting Recovery Criteria, Factor A.1: Habitat loss from invasive herbivores is effectively managed and curtailed to no longer impact habitat for the shrike. (USFWS, 2019).

Factor A.2: Impacts to the habitat from erosion, fire, and land use have been effectively reduced or managed. Fire management is updated in accordance with changes in shrike habitat, vegetation, and ignition sources. (USFWS, 2019).

Factor A.3.: Impacts from invasive plants are reduced or managed as necessary to levels that do not pose a threat to the persistence of the San Clemente loggerhead shrike. A San Clemente Island Biosecurity Instruction has been implemented to decrease likelihood of new invasive plant or animal species from establishing on the island. (USFWS, 2019).

Factor A.4.: Successful nesting has occurred in a minimum of 65 breeding territories each year for 7 sequential years. (USFWS, 2019).

Factor A.5.: At least 60 percent of the potential breeding population is distributed outside of the Shore Bombardment Area (SHOBA). (USFWS, 2019).

Factor C.1.: Impacts from nonnative predators (such as black rats and cats) have been reduced or managed to levels that do not pose a threat to the persistence of the San Clemente loggerhead shrike. (USFWS, 2019).

Factor E.1: The annual potential breeding population in the wild remains above 165 individuals for 7 years. (USFWS, 2019).

Factor E.2: A rangewide monitoring program is in place to determine long-term trends in the nesting population, specifically, nest success, breeding distribution, and annual potential breeding population (total). (USFWS, 2019).

Factor E.3 A population model is completed that: a) outlines the population size and productivity recommended for discontinuing captive breeding and reintroduction efforts, and b) develops recommended metrics for the San Clemente Island loggerhead shrike population size and demographics that reflect population stability in the absence of captive breeding. (USFWS, 2019).

Delisting Criteria:
Delisting Criteria were added in 2019. Delisting Recovery Criteria, Factor A.6.: Enough suitable habitat is protected and managed as specified in a shrike management plan (described below)

to sustain at least 65 breeding territories with successful nesting over 14 sequential years. (USFWS, 2019).

Factor A.7: Future training needs are addressed in an updated operational management plan such that training expansion does not pose a threat to the persistence of San Clemente Island loggerhead shrike. (USFWS, 2019).

Factor E.4: A minimum potential breeding population of 165 individuals is maintained and demonstrates a stable or increasing trends without augmentation from captive rearing or supplemental food for 14 years. (USFWS, 2019).

Factor E.5: A management plan is implemented for the San Clemente Loggerhead Shrike Management Plan to ensure long-term management and support sustainability of the shrike population. The Management Plan will include habitat protection, population monitoring, predator management, biosecurity management, genetic rescue scenarios, and ongoing management of fire, erosion, and land use activities that prioritize protection of the canyon woodlands and east side scrub. (USFWS, 2019).

Recovery Actions:

- Habitat Restoration. To restore habitat to provide a more suitable environment for these E/T species, revegetation, control of erosion, and removal of exotic species will be necessary (USFWS 1984).
- Eliminate selected nonnative species. The removal of various animal pest species on all these islands will clearly be beneficial to native species. These pest species have adversely modified the island ecosystems and have directly and/or indirectly competed with the native flora and fauna (USFWS 1984).
- Habitat Protection. Survival and eventual recovery of these species is dependent on adequate protection of their habitat. Regardless of other management action to conserve these E/T species, if habitat is not properly managed, recovery will not be possible (USFWS 1984).
- Develop delisting criteria (i.e., the size of population and amount of suitable habitat necessary before reclassification can be considered). Before consideration can be given for reclassifying a species (either upgrading to threatened status or delisting), it is necessary to determine the number of organisms, the size of the secure habitat, or the number of such populations/habitats required to support viable self-sustaining populations. To obtain this information and to properly manage these taxa, additional research studies are necessary.
- Evaluate success of management actions. All E/T taxa must be monitored throughout the course of the recovery program to assess its success, and to determine whether additional actions or modifications of activities are necessary (USFWS 1984).
- Increase public support. Public support for the conservation of these E/T species can be enhanced by increasing the public's awareness of the sensitivity and uniqueness of the island's ecosystems (USFWS 1984).
- Use existing laws and regulations protecting E/T species. All federal and state laws pertaining to the protection and conservation of E/T species should be used to further the recovery effort (USFWS 1984).
- Eliminate cats, black rats, and other nonnative rodents from San Clemente Island (USFWS 2009).

- Summarize and publish extant shrike resurgence data and information, vegetation restoration results, and management-related information in peer-reviewed journals to aid similar island passerine recovery efforts, and to allow comment and modification, if appropriate, of current methodology (USFWS 2009).
- Consider developing and providing for peer review a) a recovery plan using recent published and unpublished empirical data; and b) criteria for reclassification under the ESA (USFWS 2009).
- Increase emphasis on vegetation restoration to support expansion of the shrike population throughout San Clemente Island (USFWS 2009).
- Continue emphasis in population augmentation and restoration for the San Clemente loggerhead shrike (USFWS 2009).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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SPECIES ACCOUNT: *Laterallus jamaicensis ssp. jamaicensis* (Eastern Black Rail)

Species Taxonomic and Listing Information **Listing**

Status: Threatened

Physical Description

The black rail is the smallest rail in North America. Males and females are similar in size, and adults are generally pale to blackish gray, with a small blackish bill and bright red eyes. The eastern black rail is larger (mean mass=35 grams) but has less brightly colored plumage than the California black rail (mean mass = 29 grams) (Eddleman et al. 1994, unpaginated). (USFWS, 2018b) Adults range from 10-15 centimeters (cm) in total length and have a wingspan of 22-28 cm (Eddleman et al. 1994, unpaginated). The underparts from chin to abdomen are uniformly colored but are lighter on the chin and throat. The nape and upper back are chestnut and the remaining back, uppertail feathers, and remiges (wing flight feathers) are dark gray to blackish with small white spots and sometimes washed with chestnut-brown. The lower abdomen, undertail feathers and flanks are blackish streaked with narrow white and dark gray barring, washed with chestnut. Overall, males are darker and have pale to medium gray throats, while females are lighter and have pale gray to white throats (Davidson 1992a, p. 120; Eddleman et al. 1994, unpaginated). The tarsi (lower legs) and toes are a brownish gray or gray- to blackish-brown (Meanley and Stewart 1960, p. 83; Weske 1969, p. 39). Juvenile black rails are similar in appearance to adults, but have duller plumage and fewer and smaller white spots (Bent 1926, p. 329; Eddleman et al. 1994, unpaginated). The white streaking on the flanks is also usually thinner and less apparent. The eyes of juveniles get lighter with age and change from greenish olive or olive green at 4-6 weeks, to amber to hazel at 8 weeks, followed by a rufous, burnt or chrome orange, and lastly, red by about 3 months of age with the pupil remaining black; (Flores and Eddleman 1991 in Eddleman et al. 1994, unpaginated). Black rail chicks are covered in black down with an oily greenish sheen and have dark-gray or dark brownish olive eyes upon hatching (Bent 1926, p. 329; Eddleman et al. 1994, unpaginated). Chicks are only distinguishable from chicks of other rail species by their smaller size and slightly different bill coloration (Eddleman et al. 1994, unpaginated; Hand 2017, pers. comm.). Black rail chick bills are sepia in color and have a 2-5 millimeter (mm)-wide pinkish spot around the nostril (Eddleman et al. 1994, unpaginated). Eggs are smooth and buffy white to pinkish white with evenly distributed, fine, brownish or pale drab spots (Bent 1926, p. 329). The mean dimensions of 157 eastern black rail eggs were 25.99 mm in length (range = 24.43–28.10 mm) and 19.78 mm in breadth (range = 18.86–20.38 mm; Eddleman et al. 1994, unpaginated). (USFWS, 2018a)

Taxonomy

Class: Aves, Order: Gruiformes, Family: Rallidae, Species: Laterallus jamaicensis, Subspecies: Laterallus jamaicensis jamaicensis. (USFWS, 2018a) The eastern black rail is one of four recognized subspecies of black rail. The California black rail (Laterallus jamaicensis coturniculus) is the only other subspecies that occurs in North America; its range does not overlap with the eastern black rail Taylor and van Perlo 1998, p. 221; Clements et al. 2016, unpaginated). The Birds of North America and Avibase both currently recognize the eastern black rail as a valid subspecies (Eddleman et al. 1994, unpaginated; Avibase 2003, unpaginated). (USFWS, 2018b).

Also known as: Least water-hen, little black rail, little red-eyed crake, black crake. (USFWS, 2018a).

Historical Range

Historically, the eastern black rail ranged across the eastern, central, and southern United States; historical records also exist from the Caribbean and Central America. It occupied multiple areas of wetlands (including salt marshes, coastal prairies, and hay fields) throughout the range; approximately 90 percent of documented breeding-season occurrence records occurred at coastal locations and less than 10 percent were inland records, with more than 60 percent of the inland records occurring before 1950 (Watts 2016, entire). The eastern black rail also occupied multiple areas of wetlands within each analysis unit. Within the northeastern United States, historical (1836–2010) records document the eastern black rail as present during breeding months from Virginia to Massachusetts, with 70 percent of historical observations (773 records) in Maryland, Delaware, and New Jersey (Watts 2016, p. 22). Maryland, Delaware, and New Jersey are considered historical strongholds for eastern black rail in this region of the United States (the Northeast) as well as across the subspecies' entire breeding range (Watts 2016, p. 22), due to the total number and frequency of observations reported over time. Virginia, New York, and Connecticut account for an additional 21 percent of the historical records (235 records) from the Northeast (Watts 2016, p. 22). Recent (2011–2016) records from the Northeast are low in number (64 records), with almost all records restricted to outer coastal habitats (Watts 2016, pp. 22, 24). Birds previously detected in the Appalachians analysis unit were found in small depressional wetlands within active pastures; other freshwater wetlands dominated by cattails, rushes, or sedges; and drainage ditches (Watts 2016, pp. 48, 74). While these wetland types still exist within the analysis unit and may support individuals or a very low-density, scattered population (Watts 2016, pp. 48, 74), a substantial amount of this kind of habitat has been lost primarily due to the draining of freshwater wetlands for agricultural purposes. Historically, the eastern black rail was also present during breeding months at inland and coastal locations throughout southeastern coastal States (the Southeast), a region that included North Carolina, South Carolina, Georgia, Florida, Tennessee, Mississippi, Alabama, Louisiana, and Texas (Watts 2016, pp. 75–76). Of these States, Texas, Florida, South Carolina, and North Carolina contained 89 percent of all historical observations (734 records) (Watts 2016, p. 77). The other States (Georgia, Tennessee, Mississippi, Alabama, and Louisiana) either do not have a history of supporting eastern black rails consistently or are considered to be on the peripheries of known breeding areas (Watts 2016, p. 77). (USFWS, 2018b)

Current Range

Occurs in salt, brackish, and freshwater wetlands in the eastern United States (east of the Rocky Mountains), Mexico, Central America, and the Caribbean. (SSA) 90% of population is along Atlantic and Gulf coasts. The distribution of the recent records points toward a substantial southward contraction in the subspecies' range of approximately 450 kilometers (280 miles), with vacated historical sites from 33 counties extending from the Newbury marshes in Massachusetts to Ocean County, New Jersey (Watts 2016, pp. 24, 119). Further, the distribution of the recent records has become patchy along the Atlantic coast, and an evaluation of the records within the 15 counties still currently occupied suggests an almost full collapse of the eastern black rail population in the Northeast (Watts 2016, p. 24). In the Chesapeake Bay region, the distribution of eastern black rail has contracted, and the counts of birds have declined. A series of systematic surveys for eastern black rails has been conducted around the Chesapeake Bay since the early 1990s (Watts 2016, pp. 59, 67). Surveys estimated 140 individuals in the 1990–1992 survey period, decreasing to 24 individuals in 2007, and only 8 individuals in 2014, a decline of over 90 percent in less than 25 years (Watts 2016, p. 59; D. Brinker, unpublished data). Of 328 points surveyed in Virginia in 2007, 15 birds were detected; a second round of surveys in 2014 yielded two detections at 135 survey points (including all survey points with positive occurrences in the 2007 survey effort), equating to an 85 percent decline over 7 years (Watts 2016, pp. 67, 71; Wilson et al. 2015, p. 3). Recently, there have been 108 records of eastern black rails during the breeding season, and at a coarse view, the same four southeastern States that substantially supported the subspecies historically still support the subspecies (Watts 2016, pp. 77, 79). However, North Carolina shows a severe decline in the number of occupied sites, with only four properties occupied in 2014– 2015, down from nine in 1992–1993 (Watts 2016, p. 80). Additional surveys in 2017 yielded no new occupied sites in coastal North Carolina (B. Watts and F. Smith 2017, unpublished data). South Carolina shows a limited distribution, with two known occupied areas (Wiest 2018, pers. comm.) and an estimated 50 to 100 breeding pairs, leaving Texas and Florida as the current strongholds for the Southeast. At the time of the 2016 coastal assessment, it was surmised that coastal Georgia may support a breeding population of unknown size (Watts 2016, pp. 93–95); however, a coastwide survey in 2017 at 409 survey points in Georgia yielded no detections of eastern black rails (B. Watts and F. Smith 2017, unpublished data). In short, across the Atlantic and Gulf Coasts, recent observations show poor presence inland and a widespread reduction in the number of sites used across coastal habitats (Watts 2016, p. 79). (USFWS, 2018b) Maps depicting the species range are available in the SSA. (USFWS, 2018a).

Critical Habitat Designated

Yes;

Life History

Food/Nutrient Resources

Food Source

Adult: Small (<1 centimeter (cm) (0.39 inches (in))) aquatic and terrestrial invertebrates, especially insects, and seeds (e.g., Typha, Scirpus, Spartina spp.) (USFWS, 2018b).

Food/Nutrient Narrative

Adult: Eastern black rails forage on a variety of small (<1 centimeter (cm) (0.39 inches (in))) aquatic and terrestrial invertebrates, especially insects, and seeds (e.g., Typha, Scirpus, Spartina spp.) by gleaning or pecking at individual items (Eddleman, Flores, and Legare 1994, unpaginated; Ehrlich, Dobkin, and Wheye 1988, p. 102). (USFWS, 2018b) High primary production in wetland ecosystems, especially in tidal marshes, provides an abundance of food resources (Greenberg 2006, p. 3). Eastern black rails forage on a variety of small (<1 cm) aquatic and terrestrial invertebrates, especially insects, and seeds (e.g., Typha, Scirpus, Spartina spp.) by gleaning or pecking at individual items (Table 2-2) (Ehrlich et al. 1988, p. 102; Eddleman et al. 1994, unpaginated). The stomach contents of an eastern black rail in Maryland contained larval and adult aquatic beetles (3 genera of Hydrophilidae [water scavenger beetles]) and a Curculionidae species (true weevils; Spangler 1959 in Davidson 1992a, p. 122). The stomachs of two birds taken in Florida in June and December and one bird from New Jersey in May contained 98-100% animal matter that was mostly insects (Weske 1969, p. 34). Black rails are probably opportunistic foragers and changes in diet in winter are likely related to lower invertebrate availability and greater energy provided by seeds (Flores and Eddleman 1991, p. 36). (USFWS, 2018a)

Reproductive Strategy

Adult: Oviparity (USFWS, 2018b)

Lifespan

Adult: Unknown at this time (USFWS, 2018b)

Breeding Season

Egg: Eastern black rail egg-laying and incubation primarily occur from May to August with some early nesting in March and April (Watts 2016, p. 10-11; Moore and Wilson 2018, unpublished data). (USFWS, 2018)

Adult: March - September (USFWS, 2018b)

Other Reproductive Information

Adult: Eastern black rail egg laying and incubation primarily occur from May to August, with some early nesting in March and April (Watts 2016, pp. 10–11; A. Moore and J. Wilson 2018, unpublished data). The chick stage occurs from May through September. The juvenile stage begins when a chick has fledged and is independent from the parents. Eastern black rails reach the sexually mature adult life stage the spring after hatch year. Adults undergo a complete postbreeding molt each year between July and September on the breeding grounds (Pyle 2008, p. 477; Hand 2017b, p. 15). During that time, individuals simultaneously lose all of their wing flight feathers and tail flight feathers, and are unable to fly for approximately 3 weeks (Flores and Eddleman 1991, pp. iii, 62-63; Eddleman, Flores, and Legare 1994, unpaginated). (USFWS, 2018b) Adults are considered monogamous (USFWS, 2018a)

Habitat Type

Egg: Eggs are laid in a bowl constructed of live and dead fine-stemmed emergent grasses, rushes, or other herbaceous plant species, often with a canopy and a ramp (Harlow 1913, p. 269; Davidson 1992a, p. 121; Flores and Eddleman 1993, p. 84). Black rail nests are typically well hidden in a dense clump of vegetation over moist soil or shallow water (Harlow 1913, p. 269; Flores and Eddleman 1993, pp. 83-84). In Florida, 17 nests were built over mud or moist soil, mean nest height above the substrate was 6.0 cm (SD = 2.3 cm), and mean bowl diameter was 6.8 cm (SD = 1.1 cm; Legare and Eddleman 2001, p. 173). (USFWS, 2018)

Adult: Terrestrial (USFWS, 2018b)

Habitat Vegetation or Surface Water Classification

Adult: Salt, brackish and freshwater marshes that are tidally or non-tidally influenced. (USFWS, 2018b)

Geographic or Habitat Restraints or Barriers

Adult: Woody vegetation (USFWS, 2018b)

Habitat Narrative

Adult: Eastern black rails occupy relatively high elevations along heavily vegetated wetland gradients, with soils moist or flooded to a shallow depth (Eddleman et al. 1988, p. 463; Nadeau and Conway 2015, p. 292). Occupied habitats are reflective of the subspecies' movement habits. Eastern black rails fly little during the breeding and wintering seasons, and will typically flush only for a short distance when pursued (Bent 1926, pp. 329-330). Instead, the birds will remain on the ground, running quickly through dense vegetation likely using the runways of rodents and rabbits (e.g., Microtus spp.) (Armistead 2001, p. 247; Taylor and van Perlo 1998, p. 223), and are considered secretive because of this behavior. Because black rails require dense vegetative cover that allows movement underneath the canopy, and because birds are found in a variety of salt, brackish, and freshwater marsh habitats that can be tidally or non-tidally influenced, plant structure is considered more important than plant species composition in predicting habitat suitability (Flores and Eddleman 1995, pp. 357, 362). Occupied habitat tends to be primarily composed of fine-stemmed emergent plants (rushes, grasses, and sedges) with high stem densities and dense canopy cover (Flores and Eddleman 1995, p. 362; Legare and Eddleman 2001, pp. 173-174). Vegetation height is generally ≤1 meter (m) in coastal habitats, but taller in occupied cattail and bulrush marshes (Davidson 1992a, pp. 120, 126-127; Legare and Eddleman 2001, p. 170; Culver and Lemly 2013, pp. 316-318). However, when shrub densities become too high, the habitat becomes less suitable for eastern black rails. Soils are moist to saturated (occasionally dry) and interspersed with or adjacent to very shallow water (1-6 cm; Table 2-2) (Legare and Eddleman 2001, pp. 173, 175). As stated previously, eggs need a nest bowl constructed of live and dead fine-stemmed emergent, herbaceous plants (Harlow 1913, p. 269; Davidson 1992a, p. 121; Flores and Eddleman 1993, p. 84). Nests must be well hidden in a dense clump of vegetation over moist soil or shallow water to provide shelter from the elements and protection from predators (Table 2-2) (Harlow 1913, p. 269; Flores and Eddleman 1993, pp. 83-84). Flooding is a frequent cause of nest failure for eastern black rails; therefore, water levels must be lower than nests during egg-laying and incubation in order for nests to be successful (Legare and Eddleman 2001, p. 175). Mean nest height data from Florida for 17 nests was 6.0 cm; SD = 2.3 cm (Legare and Eddleman 2001, p. 173). In addition, if water depth exceeds ~2.5 cm chicks would have to swim during brood rearing and risk their down becoming waterlogged. Therefore, shallow pools that are 1-3 cm deep may be the most optimal for foraging and for chick-rearing (Hand 2017, pers. comm.). Despite this narrow requirement, some elevational variability in the substrate is required. The birds require elevated refugia with dense cover to survive high water events due to the propensity of juvenile and adult black rails to walk and run rather than fly and chicks' inability to fly. During extreme flooding events black rails may also face increased predation when birds are forced from their usual dense cover (Evens and Page 1986, entire). (USFWS, 2018a)

Dispersal/Migration

Population Information and Trends

Resiliency:

Three Analysis Units were analyzed: Great Plains, Southwest Coastal Plain, and Southeast Coastal Plain. Model selection and parameter estimates varied by AU. See App. Tables B1-B3 in Appendix B for candidate models, model ranking, and parameter estimates for the three modelled AUs. One of the parameters estimated from the dynamic occupancy model was detection probability. Since the eastern black rail is a small, cryptic marsh bird, estimating the probability of detecting the bird if it is present was important. Model results indicated that detection probability in the Southwest Coastal Plain AU and the Great Plains AU was ~0.25, meaning that when eastern black rails are present at a site, there is a 25% probability of detecting them. In the Southeast Coastal Plain AU, there was support for a year-specific detection probability and detection ranged from 0.09 to 0.53, meaning that when birds were present at a site, they were detected between 9% and 53% of the time, depending on the year. The detection probabilities calculated from our dynamic occupancy models were similar to the detection probabilities estimated for other marsh bird species, including a study of eastern black rails in Florida that calculated a 20% to 50% detection probability (Table 4-5; Legare et al. 1999, p. 119). All other model parameters (i.e., occupancy, colonization, persistence, and extinction probabilities) accounted for the detectability of the eastern black rail. The Great Plains, Southwest Coastal Plain, and Southeast Coastal Plain AUs have low resiliency based on the occupancy model results. The results indicated very low occupancy probabilities in each modelled AU; 0.25 in the Southwest Coastal Plain, 0.13 in the Great Plains, and 0.099 in the Southeast Coastal Plain. The estimates appeared to be well estimated since the standard error estimates for most parameters were less than the estimated mean (i.e., the coefficient of variations are less than 1.0). The results also indicated fairly high site extinction probabilities with accompanying low site persistence; 0.31 extinction probability in the Great Plains and 0.61 in the Southwest Coastal Plain. In the Southeast Coastal Plain, there was evidence of year specific extinction, with 2016 being as low as 0.001 and 2014 being as high as 0.57. There was little or no support for any of the models with precipitation or temperature covariates in the Great Plains or the Southeast Coastal Plain. In the Great Plains, there was weak evidence that wet season precipitation influences occupancy dynamics, and in the Southeast Coastal Plain, there was even less support that fire ants influence seasonal occupancy. There was stronger evidence in the Southwest Coastal Plain that temperature played a role in determining eastern black rail occupancy; however, for all three AUs, a null model (a model with no covariates) or a simple, year specific model was the best model or equally as good. For the Southeast Coastal Plain model, we analyzed data from Florida separately from the South Carolina dataset because there were fewer years (only two) to analyze, much smaller sample sizes, and the years of the surveys did not match up entirely with the South Carolina data. Occupancy probability was higher in Florida (0.17, SE 0.065) (SE = standard error). To combine these estimates with the results from South Carolina, we calculated a weighted average of the estimates from the two states, weighting the average by the sample size in each dataset. The Mid-Atlantic Coastal Plain AU also currently exhibits very low resiliency for eastern black rail. As mentioned in Section 4.2.1, we did not have replicated survey data during the necessary multi-year timeframe to run a dynamic occupancy analysis for the Mid-Atlantic Coastal Plain. Therefore, we used the results from the Southeast Coastal Plain AU, as well as historical and current occurrence information for the Mid-Atlantic (Section 2.5), to infer the current resiliency of the Mid-Atlantic Coastal Plain AU. Based on recent survey data, the Mid-Atlantic is considered to support fewer eastern black rails and occupied habitat patches than the Southeast. The Mid-Atlantic was once considered the stronghold for the eastern black rail not only in the northeast United States, but for the subspecies' entire breeding range (Watts 2016, p. 22). The highest count ever made for eastern black rail in a single night was over 100 calling birds on June 2, 1954 on the Eastern Shore of Maryland (Stewart and Robbins 1958 in Watts 2016, p. 60). As described in Section 2.5.1.2, survey detections have declined across the state by over 90% since the early 1990s; during Maryland DNR surveys from 1990-1992, 140 individuals were detected, followed by 24 individuals in 2007, and only 8 individuals in 2014 (Brinker 2014, unpublished data in Watts 2016, p. 64). This declining trend is not exclusive to the tidal marshes of Maryland. Overall, eastern black rail has experienced a steep decline over the past century in states within the Mid-

Atlantic AU, with an estimated 95-170 breeding pairs remaining (Watts 2016, p. 19). Current estimates of breeding pairs for each state in the Mid-Atlantic AU are: 40-60 pairs in New Jersey and North Carolina, 15-30 pairs in Maryland, 0-10 pairs in Delaware and Virginia, and 0 pairs in the District of Columbia (Watts 2016, p. 19). The uncertainty surrounding these estimates varies from low to moderate; there is moderate uncertainty for states with more extensive marshes that preclude full survey coverage (e.g., New Jersey, Maryland; Watts 2016, pp. 19, 54, 64). Because the Mid-Atlantic AU currently supports substantially fewer birds than the region once did by orders of magnitude, and because it supports fewer birds than the Southeast AU, which is characterized by low resiliency, we conclude that the Mid-Atlantic AU has even lower resiliency than the Southeast AU. The remaining three AUs, New England, Appalachians, and Central Lowlands, currently demonstrate no resiliency. There were insufficient detections to model these units and recent detections (2011 to present) were fewer than 20 records for each AU. While these three units historically did not support abundances of eastern black rail as high as the other four AUs, an evaluation of current status information yields that eastern black rails are effectively extirpated from portions of the New England, Appalachians, and Central Lowlands AUs that were once occupied. In New England, the subspecies' historical breeding range presumably extended from the Newbury marshes in Massachusetts south along the Atlantic coast (Watts 2016, p. 16). Current survey data suggests that the eastern black rail has experienced a complete range contraction from the historical northern range limit in Massachusetts, approximately 450 km south to Ocean County, New Jersey (Watts 2016, p. 18), and has been effectively extirpated from the New England AU. In 2015, the State of Connecticut concluded that the black rail was extirpated from the State and removed the species from the State's endangered species list (Section 3.10.4; Connecticut Department of Energy and Environmental Protection 2015a, p. 1; Connecticut Department of Energy and Environmental Protection 2015b, pp. 1-24; Huang 2017, pers. comm.). While the Appalachians and Central Lowlands AUs support less habitat for eastern black rails compared to the more coastal AUs, interior occurrences were more common historically (Figure 2-6). Current population estimates for States with a large area occurring within the boundaries of the Appalachians AU are effectively zero (Watts 2016, p. 19). An estimated 0-5 breeding pairs currently occur in Pennsylvania and no breeding pairs are thought to occur in New York or West Virginia (Watts 2016, p. 19). Birds previously detected in the Appalachians AU were found in small depressional wetlands within active pastures, other freshwater wetlands dominated by cattails, rushes or sedges, and in drainage ditches (Watts 2016, pp. 48, 74). While these wetland types still exist within the AU and may support individuals or a very low-density, scattered population (Watts 2016, p. 48, 74), a substantial amount of habitat has been lost primarily due to the draining of freshwater wetlands for agricultural purposes. Because breeding pair estimates are effectively zero in three states and this likely holds true for the interior portions of the other states within the Appalachians AU (based on few current detections), we conclude that the Appalachians AU for the eastern black rail has no resiliency. Similar losses of habitat have occurred in the Central Lowlands AU and there are currently few detections of eastern black rails across the AU (Figure 2-6). Moreover, the current detections are not consistent from year to year even when habitat appears to remain suitable. Indiana DNR surveys for eastern black rails at multiple sites from 2010-2016 yielded one detection at a single site known to support black rails previously (Gillet 2017, unpublished data). In 2006, only three birds had been reported in Indiana for the past 20 years (Brock 2006, unpaginated). In summary, eastern black rail AUs have low to no resiliency in the contiguous United States. We have low confidence that eastern black rails maintain sufficient presence in the New England, Appalachians, and Central Lowlands AUs due to recent low numbers of detections and documented extirpations from previously occupied areas. In addition, the Great Plains, Southwest Coastal Plain, and Southeast Coastal Plain AUs have low resiliency due to low occupancy probabilities, while the Mid-Atlantic AU has even lower resiliency and is less viable than the Great Plains, Southwest Coastal Plain, and Southeast AUs. Lastly, resiliency for the international portion of the eastern black rail's range is more uncertain than the contiguous United States; the sparsity of historical and current records, including nest records, suggests that resiliency outside of the contiguous United States is likely low. In the current condition, three AUs (New England, Appalachians, and Central Lowlands) have no resiliency, and are considered effectively extirpated due to very few recent occurrences throughout these AUs. The Great Plains, Southwest Coastal Plain, and Southeast Coastal Plain AUs were determined to have low resiliency and the Mid-Atlantic AU had even lower resiliency. For future condition, we predicted the proportion of sites occupied in the future based on the current number of sites occupied and used our model to explore what rates of habitat loss might lead to viability of the eastern black rail. In terms of resiliency, the four remaining AUs (Mid-Atlantic Coastal Plain, Great Plains, Southwest Coastal Plain, and Southeast Coastal Plain) have a high probability of extirpation (extinction) under all scenarios by 2100. The scenarios yielded similar results across the Mid-Atlantic Coastal Plain, Great Plains, Southwest Coastal Plain, and Southeast Coastal Plain AUs with some variation in the time to extinction. However, the difference in the time to extinction among the five plausible scenarios was no greater than 10 years for each AU (Table 5-3). In addition, all AUs generally exhibited a consistent downward trend in the proportion of sites remaining occupied after the first ~25 years for all scenarios. Given that most of the predicted declines in eastern black rail occupancy were driven by habitat loss rates, and future projections of habitat loss are expected to continue and be exacerbated by sea level rise or groundwater loss, resiliency of the four remaining AUs is expected to decline further. We expect all eastern black rail AUs to have no resiliency by 2068, as all are likely to be extirpated by that time. We have no reason to expect the resiliency of eastern black rail outside the contiguous United States to improve in such a manner that will substantially contribute to eastern black rail viability within the contiguous United States portion of the range. Limited historical and current data, including nest records, indicates that resiliency outside of the contiguous United States will continue to be low into the future, or decline if habitat loss or other risk factors continue. (USFWS, 2018a).

Representation:

Historically, the eastern black rail had a wide distribution and exhibited latitudinal variability of analysis units. For this SSA, seven analysis units were identified across the geographic range of the eastern black rail. Three of the AUs (New England, Appalachians, and Central Lowlands) currently have no resiliency, and therefore, this latitudinal variability (higher latitudes) has effectively been lost to the subspecies. While these AUs have experienced changes in their respective environments, wetland habitats continue to be present on the landscape and the subspecies was represented in the past. This suggests that the subspecies has a very narrow ecological niche (elevation, vegetation structure, and hydrology) in both time and space and lacks the adaptive capacity to occupy different niche spaces that might be available in wetlands present across the landscape. In addition to the three AUs with no resiliency, three of the AUs have low resiliency and one has very low resiliency across the geographic range. We have no evidence that eastern black rails are dispersing into new areas at a sufficient rate to maintain viability at such a level that counteracts the impacts from habitat loss, sea level rise, or other factors. In fact, eastern black rails show a limited ability to fly long distances during the breeding and wintering seasons; and only a portion of the birds fly long distances during spring and fall migration. Therefore, even though the eastern black rail still technically occurs at varying latitudes, we conclude that the subspecies currently has a low level of representation across its range. When considering habitat variability, we determined the eastern black rail has a level of adaptive potential by using similar habitats elements (i.e., higher elevation areas within wetlands with dense vegetation, moist soils, and shallow flood depth) within different wetland types within analysis units. Observations of the subspecies indicate that individuals are currently found predominantly near coastal waters in salt and brackish marsh habitats and to a lesser degree in freshwater wetland habitats. However, individuals do require the same habitat elements within each habitat type. Vegetation species and the presence of tidal influence may differ between habitat types, but all suitable habitats have dense vegetation that provides substantial cover. The eastern black rail is a very shallow water wetland adapted bird, occupying the wetland fringe between emergent wetlands and uplands. Birds require these conditions to be present throughout the period when they are present. Individuals are capable of finding new locations, including habitat patches that are ephemeral in nature, that have the required habitat elements (Watts 2018, pers. comm.). However, there may be other factors that are not currently known to us that influence eastern black rail presence, since not all wetland habitats that appear to be suitable are currently occupied (Schwarzer 2017, pers. comm.). There is no genetic data currently available for the eastern black rail. These considerations support our conclusion that the subspecies has some adaptive capacity by using different emergent wetland habitats; however, given the low level of latitudinal representation, the subspecies may be vulnerable to short- and long-term environmental changes. Future Representation: In the current condition analysis, we determined the eastern black rail has three AUs (Great Plains, Southeast Coastal Plain, and Southwest Coastal Plain) with low resiliency and one AU (Mid-Atlantic) with very low resiliency. In addition, with the effective extirpation of three AUs (New England, Appalachians, and Central Lowlands), the latitudinal variability of these AUs has been effectively lost to the subspecies, and therefore, we determined the eastern black rail has a reduced level of representation currently. In terms of habitat variability, we concluded the eastern black rail has some adaptive capacity to changing environmental conditions because it uses similar habitat elements across different wetland types (salt, brackish, and freshwater). In the next 25 years (by the year 2043), the Great Plains AU will likely be extirpated (or effectively extirpated) leading to the loss of the remaining higher latitudinal representative unit for the eastern black rail. In addition to this loss, the three remaining AUs (Mid-Atlantic Coastal Plain, Southwest Coastal Plain, and Southeast Coastal Plain) will likely be lost within the next 50 years. Thus, the eastern black rail will likely have no representation by approximately 2068. (USFWS, 2018a)

Redundancy:

Despite having a wide distribution, the eastern black rail currently has a low level of redundancy across its range. We evaluated the resiliency for the seven AUs and determined three have no resiliency, one has very low resiliency, and three have low resiliency (see Section 4.3.1). With the loss of three AUs in the upper latitudes of the range, the subspecies has reduced ability to withstand catastrophic events, such as hurricanes and tropical storms, which could impact the lower latitudinal AUs. Given the lack of habitat connectivity and the patchy and localized distribution, it would be difficult for the subspecies to recover from a catastrophic event in one or more AU. Considering the low to no resiliency for all AUs of the eastern black rail, this supports our conclusion that the subspecies has low redundancy across the entire range. Future Species Redundancy: Currently, the eastern black rail has four AUs with some level of resiliency (low and very low) spread throughout its range (Figures 4-1, 4-2). Under current condition, we determined that three of the seven AUs have no resiliency, and therefore, the subspecies is likely extirpated in these AUs resulting in a large range contraction and a current low redundancy for the subspecies. We analyzed the four remaining AUs under future scenarios and determined the eastern black rail will have zero redundancy under all plausible scenarios by 2100. In fact, the Great Plains AU will likely be extirpated in 15 to 25 years leading to further reduction (from a current low condition) in redundancy by 2043 and resulting in only coastal populations of the eastern blarail remaining. By only having coastal AUs remaining (and in even lower resiliency than current condition), this will further limit the ability of the eastern black rail to withstand catastrophic events such flooding from hurricanes and tropical storms. By 2068, we expect all eastern black rail AUs to be likely extirpated. (USFWS, 2018a).

Population Size:

1299 individuals on upper Texas coast, 355-815 breeding pairs on Atlantic Coast from New Jersey to Florida (including the Gulf Coast of Florida). (USFWS, 2018b) The total population estimate for eastern black rail in Atlantic and Gulf Coast states was revised from 945 – 2,250 breeding pairs in 2013 to 455 – 1,315 breeding pairs in 2016. (USFWS, 2018a).

Additional Population-level Information:

See SSA for tabulated population estimates by state for USA. (USFWS, 2018a)

Population Narrative:

The best available scientific data suggest that the remaining strongholds support a relatively small total population size: an estimated 1,299 individuals on the upper Texas coast within protected areas prior to Hurricane Harvey, and an estimated 355 to 815 breeding pairs on the Atlantic Coast from New Jersey to Florida (including the Gulf Coast of Florida). There are no current population estimates from the interior States (Colorado, Kansas, or Oklahoma), although there are consistent populations of eastern black rails at Quivira NWR in Kansas and at least four sites in Colorado where the subspecies is encountered in the spring and summer. We have no information to indicate that the eastern black rail is present in large numbers in the Caribbean or Central America. (USFWS, 2018b)

Threats and Stressors

Stressor: Habitat fragmentation, loss and degradation as a result of sea level rise along the coast and ground and surface water withdrawals are having a negative impact on the eastern black rail now and will continue to impact this subspecies into the future. (USFWS, 2018b)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Incompatible land management techniques, such as the application of prescribed fire, haying, mowing, and grazing, have negative impacts on the bird and its habitat, especially when conducted at sensitive times, such as the breeding season or the flightless molt period. (USFWS, 2018b) Fire threates include variances in frequency and timing, pattern and extent. Impounded wetland management practices are another stressor. (USFWS, 2018a)
Exposure:
Response:
Consequence:

Narrative:

Stressor: Stochastic events, such as flood events and hurricanes, can have significant impacts on populations and the subspecies' habitat. For example, the impacts of Hurricane Harvey on the Texas coastal populations of eastern black rail likely caused direct mortality as well as short-term habitat loss, as the hurricane occurred during the flightless molt period and resulted in the habitat being flooded for a long period of time. (USFWS, 2018b)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Human disturbance to the eastern black rail occurs throughout the bird's range and is driven by the bird's rarity and interest by the birding community to add this bird to individual life lists. (USFWS, 2018b) Human activities, such as birdwatching and hiking, have been shown to disturb breeding and nesting birds. Disturbance may result in nest abandonment, increased predation, and decreased reproductive success. (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Altered Plant Communities (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Altered Hydrology, including groundwater declines, subsidence, drainage modifications. (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Climate Change, including sea level rise and tidal flooding and wildfire pattern changes. (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Oil and chemical spills (such as Deepwater Horizon spill) and environmental contaminants (indirect effects to prey base) (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Disease, though no documented cases, West Nile is a potential threat. (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Stressor: Altered food webs (USFWS, 2018a)
Exposure:
Response:
Consequence:
Narrative:

Recovery

Conservation Measures and Best Management Practices:

- Migratory Bird Treaty Act of 1918 (MBTA; 16 U.S.C. 703 et seq.). (USFWS, 2018b)
- Migratory Bird Treaty Act of 1918 (MBTA; 16 U.S.C. 703 et seq.) (USFWS, 2018b)
- State protections: DE, IL, IN, MD, NJ, NY, VI. (USFWS, 2018b)
- Atlantic Coast Joint Venture: As part of this initiative, the ACJV Black Rail Working Group has drafted population goals for the eastern black rail and is developing habitat delivery options within the Atlantic Flyway. In addition, the ACJV is coordinating the development of a ‘‘saltmarsh conservation business plan.’’ The business plan will identify stressors to Atlantic and Gulf Coast tidal marshes and the efforts needed to conserve these habitats to maintain wildlife populations. (USFWS, 2018b)
- Gulf Coast Joint Venture: As a priority species, the black rail is provided consideration during the review of North American Wetland Conservation grant applications (Vermillion 2018, pers. comm.). Although detailed planning for the eastern black rail is not yet complete, the subspecies is considered in coastal marsh habitat delivery efforts discussed by GCJV Initiative Teams. Eastern black rails are believed to benefit from a plethora of coastal marsh habitat delivery efforts of GCJV partners, including projects authorized under the North American Wetland Conservation Act (16 U.S.C. 4401 et seq.), the Coastal Wetlands Planning, Protection and Restoration Act (16 U.S.C. 3951 et seq.), and the Service’s Coastal Program, as well as management actions on State and Federal refuges and wildlife management areas. Eastern black rails will benefit when projects conserve, enhance, or restore suitable wetland habitat and when management practices, such as the timing of prescribed burns and brush-clearing activities, are compatible with the life history of the subspecies. (USFWS, 2018b)
- Texas Black Rail Working Group (Shackelford 2018, pers. comm.): The main purpose of the group is to provide a forum for collaboration between researchers and stakeholders to share information about what is known about the species, identify information needs, and support conservation actions. (USFWS, 2018b)
- Fire Management Activities (USFWS, 2018b)
- Haying, Mowing, and Other Mechanical Treatment Activities (USFWS, 2018b)
- Grazing Activities (USFWS, 2018b)

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12-Month Petition Finding and Threatened Species Status for Eastern Black Rail with a Section 4(d) Rule. Proposed Rule. 50 CFR Part 17. Vol 83, no. 195, pg. 506010

SPECIES ACCOUNT: *Loxioides bailleui* (Palila (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Palila is a medium sized (38-40 g), finch-billed Hawaiian honeycreeper whose life history and survival are linked to mamane (Sophora chrysophylla), an endemic dry-forest tree in the legume family. Palila have a yellow head and breast, greenish wings and tail, a gray back, and white underparts. Males have a black mask, and females have less yellow on the head and a gray mask. Juveniles have wing bars. Their song and calls consist of bubbly, canary-like warbles (Banko et al. 2002). Adults aggregate in small flocks prior to the breeding season, and fledglings often join flocks after nesting.

Current Range

Palila occurred in lowland habitats on Kaua'i and O?ahu when Polynesians arrived in Hawai'i (Olson and James 1991). When Europeans arrived, Palila had been extirpated from Kaua'i and O?ahu but were still found over about 1,300 km2 of Hawai'i Island. Over the last 60 years, the species' range has been dramatically reduced. Today, all of the breeding population occurs in <45 km2 on the southwestern slope of Mauna Kea, about 1% of their historical Hawai'i Island range (Scott et al. 1984, Pratt et al. 1997, Banko et al. 2013).

Critical Habitat Designated

Yes; 9/22/1977.

Legal Description

On August 11, 1977, the Director, U.S. Fish and Wildlife Service thereinafter, the Director and the Service, respectively) issued a rulemaking which determined Critical Habitat for palila (Psittirostra bailleui) pursuant to Section 7 of the Endangered Species Act Of 1973 (42 FR 47840 - 47845). A Correction and Augmentation Final Rule was issued on September 22, 1977 (42 FR 47840-47845).

Critical Habitat Designation

Hawaii. An area of land, water, and airspace on the Island of Hawaii, Hawaii County, with the following components:

(1) The State of Hawaii Mauna Kea Forest Reserve, except (a) that portion above the 10,000 foot contour line, (b) that portion south of the Saddle Road (State Highway 20), (c) lands owned by the United States in the Pohakuloa Training Area north of the Saddle Road (State Highway 20) established by Executive Order 1719 (Parcel 6, State of Hawaii Tax Map Key 4-4-16, Third Division), (d) that portion (Parcel 10, Kaohe IV, State of Hawaii Tax Map Key 44-16. Third Division) lying north of the Saddle Road (State Highway 20) and south of the Power Line Road;

(2) that portion of the State of Hawaii Kaohe Game Management Area (Parcel 4, State of Hawaii Tax Map Key 4-4-15. Third Division) to the north and east of the Saddle Road (State Highway 20);

(3) that portion of the Upper Waikii Paddock (Parcel 2, State of Hawaii Tax Map Key 4-4-15, Third Division) northeast of the Saddle Road (State Highway 20);

(4) that portion of the lands of Humuula between Puu Kahinahina and Kole lying southeast of the Mauna Kea Forest Reserve fence (portions of Parcels 2, 3, and 7, State of Hawaii Tax Map Key 3-8-1, Third Division) which are included in State conservation district.

Primary Constituent Elements/Physical or Biological Features

The palila depends on the area delineated below for food, shelter, and nesting sites; it cannot survive without the mamane and naio trees found therein. Moreover, the delineated area apparently contains the world's entire known population of palila, and supports most of the large and intermediate-sized mamane and naio trees on Mauna Kea. This area is large enough to allow space for the population to expand, and includes a full range of altitudinal and geographical sites needed by the palila for normal life cycle movement. Such movement is the response of the species to shifting seasonal and annual patterns of flowering, seed set, and ensuing pod development of the mamane vegetation.

PCEs not described. Based on the text aboved, it can be assumed that (i) Mamane and naio trees, and (ii) altitudinal and geographical sites that allow the palila to respond to shifting seasonal and annual patterns of mamane vegetation are major constituent elements required by this species.

Special Management Considerations or Protections

Not available

Life History

Feeding Narrative

Adult: Green mamane seeds make up most of the diet of adults and nestlings, but mamane flowers, buds, and leaves, and naio berries also are consumed. Palila density, reproduction, and survival are strongly related to mamane pod availability (Scott et al. 1984, 1986; Banko et al. 2002). Caterpillars and other insects are fed to nestlings and also are eaten by adults. Mamane seeds contain compounds that are toxic to most vertebrates (Banko et al. 2002). While Palila appear to be immune to these compounds, their concentration may vary among trees, potentially contributing to the species' preference for certain trees. This preference means that more trees are needed to support Palila than would be predicted based on the number of pods harvested during a day (Banko et al. 2009). In addition, mamane flowers asynchronously at different elevations and trees distributed across an elevational gradient increase the availability of mamane seeds to Palila. The elevational distribution of mamane is the most important predictor of suitable Palila habitat (Scott et al. 1984) and Palila are restricted to the largest remaining expanse of mamane forest on Mauna Kea (Scott et al. 1984, Jacobi et al. 1996, Johnson et al. 2006, Leonard et al. 2008, Banko et al. 2013).

Reproduction Narrative

Adult: Palila form long-term pair bonds. Females build nests, usually in large, mature mamane trees, and males defend a small territory around the nest tree. Females incubate eggs, brood nestlings, and feed young nestlings with food delivered by males; males feed older nestlings directly. First-year males sometimes help a pair by defending the nest and feeding the female and nestlings, and usually are related to the female or male. Fledglings depend on their parents for three to four months after fledging. Pairs often renest after nest failure and sometimes renest after fledging a brood, but Palila typically have a low reproductive capacity and thus are slow to recover from stresses.

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Mamane and naio (Myoporum sandwicense) trees

Habitat Narrative

Adult: Palila are found in dry subalpine forest from 2,000-3,000 m elevation dominated by mamane and naio (Myoporum sandwicense) trees (Banko et al. 2002), as well as ʻiliahi (Santalum paniculatum) ʻakoko (Euphorbia olowaluana), and pilo (Coprosma montana). Important understory shrubs include ʻaʻaliʻi (Dodonaea viscosa), pukiawe, naʻena ʻe (Dubautia arborea), and ʻakala.

Dispersal/Migration

Population Information and Trends

Population Trends:

Declining

Number of Populations:

1 - 5 (NatureServe, 2015)

Population Size:

2070. Counts of palila have declined steadily since a peak in 2003 (Camp et al. 2014), with a 2014 estimate of 1,697 to 2,508 individuals. The 2015 official population estimate has not been calculated to date, but the preliminary estimate of raw palila detections was roughly 50 percent below the 2014 number of detections (C. Farmer, American Bird Conservancy, pers. comm. 2015) (USFWS, 2015). As of September 30, 2014, there were 35 palila in captivity at the Maui Bird Conservation Center and the Keauhou Bird Conservation Center (Hawaii Endangered Bird Conservation Program [HEBCP] 2014) (USFWS, 2015).

Population Narrative:

Range-wide population surveys have been conducted annually since 1980 (Johnson et al. 2006, Leonard et al. 2008, Banko et al. 2013). From 1980 to 2004, population estimates fluctuated between 2,000 and 7,000 birds, but no statistically significant trends were detected (Johnson et al. 2006). However, Leonard et al. (2008) documented a significant decline beginning in 2003 that continued through 2011. From 2003 to 2011, population estimates declined each year by an average of 586 ± 106 birds for a mean annual loss of 17% ± 3.5 or 79% overall (Banko et al. 2013). The 2011 population estimate was 1,263 individuals. Surveys conducted in January 2014 resulted in a population estimate of 2,070 individuals (Camp et al. 2014).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Prior to the arrival of humans, the Hawaiian archipelago supported a remarkable avifauna comprised of at least 107 endemic species, including flightless geese, ibis, and rails and a radiation of at least 59 species in the subfamily Drepanidinae (Olson and James 1991, James and Olson 1991, James 2004). In the years since human colonization, 67 bird species have been confirmed lost, 46 prior to the arrival of Europeans and 23 since 1778 (Olson and James 1991, James and Olson 1991, Pyle 1997, Banko et al. 2001). Of the 42 extant endemic taxa, 31 are federally listed (29 species and 2 sub-species). Ten of these taxa have not been observed in as many as 40 years and their status is unknown (Service 2006). Habitat destruction, non-native diseases and predators, and habitat degradation by introduced ungulates and invasive plants are the main threats now facing Hawaii's remaining endemic birds (van Riper and Scott 2001, Service 2006).

Stressor: Habitat Loss and Degradation
Exposure:
Response:
Consequence:
Narrative: The loss, fragmentation, and degradation of native Hawaiian Island habitats began over 700 years ago when Polynesians settled the archipelago, and accelerated with the arrival of Europeans in 1778. As a result, all native Hawaiian birds have been adversely affected. European settlement not only caused the further loss and degradation of native forest but also initiated a long history of alien species introductions, including invasive plants, goats (Capra hircus), cattle, sheep (Ovis aries), and pigs (Sus scrofa) all of which have degraded native forest for centuries. Introduced ungulates have devastated Hawaiian forests which evolved without mammalian browsers and grazers and have no defenses against them. Ungulates also contribute to soil erosion, prevent regeneration of native plants, facilitate the invasion of alien plants, and create breeding habitat for mosquitoes (Service 2009). Non-native, invasive plants have profoundly altered native habitats in Hawaiʻi. Non-native ungulates have degraded Palila habitat for 200 years and continue to threaten its remaining habitat. Low elevation mamane forest was converted to pasture for cattle ranching, and feral goats, feral sheep and mouflon sheep (O. musimon) degraded high elevation habitat by browsing on native trees and suppressing regeneration (Bryan 1937, Scowcroft and Giffin 1983, Scott et al. 1984) effectively compressing the belt of mamane forest on which the Palila depends.

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Hawaiian birds evolved in the absence of mammalian predators and have little to no adaptive behavioral responses to their presence. The nests, adults, and fledglings of all Hawaiian bird species are vulnerable to feral cats (Felis catus), rats (Rattus spp.), small Indian mongoose (Herpestes auropunctatus), dogs (Canis familiaris), and feral pigs (Service 2009).

Stressor: Disease
Exposure:

Response:
Consequence:
Narrative: Avian malaria (Plasmodium relictum) and avian pox virus (Poxvirus avium) carried by the alien southern house mosquito (Culex quinquefasciatus) resulted in the extinction of many Hawaiian birds and currently limits the distribution of most extant native forest birds to high elevation forests where cool temperatures limit mosquitoes (van Riper et al. 1986, Atkinson et al. 1995, Atkinson and LaPointe 2009). Malaria and pox are not a threat to the Palila because mosquitos are rare in the high-elevation, dry habitat that they occupy. Toxoplasmosis is a widespread disease caused by a protozoan parasite, Toxoplasma gondii, and can affect all birds and mammals (Elmore et al. 2010, Innes 2010). Cats are the primary reservoir of infection and one cat can shed millions of oocytes that can persist for months in damp soil (Elmore et al. 2010, Innes 2010). West Nile virus is another mosquito-borne pathogen that infects a wide range of birds, including corvids (Kilpatrick et al. 2006). West Nile virus spread rapidly across North America from 2000 to 2005 (Marra et al. 2004), but it has not been recorded in Hawaiʻi.

Stressor: Human Conflicts/Disturbance
Exposure:
Response:
Consequence:
Narrative: Habitat restoration (e.g., fencing, ungulate eradication) needed to re-establish Palila, but a small, vocal minority, primarily hunters, has opposed ungulate control in Palila Critical Habitat. This opposition has slowed and complicated effective management and local government officials have resisted eradication efforts.

Stressor: Climate Change
Exposure:
Response:
Consequence:
Narrative: Increasing air temperatures associated with climate change are likely to exacerbate the threat of disease to native Hawaiian birds by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning et al. 2002, Harvell et al. 2002, Hay et al. 2002, Giambelluca and Luke 2007, Giambelluca et al. 2008, Loiseau et al. 2012). An increase in temperature of 2°C, which is a conservative figure based on recent data (IPCC 2007), would decrease the area of disease-free forest in the species current range from 40 km2 to 9 km2 (Benning et al. 2002, Giambelluca et al. 2008, Hammond et al. 2009). A 2°C temperature increase would allow regular disease transmission in 85% of the area on Kauaʻi where it is now only periodic (Benning et al. 2002). Disease prevalence and the prevalence of mosquitos are increasing across the Alakaʻi (Atkinson and Utzurrum 2010, Atkinson et al. 2014. Drought reduces mamane seed production and likely contributes to the mortality of mature trees (Juvik et al. 1993), especially those stressed by browsing (Banko et al 2013), pathogens (Gardner and Trujillo 2001), and competition from invasive grasses and weeds (Banko et al. 2009). Drought conditions have persisted on Mauna Kea since 2000 but have been most severe since 2006 (Banko et al. 2014).

Stressor: Small Populations
Exposure:
Response:
Consequence:

Narrative: Small populations are more vulnerable to extinction than large populations because of the higher risks posed by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002).

Stressor: Hurricanes
Exposure:
Response:
Consequence:
Narrative: Major hurricanes struck Kauaʻi in 1983 and 1992 and degraded native forests by destroying large trees, creating gaps into which alien plants could expand, and spreading invasive plants.

Stressor: Predators (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative: The Mauna Kea Forest Restoration Project (MKFRP) conducts predator control on the west slope of Mauna Kea. In the spring of 2015, the MKFRP updated their predator trapping methods and have since caught a record number of cats (MKFRP 2015). From June 1, 2015, to August 17, 2015, the improved trapping system caught 25 cats, 16 mongoose, and 2 rats; in addition Division of Forestry and Wildlife (DOFAW) staff caught 18 cats and 18 mongoose at game bird water units (MKFRP 2015). Previous trapping efforts typically caught zero to five cats per quarter. It is not clear yet whether there is a new influx of cats to the south slope of Mauna Kea or if cat numbers have been higher than previously thought (USFWS, 2015).

Stressor: Drought conditions (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative: Drought conditions on Mauna Kea occurred during 74 percent of the months from 2000 to 2010, with drought recorded in all but two months from 2006 to 2010 (Banko et al. 2013) (USFWS, 2015).

Stressor: Insect pest infestation (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative: Myoporum sandwicense (naio) is an important tree species in Mauna Kea dry forests, and is especially prevalent in lower elevations of palila core habitat. Naio thrips, Klambothrips myopori, is a recently established insect pest which infests M. sandwicense in Hawaii, and was first found on Hawaii Island in December, 2008. High infestation by the thrips causes branch die-back, and can eventually result in tree death. Damage from naio thrips has been observed on Mauna Kea, and has the potential to substantially reduce the number of M. sandwicense in palila critical habitat and leave large stands of dead trees that are prone to fire (USFWS, 2015).

Stressor: Climate change degradation of habitat (USFWS, 2015).
Exposure:

Response:
Consequence:
Narrative: Climate change degradation of habitat – Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria 3 (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. In Hawaii, the threshold temperature for transmission of avian malaria has been estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak P. relictum prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Benning et al. 2002). Lia et al. (2015) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and expect high elevation areas to remain mosquito free only to midcentury due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for palila, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Recovery

Conservation Measures and Best Management Practices:

- Alien Ungulate Removal. Fencing and removal of alien ungulates from native habitats and from areas with restoration value are among the highest priority actions with the greatest potential benefit for Hawaiian bird species (Wallace and Leonard 2011). Removing ungulates, especially pigs, improves habitat quality and can reduce mosquito breeding sites (Goff and van Riper 1980). Such efforts will require a considerable influx of new funding and unprecedented outreach to gain the social and political support required for success, as projects will result in fewer hunting opportunities.
- Alien Predator Control. Keeping predators such as rodents, exotic snakes such as the brown treesnake, and cats away from crucial habitats of native Hawaiian birds can boost nesting success and survival of adult and young birds (VanderWerf 2008). Predator-proof fencing would protect critical nesting sites, although set-up costs are very high (e.g., $300 per meter of fencing). A more cost-effective option is use of rodenticides, such as diphacinone, which was recently approved for aerial application in Hawaiʻi. Though diphacinone application poses little threat to human health and most non-target species when applied according to label guidelines, we'll need to engage in education and outreach to gain widespread public approval for this approach. In addition, the federal and state government must be proactive in expanding biosecurity measures to prevent new invasive species from becoming established in Hawaiʻi (Kueffer and Loope 2009). One of the greatest potential biosecurity threats is the accidental introduction of the brown tree snake (Boiga irregularis), which has already devastated birdlife on Guam.
- Alien Plant Control. There is an urgent need for targeted efforts to reduce the spread of invasive, exotic plants in areas important to native Hawaiian birds. Fountain grass (Cenchrus setaceus), for example, a species indigenous to tropical Africa and Asia, is spreading in dry forest and grasslands, including the last remaining habitat of the Palila on the slopes of the Mauna Kea volcano, where the grass increases wildfire risk.
- Captive Breeding and Translocation. Captive propagation is critical for several Hawaiian birds. Captive propagation provides individuals to bolster existing wild populations, and, combined with translocation of wild birds, allows managers to establish new populations in protected or restored

habitats. Translocation has already been used to create “insurance” populations for species restricted to single sites.

- Disease Management. Reducing the incidence of avian malaria and avian pox is the greatest Hawaiian bird conservation challenge, as managers currently have few available tools to combat the diseases (Atkinson and LaPoint 2009). Strategies to reduce mosquitoes in discrete areas include: removing pigs to reduce habitat degradation that creates mosquito breeding habitat; insecticide application; and a new technique known as cytoplasmic incompatibility, which uses parasites to cause a sperm-egg incompatibility between the gametes of infected male and uninfected female mosquitoes. Fortunately, some bird species can evolve resistance to malaria over relatively short periods of time (Atkinson and LaPointe 2009). Captive propagation of disease-resistant individuals may help species weather the epidemics, as will reducing mortality from other factors, such as nest predation from feral cats and other introduced mammalian predators (Kilpatrick 2006).
- Climate Adaptation. To help native Hawaiian bird species avoid an upward-climbing mosquito-disease zone, we might consider planting forests above the current tree line, but this may be complicated by climate change-induced shifts in rainfall patterns (Giambelluca and Luke 2007). Assisted migrations and reintroductions of populations of the most endangered birds are other possibilities. And mitigating threats we can control—such as removing ungulates and controlling predators and weeds—will make birds and their habitats more resilient to climate change (Hunter et al. 2010).
- MKFRP – The MKFRP conducts weed control, forest restoration, forest monitoring, fence monitoring and maintenance, community outreach, volunteer trips, and ungulate control at Kaohe and Puu Mali Restoration Areas and in palila core habitat. From 2010 to 2013, 70,000 seedlings and 4,688 trees were planted (with assistance from volunteers and other partners) (USFWS, 2015).
- Predator control – The MKFRP and DOFAW conduct predator trapping on the southwestern slopes of Mauna Kea within palila core habitat (USFWS, 2015).
- Ungulate control – Beginning in April, 2013, DOFAW ramped up removal efforts of ungulates in palila critical habitat. To date, approximately 3,200 goats and sheep have been removed from critical habitat (J. Vetter, DOFAW, pers. comm. 2015). Removal efforts continue, with an average of 40-50 animals removed per month in 2014-2015 (J. Vetter, pers. comm., 2015) (USFWS, 2015).
- Fencing – To date, there are 100 kilometers (62.5 miles) of fencing around palila critical habitat and around the Kaohe and Puu Mali restoration areas. Twenty-four kilometers (15 miles) of fencing still needs to be completed on the north slope of Mauna Kea (USFWS, 2015).
- Two helicopter water dip tanks were installed in 2015 on the west slope of Mauna Kea, within occupied palila habitat, to improve fire response capacity (USFWS, 2015).
- Surveys – Annual palila surveys are conducted in January or February each year to monitor the range and abundance of palila (USFWS, 2015).
- The current goals of the HEBCP are to increase the captive palila population to a sufficient size and level of productivity to provide cohorts of young birds for release, to resume releases of captive-reared birds onto Mauna Kea or other suitable sites, and to maintain a second flock of palila at the Maui facility (HEBCP 2014) (USFWS, 2015).

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SPECIES ACCOUNT: *Loxops caeruleirostris* (Akekee, Kaua'I akepa)

Species Taxonomic and Listing Information

Listing Status: Endangered; 05/13/2010; Pacific Region (R1) (USFWS, 2016)

Physical Description

The ʻAkekeʻe is a small (10-12 g) insectivorous Hawaiian honeycreeper endemic to Kauaʻi. Males are bright yellow below, greenish above, with a yellow forehead and rump (Pratt et al. 1987, Lepson and Pratt 1997, Pratt 2005). Females are similar, but more drab and slightly smaller. Both sexes have a dark mask that extends from the base of the bill to the eye. The bill is pale bluish, short, and pointed, and the tips of the mandibles are slightly crossed; a characteristic shared with the Hawaiʻi ʻAkepa (L. coccineus). The tail is notched and somewhat longer than other Hawaiian honeycreepers. The song is a wavering trill that changes in pitch and speed; call notes given by males and females include a soft "sweet" (Pratt et al. 1987, Lepson and Pratt 1997). ʻAkekeʻe are most often observed in pairs or family groups.

Current Range

The ʻAkekeʻe is categorized as Critically Endangered by the IUCN and was federally-listed as endangered under the ESA on April 13, 2010 (75 FR 18960). Critical Habitat was designated for the ʻAkekeʻe at the time of listing. ʻAkekeʻe was described as "quite plentiful" (Bryan and Seale 1901) and common "over a large part of the high plateau" in the late 1800s (Perkins 1903), and probably occurred throughout upper elevation forested regions of the island (Munro 1944). Richardson and Bowles (1964) reported that it was fairly common in higher elevation forests.

Critical Habitat Designated

Yes; 4/13/2010.

Legal Description

On April 13, 2010, the U.S. Fish and Wildlife Service (Service) designated critical habitat for Loxops caeruleirostris (Akekee) under the Endangered Species Act of 1973, as amended. The critical habitat designation includes six critical habitat units (CHUs), in Hawaii (75 FR 18960-19165).

Critical Habitat Designation

The critical habitat designation for Loxops caeruleirostris includes six CHUs on the Island of Kauai, Hawaii (75 FR 18960-19165).

Unit 1: Kauai—Montane Mesic—Section 1: Montane Mesic–Section 1 consists of 2,423 ac (980 ha) in the montane mesic ecosystem, including the area above Honopu Valley to Mahanaloa Valley, on State owned land in Kokee State Park, the Na Pali-Kona Forest Reserve, and Kuia NAR (Figure 3-A). The entire section is within previously designated critical habitat for the plant species, falling within Critical Habitat Unit 11 of 50 CFR 17.99(a)(1), Map 70c, and is occupied by the plants Chamaesyce remyi var. remyi, Labordia helleri, Myrsine knudsenii, Platydesma rostrata, Psychotria grandiflora, Stenogyne kealiae, and Tetraplasandra flynii. This section is also occupied by the akekee and the picture-wing fly; maps of critical habitat for these species can be found at 50 CFR 17.95(b) for the akekee and akikiki (Unit 1–Montane Mesic), and at 50 CFR 17.95(i) for the picture-wing fly (Unit 1–Montane Mesic). This section also contains unoccupied habitat that is essential to the conservation of these nine species by providing the physical and biological features necessary for the expansion of the existing wild populations. This section includes the montane mesic forest, the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane mesic ecosystem (Table 3), as well as species-specific PCEs for the akekee and akikiki (arthropod prey) and picture-wing fly (the larval-stage host plants, Cheirodendron sp. and Tetraplasandra sp.). Although Montane Mesic–Section 1 is not known to be occupied by the species Diellia mannii, Myrsine mezii, and the akikiki, we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historic range. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Unit 2: Kauai—Montane Mesic—Section 2: Montane Mesic–Section 2 consists of 376 ac (152 ha) in the montane mesic ecosystem and includes a portion of the area surrounding a tributary of Nawaimaka Stream east to Kumuwela Ridge (Figure 3-A, above). The entire section is State-owned within Kokee State Park, and includes 8 ac (3 ha) of newly designated critical habitat. This section is occupied by Diellia mannii and the picture-wing fly Drosophila sharpi, and includes the montane mesic forest, the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane mesic ecosystem (Table 3), as well as the larval-stage host plants (Cheirodendron sp. and Tetraplasandra sp.) associated with the picture-wing fly. This section also contains unoccupied habitat that is essential to the conservation of these two species by providing the physical and biological features necessary for the expansion of the existing wild populations. Although Montane Mesic–Section 2 is not known to be occupied by the plants Chamaesyce remyi var. remyi, Labordia helleri, Myrsine knudsenii, Myrsine mezii, Platydesma rostrata, Psychotria grandiflora, Stenogyne kealiae, and Tetraplasandra flynnii, or by the birds the akekee and akikiki, we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historical range, as well as species-specific PCEs for the akekee and akikiki (arthropod prey). Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery. For the plants, that portion of the section that overlies previously designated critical habitat falls within Critical Habitat Unit 11 of 50 CFR 17.99(a)(1), Map 70c. The previously undesignated land comprises Critical Habitat Unit 21 of 50 CFR 17.99(a)(1), Map 217d. Maps of critical habitat for the akekee and akikiki can be found at 50 CFR 17.95(b) (Unit 2–Montane Mesic), and for the picture-wing fly at 50 CFR 17.95(i) (Unit 2–Montane Mesic).

Unit 3: Kauai—Montane Mesic—Section 3: Montane Mesic–Section 3 consists of 139 ac (56 ha) in the montane mesic ecosystem, including the upper portion of the Nawaimaka Valley up to Kapukapaia Ridge, on State-owned land in the Na Pali-Kona Forest Reserve (Figure 3-B). This section is not in previously designated critical habitat and includes the only montane mesic forest occupied by the plant Myrsine mezii, and the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane mesic ecosystem (Table 3). This section also contains unoccupied habitat that is essential to the conservation of this species by providing the physical and biological features necessary for the expansion of the existing wild population. Although Montane Mesic–Section 3 is not known to be occupied by the plants Chamaesyce remyi var. remyi, Labordia helleri, Myrsine knudsenii, Myrsine mezii, Platydesma rostrata, Psychotria grandiflora, Stenogyne kealiae, and Tetraplasandra flynnii; by the birds the akekee and akikiki; or by the picturewing fly Drosophila sharpi, we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historic range. It also provides for the species-specific PCEs for the akekee and akikiki (arthropod prey) and the larval-stage host plants (Cheirodendron sp. and Tetraplasandra sp.) associated with D. sharpi. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery. For the plants, this section comprises Critical Habitat Unit 22 of 50 CFR 17.99(a)(1), Map 217e. Maps of critical habitat for the akekee and akikiki can be found at 50 CFR 17.95(b) (Unit 3– Montane Mesic), and for the picturewing fly at 50 CFR 17.95(i) (Unit 3– Montane Mesic).

Unit 4: Kauai—Montane Wet—Section 1: Montane Wet–Section 1 consists of 13,055 ac (5,257 ha) in the montane wet ecosystem, extending across the Alakai Plateau from Hanakoa to Mount Waialeale, on State (12,628 ac, 5,110 ha) and privately owned (427 ac, 173 ha) land in the Na Pali Coast State Park, the Alakai Wilderness Preserve, the Na PaliKona and Halelea forest reserves, and Hono o Na Pali NAR. It is occupied by the plants Astelia waialealae, Chamaesyce remyi var. remyi, Dryopteris crinalis var. podosorus, Dubautia waialealae, Geranium kauaiense, Keysseria erici, K. helenae, Labordia helleri, L. pumila, Lysimachia daphnoides, Melicope degeneri, M. puberula, Myrsine mezii, Phyllostegia renovans, and Platydesma rostrata; by the akekee and akikiki; and by the picture-wing fly. This section also contains unoccupied habitat that is essential to the conservation of these 18 species by providing the physical and biological features necessary for the expansion of the existing wild populations. This section includes the montane wet forest, the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane wet ecosystem (Table 3), and the species-specific PCEs including (1) bogs (identified as PCEs for Dubautia waialealae, Geranium kauaiense, Keysseria erici, Keysseria helenae, Labordia pumila) (2) bog hummocks (identified as PCEs for Astelia waialealae and Lysimachia daphnoides); (3) arthropod prey (identified as PCEs for the akekee and the akikiki); and (4) larval-stage host plants, Cheirodendron and Tetraplasandra sp., (identified as a PCE for the picture-wing fly). Although Montane Wet–Section 1 is not known to be occupied by the plants Dubautia kalalauensis, Psychotria grandiflora, and Tetraplasandra flynnii, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historical range. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Unit 5: Kauai—Montane Wet—Section 2: Montane Wet–Section 2 consists of 790 ac (320 ha) in the montane wet ecosystem, extending from Kahuamaa Flat south to the edge of Waimea Canyon, on State-owned land in Kokee State Park (Figure 4, above). The entire section is within previously designated critical habitat, and is occupied by the plants Chamaesyce remyi var. remyi, Dubautia kalalauensis, Labordia helleri, Melicope puberula, Platydesma rostrata, Psychotria grandiflora, and Tetraplasandra flynii, and by the akekee. This section includes montane wet forest, potentially some small-scale boggy areas, the moisture regime, and canopy, subcanopy and understory plant species identified as PCEs in the montane wet ecosystem, and arthropod prey (identified as a speciesspecific PCE for the akekee). Although Montane Wet–Section 2 is not known to be occupied by the plants Astelia waialeale, Dryopteris crinalis var. podosorus, Dubautia waialeale, Geranium kauaiense, Keysseria erici, Keysseria helenae, Labordia pumila, Lysimachia daphnoides, Melicope degeneri, Myrsine mezii, and Phyllostegia renovans; by the akikiki; or by the picture-wing fly, Drosophila sharpi, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historical range. This area also supports the arthropod prey identified as a PCE for the akikiki, and the larval-stage host plants (Cheirodendron and Tetraplasandra spp.) identified as a PCE for the picturewing fly. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Unit 6: Kauai—Montane Wet—Section 3 Montane Wet–Section 3 consists of 413 ac (167 ha) in the montane wet ecosystem, encompasses the summit of Namolokama, on State (156 ac, 63 ha) and privately owned (257 ac, 104 ha) land in the Halelea Forest Reserve. It is entirely within previously designated critical habitat, and is occupied by the plants Keysseria erici and Labordia pumila. This section includes the montane wet forest, the moisture regime, and the canopy, subcanopy, and understory plant species identified as PCEs in the montane wet ecosystem, and bogs (identified as a species-specific PCE for K. erici). Although Montane Wet–Section 3 is not known to be occupied by the plants Astelia waialeale, Chamaesyce remyi var. remyi, Dryopteris crinalis var. podosorus, Dubautia kalalauensis, D. waialeale, Geranium kauaiense, Keysseria helenae, Labordia helleri, Lysimachia daphnoides, Melicope degeneri, M. puberula, Myrsine mezii, Phyllostegia renovans, Platydesma rostrata, Psychotria grandiflora, and Tetraplasandra flynnii; by the akekee and akikiki; or by the picture-wing fly, Drosophila sharpi, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historic range. It also supports the arthropod prey identified as a PCE for the akekee and akikiki, and the larval-stage host plants (Cheirodendron and Tetraplasandra spp.) identified as a PCE for the picture-wing fly. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Primary Constituent Elements/Physical or Biological Features

Primary constituent elements (PCEs) are the physical and biological features of critical habitat essential to a species' conservation. The PCEs of Loxops caeruleirostris critical are the following (75 FR 18960-19165):

In units 1, 2, and 3, the primary constituent elements of critical habitat for Akekee (Loxops caeruleirostris) are: (A) Elevation: 3,000 to 5,243 ft (914 to 1,598 m). (B) Annual precipitation: 50 to 75 inches (127 to 190 centimeters). (C) Substrate: Weathered aa lava flows, rocky mucks, thin silty loams, deep volcanic ash soils. (D) Canopy: Acacia, Metrosideros, Psychotria, Tetraplasandra, Zanthoxylum. (E) Subcanopy: Cheirodendron, Coprosma, Kadua, Ilex, Myoporum, Myrsine. (F) Understory: Bidens, Dryopteris, Leptecophylla, Poa, Scaevola, Sophora. (G) Arthropod prey.

In units 4, 5, and 6, the primary constituent elements of critical habitat for Akekee (Loxops caeruleirostris) are: (A) Elevation: 3,000 to 5,243 ft (914 to 1,598 m). (B) Annual precipitation: Greater than 75 inches (190 centimeters). (C) Substrate: Well-developed soils, montane bogs. (D) Canopy: Acacia, Charpentiera, Cheirodendron, Metrosideros. (E) Subcanopy: Broussaisia, Cibotium, Eurya, Ilex, Myrsine. (F) Understory: Ferns, Carex, Coprosma, Leptecophylla, Oreobolus, Rhynchospora, Vaccinium. (G) Arthropod prey.

Special Management Considerations or Protections

Manmade features and structures, such as buildings, roads, railroads, airports, runways, other paved areas, lawns, and other urban landscaped areas, existing on the effective date of this rule do not contain one or more of the primary constituent elements.

The primary threats to the physical and biological features essential to the conservation of all of these species include habitat destruction and modification by feral ungulates, predation by nonnative species, competition with nonnative species, hurricanes, landslides, flooding, and climate change. The reduction of these threats will require the implementation of special management actions within each of the critical habitat areas identified in this final rule.

Life History

Feeding Narrative

Adult: ʻAkekeʻe forage for insects, insect larvae, and spiders on the outer branches and leaves of ʻohiʻa trees, and occasionally in other trees and understory shrubs (Lepson and Pratt 1997). Prey is taken primarily by gleaning, and the asymmetrical crossed mandibles are used to pry open leaf buds and flower buds, similar to the behavior used by crossbills (Loxops spp.). The species' methodical probing of leaf buds is distinctive and can be used to identify the species.

Reproduction Narrative

Adult: Only six nests of the ʻAkekeʻe have been found and there is limited information about its breeding biology, but the nesting season is thought to extend from March-June (Lepson and Pratt 1997, E. VanderWerf unpubl. data). Nests occur 9-12 m above the ground in the crown of ʻohiʻa trees and are constructed of moss and lichen lined with fine grasses and soft bark strips (Eddinger 1972b, Berger 1981, Lepson and Pratt 1997). There is no information about nest success, reproductive rates, survival of adults or juveniles, or movements (Foster et al. 2000, Service 2006), but the reproductive biology of the ʻAkekeʻe is likely similar to that of the closely related, and well-studied, Hawaiʻi ʻAkepa (Loxop coccineus). Both sexes help build the nest, but the female alone probably incubates the eggs, and both sexes probably feed the nestlings (Eddinger 1972b, Lepson and Pratt 1997). From 2012 to 2014, eight akekee nests were monitored to assess basic nesting biology parameters (e.g., brood size; nest height; length of construction, incubation, and nestling periods) and to derive estimates of nesting success and investigate causes of failure. Mean nest height for akekee was (11.1 ± 2.3 m Standard Deviation [SD]). Nesting success, calculated using program MARK, was 0.71 ± 0.17 Standard Error (SE). Two of the eight akekee nests failed. One nest failed due to poor nest attendance and the other to hatching failure. Nest sample sizes were small and should be considered with caution; however, these results suggest that low nesting success may not be a primary cause of decline in these species. No rat predation was observed on akekee nests (Hammond et al. 2015). A captive breeding project was initiated for akekee in 2015. Two of the five nests collected had clutches of three eggs and one nest had a clutch of four eggs (Kauai Forest Bird Recovery Project 2017). There are currently six akekee in captivity, two from 2016 collections and four from 2017 (Hawaii Endangered Bird Conservation Program, San Diego Zoo Global 2017). Over the course of the captive breeding project, Kauai Forest Bird Recovery Project noted several renesting attempts as well as double brooding after egg collections (USFWS, 2017).

Habitat Narrative

Adult: ‘Akeke‘e are found in mesic and wet native montane forests dominated by ‘ohi‘a, koa, ‘o lapa, lapalapa, ‘ohi‘a ha, kawau, and kolea, with a diverse understory of native plants including ‘ohelo, and kanawao. Akekee are found in wet native montane forests dominated by Metrosideros polymorpha (ohia), Acacia koa (koa), Cheirodendron trigynum (olapa), Cheirodendron spp. (lapalapa), and Syzygium sandwicensis (ohia ha). Roughly 51 square kilometers (19 square miles) on the Alakai Plateau remains as suitable habitat for akekee (Paxton et al. 2016). In the eastern edge of the species range, annual rainfall exceeds 13,000 millimeters (512 inches) per year, declining to 2200 millimeters (87 inches) at the western edge at Na Pali Kona Forest Reserve (Giambelluca et al. 2013). The forest understory is occupied by many species of native shrubs and small trees, typically including Vaccinium calycinum (ohelo), Broussaisia arguta (kanawao), Clermontia faurei (ohawai), Ilex anomala (kawau), Myrsine lessertiana (kolea), Dubautia spp. (naenae), and Leptecophylla tameiameiae (pukiawe). The ground cover consists of various ferns, mosses, herbs and lichens. Akekee and habitat covariates were surveyed within five study areas on the Alakai Plateau along a gradient of forest conditions. Occupancy rates increased from west to east along the plateau, but were low throughout the range of akekee. Canopy height was positively correlated with occupancy for akekee, which suggests the damage done by hurricanes in 1982 and 1992 may be one factor restricting these birds to the most intact forest remaining. Invasive plants such as Hedychium gardnerianum (Himalayan ginger) were more prevalent in the western portion of the plateau resulting in less native plant cover. Native plant cover is higher in the eastern areas of the plateau where akekee occupancy is highest, although ground disturbance by feral ungulates was also higher in these areas (Behnke et al. 2016). To date, all akekee nests have been found in ohia (Hammond et al., 2015, KFBRP unpubl. data) (USFWS, 2017).

Dispersal/Migration

Population Information and Trends

Species Trends:

Akekee occupancy increases gradually from west to east across the Alakai Plateau (Behnke et al. 2016). The highest known densities of akekee historically occurred on the plateau at Halepaaki, Halehaha and Mohihi (Foster et al. 2004, Camp and Gorresen 2010). These studies indicated that Kawaikoi, the western most study area, supported medium densities of akekee (Foster et al. 2004), but few birds were observed during subsequent surveys in 2005 and 2008 (Camp and Gorresen 2010). Behnke et al. (2016) found that detection probability was low ($p = 0.30 \pm 0.19$) for akekee and occupancy (ψ) differed substantially between Kawaikoi and Halepaakai ($\psi = 0.03 \pm 0.10$ and $\psi = 0.53 \pm 0.33$, respectively). Akekee has experienced rapid range contraction since 2000 and are now limited to 51 square kilometers (19 square miles) on the plateau, a reduction of 61% (Paxton et al. 2016) (USFWS, 2017).

Population Size:

3,111 ± 591 birds 2008. A new publication by Paxton et al. (2016) documents the population decline and range contraction for akekee and other avifauna on Kauai. The study looked at the average change in density over a 25-year period for both the interior and exterior areas of the Alakai Plateau. Akekee has declined precipitously, with the 2012 population sizes estimated to be only 945 (95% Confidence Interval [CI], 460 to 1547) individuals. Unlike in previous surveys

(2000, 2005, 2007, and 2008), akekee was not detected by systematic surveys in the periphery of its range in 2012, although incidental sightings indicate continued but limited occurrence. If current rates of decline continue, extinction is predicted in the coming decades (USFWS, 2017).

Population Narrative:

The first quantitative information on the population size and distribution of the ʻAkekeʻe was based on extensive surveys conducted from 1968-1973, which yielded an island-wide population estimate of 5,066 ± 840 birds (Service 1983). Most individuals were found in the Alakaʻi Plateau area and the Kokeʻe area west of the Alakaʻi at elevations from 800-1,370 m. In 1981, the number of ʻAkekeʻe estimated to occur in a 25 km2 area of the southeastern Alakaʻʻi was 1,700 ± 300, with higher densities in the higher, more remote regions of the eastern Alakaʻi Plateau and lower densities toward the west in the Kokeʻe region (Scott et al. 1986). In 1968-1973, the ʻAkekeʻe population in this same area was estimated to be 600 ± 200 birds (Service 1983). The estimated population was 7,839 ± 704 birds in 2000, 5,669 ± 1,003 birds in 2005, and 3,111 ± 591 birds 2008 (DOFAW and USGS, unpubl. data). The most current estimate for the ʻAkekeʻe population is ca. 750 birds (DOFAW unpubl. data). The geographic range occupied by ʻAkekeʻe was approximately 88 km2 in 1970 (Service 1983, Scott et al. 1986), and this was reported not to have changed in 2000 (Foster et al. 2004), but surveys in 2008 failed to find the species in many areas where it was previously observed, and its range is now estimated to be approximately 50 km2 (DOFAW, unpubl. data).

Threats and Stressors

Stressor: Habitat destruction or modification (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The loss, fragmentation, and degradation of native Hawaiian Island habitats began over 700 years ago when Polynesians settled the archipelago, and accelerated with the arrival of Europeans in 1778. As a result, all native Hawaiian birds have been adversely affected. European settlement not only caused the further loss and degradation of native forest but also initiated a long history of alien species introductions, including invasive plants, goats (Capra hircus), cattle, sheep (Ovis aries), and pigs (Sus scrofa) all of which have degraded native forest for centuries. Introduced ungulates have devastated Hawaiian forests which evolved without mammalian browsers and grazers and have no defenses against them. Ungulates also contribute to soil erosion, prevent regeneration of native plants, facilitate the invasion of alien plants, and create breeding habitat for mosquitoes (Service 2009). Non-native, invasive plants have profoundly altered native habitats in Hawaiʻi. Contractions in the ranges of the ʻAkikiki and the ʻAkekeʻe have occurred at their edges (Foster et al. 2004) where disturbance and the effects of feral ungulates and invasive alien plants are most severe, suggesting degradation of forest habitat has played a role in that range contraction.

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Predation. Hawaiian birds evolved in the absence of mammalian predators and have little to no adaptive behavioral responses to their presence. The nests, adults, and fledglings of

all Hawaiian bird species are vulnerable to feral cats (Felis catus), rats (Rattus spp.), small Indian mongoose (Herpestes auropunctatus), dogs (Canis familiaris), and feral pigs (Service 2009). Disease. Avian malaria (Plasmodium relictum) and avian pox virus (Poxvirus avium) carried by the alien southern house mosquito (Culex quinquefasciatus) resulted in the extinction of many Hawaiian birds and currently limits the distribution of most extant native forest birds to high elevation forests where cool temperatures limit mosquitoes (van Riper et al. 1986, Atkinson et al. 1995, Atkinson and LaPointe 2009). Although based on a small sample, the prevalence of malaria in the ʻAkikiki increased from zero between 1994-1997 to 40% between 2007-2009 (Atkinson and Utzurrum 2014). In addition, most of this species' decline has occurred at lower elevations on the edge of its range (Foster et al. 2004), suggesting that disease has contributed to these losses. Toxoplasmosis is a widespread disease caused by a protozoan parasite, Toxoplasma gondii, and can affect all birds and mammals (Elmore et al. 2010, Innes 2010). Cats are the primary reservoir of infection and one cat can shed millions of oocytes that can persist for months in damp soil (Elmore et al. 2010, Innes 2010). West Nile virus is another mosquito-borne pathogen that infects a wide range of birds (Kilpatrick et al. 2006). West Nile virus spread rapidly across North America from 2000 to 2005 (Marra et al. 2004), but it has not been recorded in Hawaiʻi.

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: Increasing air temperatures associated with climate change are likely to exacerbate the threat of disease to native Hawaiian birds by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning et al. 2002, Harvell et al. 2002, Hay et al. 2002, Giambelluca and Luke 2007, Giambelluca et al. 2008, Loiseau et al. 2012). Drought reduces mamane seed production and likely contributes to the mortality of mature trees (Juvik et al. 1993), especially those stressed by browsing (Banko et al 2013), pathogens (Gardner and Trujillo 2001), and competition from invasive grasses and weeds (Banko et al. 2009). Drought conditions have persisted on Mauna Kea since 2000 but have been most severe since 2006 (Banko et al. 2014).

Stressor: Small populations
Exposure:
Response:
Consequence:
Narrative: Small populations are more vulnerable to extinction than large populations because of the higher risks posed by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002).

Stressor: Hurricanes
Exposure:
Response:
Consequence:
Narrative: Major hurricanes struck Kauaʻi in 1983 and 1992 and degraded native forests by destroying large trees, creating gaps into which alien plants could expand, and spreading invasive plants. The effects of these hurricanes on the ʻAkikiki and the ʻAkekeʻe are unknown.

Stressor: Habitat degradation resulting from the invasion of many nonnative weeds (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Habitat degradation resulting from the invasion of many nonnative weeds has drastically changed the forest structure and integrity. Two hurricanes in 1982 and 1992 severely disturbed areas of native forest and made space for the germination and expansion of nonnative plants. Established ecosystem-altering invasive plant species which degrade akekee habitat include (USFWS 2012, in prep); o Andropogon virginicus (broomsedge) o Clidemia hirta (Koster's curse) o Digitaria insularis (sourgrass) o Erigeron karvinskianus (daisy fleabane) o Grevillea robusta (silk oak) o Hedychium flavescens (yellow ginger) o Hedychium gardnerianum (Himalayan ginger) o Lantana camara (lantana) o Leucaena leucocephala (koa haole) o Melinus minutiflora (molasses grass) o Morella faya (firetree) o Passiflora tarminiana (banana poka) o Psidium cattleianum (strawberry guava) o Psidium guayava (common guava) o Rubus argutus (prickly Florida blackberry) o Rubus rosifolius (thimbleberry) o Sphaeropteris cooperi (Australian treefern) (USFWS, 2017).

Stressor: Ungulate degradation of habitat (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Ungulate degradation of habitat – Feral pigs (Sus scrofa) and goats (Capra hircus) (Cabin et al. 2000; Scott et al. 2001; USFWS 2006a, 2010a). Degradation of forest habitat has likely played an important role in causing the range contraction of the akekee. Most of the decline has occurred at lower elevations on the edge of the species' range (Foster et al. 2004; Behnke et al. 2016), where disturbance and the effects of ungulates and established ecosystem-altering invasive plant species are most severe. Continued habitat degradation from established ecosystem-altering invasive plant species and feral ungulates is likely to continue damaging forest structure and integrity, and thus likely to result in continued loss of habitat (USFWS, 2017).

Stressor: Rapid Ohia Death (ROD) (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Rapid Ohia Death (ROD) – Currently the Ceratocystis fungus which causes ROD is restricted to Hawaii Island. The crowns of infected ohia (Metrosideros polymorha) trees turn yellowish (chlorotic) and subsequently brown within days to weeks; dead leaves typically remain on branches for some time. In the lower Puna district on Hawaii Island, stands infected with ROD have shown greater than 90% mortality within 2 to 3 years. Over 75,000 acres of ohia-dominated forests have been impacted (University of Hawaii at Manoa 2017). Ohia trees make up the largest portion of the canopy in the native wet forests in which akekee are found. Akekee predominantly feed on spiders, psyllids, and caterpillars (Lepson and Pratt 1997) while foraging in the terminal leaf nodes of ohia. To date, all akekee nests have been found in ohia (Hammond et al., 2015, KFBRP unpubl. data). If ROD becomes established on Kauai, it will further degrade what remains of akekee habitat and have the potential to negatively impact available food (invertebrate) resources (USFWS, 2017).

Stressor: Avian malaria and avian pox (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Avian malaria and avian pox– Avian diseases, transmitted by mosquitoes (Culex quinquefasciatus), specifically pox (Poxvirus avium) and malaria (Plasmodium relictum) are thought to play a major role in limiting the distribution of akekee. Akekee is restricted to higher elevation areas where mosquitoes and the diseases they carry are less prevalent (Scott et al. 1986), but mosquitoes have been captured as high as Sincock's Bog and are likely to occur at the highest elevations on Kauai (D. LaPointe, USGS per. comm). A single infected akekee (1/16, 6.3%) was detected at Kawaikoi Stream in 1994, but no infected akekee (0/4) were detected in the period between 2007 and 2013 (Atkinson et. al 2014). Prevalence appeared to decrease in akekee (6.3% to 0%), but this may be a reflection of high disease-associated mortality in the wild given the high susceptibility of native honeycreepers to malaria in experimental studies (Atkinson et al. 1995). However, it is impossible to tell from these data whether survival rates of infected akekee are high or low. Low infection rates could reflect either low transmission rates or high mortality of infected birds (USFWS 2006a) (USFWS, 2017).

Stressor: Predation from introduced and native species (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Predation from introduced and native species – The biology of akekee has been little studied and predation on adults and nests has not been documented but several introduced mammals known to be serious predators on Hawaiian forest birds are present on the Alakai Plateau where akekee occur (Tweed et al. 2000), including all three species of rats (Rattus spp.) present in Hawaii, and feral cats (Felis catus). Two species 12 of owls, the native pueo or Hawaiian short-eared owl (Asio flammeus sandwichensis) and introduced barn owl (Tyto alba), are known to prey on forest passerines (Snetsinger et al. 1994) (USFWS, 2017).

Stressor: Nonnative wasp predation (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Nonnative wasp predation – Western yellowjacket wasps (Vespula pensylvanica) are a potential threat as they may compete for food with insectivorous forest birds such as akekee and perhaps kill and eat the nestlings of the listed forest birds (USFWS 2006a) (USFWS, 2017).

Stressor: Invasive species – Nonnative bird competition (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Invasive species – Nonnative bird competition – It has also been suggested that the akekee may be negatively impacted by competition from the insectivorous Japanese white-eye (Zosterops japonicas) (Mountainspring and Scott 1985) (USFWS, 2017).

Stressor: Small population size (USFWS, 2017).
Exposure:

Response:
Consequence:
Narrative: Small population size –The lack of genetic diversity poses potential that is likely with a small population size poses problems (Caughley and Gunn 1996). Species that are endemic to a single island and highly localized, such as the akekee, are inherently more vulnerable to extinction than widespread species because of the higher risks posed to a single population by random demographic fluctuations and localized catastrophes such as fires, hurricanes and disease outbreaks (USFWS, 2017).

Stressor: Climate change (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Climate change – Climate change poses a threat to the akekee by causing an increase in elevation at which regular transmission of avian malaria occurs (Benning et al. 2002; Atkinson et al. 2014; Fortini et al. 2015). Experimental evidence has shown that the malarial parasite does not develop in birds below 13 degrees Celsius (55 degrees Fahrenheit) and field studies have found that maximum malaria transmission occurs where mean ambient summer temperature is 17 degrees Celsius (63 degrees Fahrenheit; La Pointe 2000). Between 13 and 17 degrees Celsius, malaria transmission is limited and usually associated with warmer periods, such as El Nino events (Feldman et al. 1995). There are no forested areas on Kauai where mean ambient temperature is below 13 degrees Celsius, meaning all areas are currently subject to malaria at least periodically. Downscaled end-of-century climate projections for Hawaii based on a 13 moderate A1B emission scenario (Intergovernmental Panel on Climate Change 2000) suggest an average 2.6 degrees Celsius warming in areas that Hawaiian forest birds currently inhabit (Zhang et al. 2011). Under this scenario and continued disease-driven distribution limitation, akekee are expected to lose all of their range by 2100 (Fortini et al. 2015) (USFWS, 2017).

Recovery

Reclassification Criteria:
Criterion 1: A total population of 5,000 birds throughout 75 percent of the recovery area and the species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species. The criterion has not been met. The current population is estimated to be 945 individuals (95% Confidence Interval (CI) 460 to 1547) (Paxton et al. 2016) (USFWS, 2017).

Criterion 2: Quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or demographic monitoring shows that each population or the 5 metapopulation exhibits an average intrinsic growth rate (lambda λ) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason. This criterion has not been met; adequate quantitative survey methods for akekee have proven difficult because they spend most of their time in the upper forest canopy and are inconspicuous. Demographic monitoring has not been adequate to determine average growth rate for this species (USFWS, 2017).

Criterion 3: Sufficient recovery area is protected and managed to achieve Criteria 1 and 2 above. This criterion has not been met. Akekee populations have undergone a dramatic range contraction from 126 square kilometers (48 square miles) to less than 50 square kilometers (19 square miles) over the past decade (Paxton et al. 2016). Approximately 15 square kilometers (5.8 square miles) have some form of threat abatement occurring (ungulate exclusion, invasive plant removal and/or predator control); however, no areas are being managed for avian disease (Kauai Watershed Alliance and Hawaii Division of Forestry and Wildlife, Kauai Natural Area Reserve Program. pers. comm. 2017) (USFWS, 2017).

Criterion 4: The mix of threats that were responsible for the decline of the species have been identified and controlled. Threats responsible for the decline of akekee have been identified, but are not adequately controlled. Akekee may be delisted when all four of the criteria above have been met for a 30-year period and total population is 8,000 adults (USFWS, 2017).

Conservation Measures and Best Management Practices:

- Alien Ungulate Removal. Fencing and removal of alien ungulates from native habitats and from areas with restoration value are among the highest priority actions with the greatest potential benefit for Hawaiian bird species (Wallace and Leonard 2011). Removing ungulates, especially pigs, improves habitat quality and can reduce mosquito breeding sites (Goff and van Riper 1980). Such efforts will require a considerable influx of new funding and unprecedented outreach to gain the social and political support required for success, as projects will result in fewer hunting opportunities.
- Alien Predator Control. Keeping predators such as rodents, exotic snakes such as the brown treesnake, and cats away from crucial habitats of native Hawaiian birds can boost nesting success and survival of adult and young birds (VanderWerf 2008). Predator-proof fencing would protect critical nesting sites, although set-up costs are very high (e.g., $300 per meter of fencing). A more cost-effective option is use of rodenticides, such as diphacinone, which was recently approved for aerial application in Hawaiʻi. Though diphacinone application poses little threat to human health and most non-target species when applied according to label guidelines, we'll need to engage in education and outreach to gain widespread public approval for this approach. In addition, the federal and state government must be proactive in expanding biosecurity measures to prevent new invasive species from becoming established in Hawaiʻi (Kueffer and Loope 2009). One of the greatest potential biosecurity threats is the accidental introduction of the brown tree snake (Boiga irregularis), which has already devastated birdlife on Guam.
- Alien Plant Control. There is an urgent need for targeted efforts to reduce the spread of invasive, exotic plants in areas important to native Hawaiian birds. Fountain grass (Cenchrus setaceus), for example, a species indigenous to tropical Africa and Asia, is spreading in dry forest and grasslands where the grass increases wildfire risk.
- Captive Breeding and Translocation. Captive propagation is critical for several Hawaiian birds. Captive propagation provides individuals to bolster existing wild populations, and, combined with translocation of wild birds, allows managers to establish new populations in protected or restored habitats. Translocation has been used to create "insurance" populations for species restricted to single sites.
- Disease Management. Reducing the incidence of avian malaria and avian pox is the greatest Hawaiian bird conservation challenge, as managers currently have few available tools to combat the diseases (Atkinson and LaPoint 2009). Strategies to reduce mosquitoes in discrete areas include: removing pigs to reduce habitat degradation that creates mosquito breeding habitat; insecticide application; and a new technique known as cytoplasmic incompatibility, which uses parasites to

cause a sperm-egg incompatibility between the gametes of infected male and uninfected female mosquitoes. Fortunately, some bird species can evolve resistance to malaria over relatively short periods of time (Atkinson and LaPointe 2009). The Hawaiʻi ʻAmakihi (Hemignathus virens) and the Oʻahu ʻAmakihi (H. flavus), whose populations were greatly reduced at low elevations, are apparently on the road to tolerating or developing resistance to malaria, as both are undergoing remarkable and rapid population increases. Captive propagation of disease-resistant individuals may help species weather the epidemics, as will reducing mortality from other factors, such as nest predation from feral cats and other introduced mammalian predators (Kilpatrick 2006).

- Climate Adaptation. To help native Hawaiian bird species avoid an upward-climbing mosquito-disease zone, we might consider planting forests above the current tree line, but this may be complicated by climate change-induced shifts in rainfall patterns (Giambelluca and Luke 2007). Assisted migrations and reintroductions of populations of the most endangered birds are other possibilities. And mitigating threats we can control—such as removing ungulates and controlling predators and weeds—will make birds and their habitats more resilient to climate change (Hunter et al. 2010).
- Avian malaria and pox / mosquito vector control. Implement landscapelevel control of the mosquito vector (Culex quinquefasciatus) by using existing and developing technologies such as Wolbachia to control populations and bio-pesticides to treat larvae. Continue to investigate novel technologies to confront mosquito vectors and mosquito-borne pathogens in the Hawaiian Islands (USFWS, 2017).
- Biosecurity. Implement a statewide interagency biosecurity plan to prevent ROD and other detrimental non-native species from becoming established on Kauai (Hawaii Department of Agriculture, 2017). An effective biosecurity plan requires a comprehensive approach that includes: • Pre-border policies and processes to prevent invasive species from making their way to the state of Hawaii • Border policies and processes that support inspecting incoming items to ensure minimal risk of pest entry into the state • Post-border policies and processes that support detecting and responding to new incursions of invasive species and controlling established invasive species wherever possible (USFWS, 2017).
- Captive Propagation and Reintroduction Programs. Augmentation of natural dispersal and recolonization of recovering habitat through reintroduction of captive-bred akekee in selected areas is desirable. Such reintroductions may increase the range of the species and the probability that the species will survive future catastrophes such as hurricanes or disease outbreaks (USFWS, 2017).
- Habitat Protection and Management. Habitat protection and management should continue to occur in areas in which akekee occupancy is the highest. Prospects for recovery lie in maintaining and restoring forest habitat by developing, testing, and applying broad-scale habitat restoration measures, including: minimizing populations of feral ungulates through a combination of hunting, fencing, snaring, and possibly development of lethal non-toxicant devices for use in areas inaccessible to hunters or in areas closed to hunters; controlling the encroachment of invasive plants and insects through tested bio-control and where feasible, mechanical and chemical measures; and continuing enforcement of State and Federal laws that protect against destructive human activities and development (USFWS, 2017).
- Predator Control. A need exists to develop, test, register, and apply toxicants for control of feral cats and introduced rodents in remote forested habitat. Prevention of additional introductions of exotic plants, 15 insects, mammals (especially the mongoose [Herpestes auropunctatus], currently a resident on other Hawaiian islands) and alien birds that may act as predators on, or competitors with, native birds is necessary (USFWS, 2017).
- Population Surveys, Monitoring. Continued monitoring of the status of forest bird populations and their habitats is necessary to measure the effectiveness of management actions such as those listed

above. Future research should assess post-fledging, juvenile, and adult survival as potential causes of population declines. Determining which demographic parameters currently have the largest negative impact on the population is imperative for guiding effective management actions to conserve these species (USFWS, 2017).

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USFWS 2017. 5-Year Review. Species reviewed: Akekee (Loxops caeruleirostris).

SPECIES ACCOUNT: *Loxops coccineus (=L. c. coccineus)* (Hawaii akepa, `akakane)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/13/1970; Pacific Region (R1) (USFWS, 2016)

Physical Description

A red-orange or green-yellow, 4 - 5-inch songbird with an asymmetrical bill. Adult male is bright orange-red, female is greenish above and yellow below; bill is short and conical, with the tips of the mandibles slightly skewed; overall length about 10 cm (Berger 1981, Pratt et al. 1987, Hawaii Audubon Society 1993). Length is 10 cm and weight is 10 - 12 g. Male is brilliant orange after 2-year plumage maturation; subadult males are duller and browner with patches of orange and gray or grayish green. Females grayish green, paler below, but range from entirely dull gray to green dorsally with orange yellow on face and venrally. Bill horn-colored or pale yellow; tip dark, with lower mandible curved to one side (Lepson and Freed 1997) (NatureServe, 2015).

Taxonomy

The bird was originally described as Fringilla coccinea from specimens collected by the James Cook expedition of 1779 (Medway 1981). It was occasionally placed in the genus Hypoloxias (Wilson and Evans 1890 to 1899). Its current nomenclature is based on Rothschild (1893 to 1900). The Hawai`i `akepa shares subspecific status with the Maui `akepa (Loxops c. ochraceus) and the O`ahu `akepa (Loxops c. rufus). The O`ahu subspecies is extinct and the Maui subspecies was last observed in 1995 (Reynolds and Snetsinger 2001) (USFWS, 2010). The scientific name of the species was officially listed as Loxops coccineus effective May 17, 2016. (USFWS, 2016).

Historical Range

Formerly widespread on the island of Hawaii and reportedly abundant in parts of Kona, Hilo, and on Kohala Mountain (NatureServe, 2015).

Current Range

Now resident in four disjunct populations on the windward slopes of Mauna Loa and Mauna Kea, including Kau Forest, Hamakua, Keauhou Ranch, and Kilauea Forest (Ralph and Fancy 1994). Most common in the Kau Forest and Hamakua (Ralph and Fancy 1994) (NatureServe, 2015). The Hawaii akepa occurs as disjunct populations in north and central windward Hawaii, Kau, Kona, and Hualalai regions on Hawaii (USFWS, 2015). The major change in distribution historically has been the complete loss of birds from lower elevations, below 1,300 meters (4,300 feet) above sea level (asl). However, the range also has contracted at upper elevations (Freed 1999, Scott et al. 1986) (USFWS, 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores. Diet includes caterpillars, spiders, occasionally nectar. Feeds among leaves, buds, and flowers of forest canopy (Pratt et al. 1987). Uses bill to pry apart plant structures that may contain insects (NatureServe, 2015). Foraging occurs mainly on the terminal leaf clusters of `ohi`a, and to a lesser extent among koa leaves and seedpods (Perkins 1903, Conant 1981a, Fretz 2000) (USFWS, 2006).

Reproduction Narrative

Adult: Appears to retain mate for more than one year (Ralph and Fancy 1994). Lepson (1991) reported that adult survivorship is extraordinarily high and prebreeding sexual competition is extremely long. Annual adult survival at Keauhou Ranch was 0.70 (Ralph and Fancy 1994) (NatureServe, 2015). The Hawai`i `akepa is an obligate cavity nester, with most nests found in large old-growth `ohi`a (Metrosideros polymorpha) and koa (Acacia koa) trees (Lepson and Freed 1997, Freed 2001). It has a clearly defined breeding season, with nest-building from early March to late May, egg-laying from mid-March to late May, hatching in late March to early June, and fledging from April 2 to June 30 (Lepson and Freed 1997). Fledglings stay with their parents until September or October. Only one brood can be raised per year. Females do all or most of the nest building and incubate, brood, and feed the chicks; males assist by feeding the female both on and off the nest and by feeding the young (Lepson and Freed 1997). Clutch size ranges from one to three eggs, with two as the modal number (Lepson and Freed 1997). This species exhibits an even sex ratio (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Occurs > 4,300 ft. elevation (USFWS, 2010; see current range/distribution)

Spatial Arrangements of the Population

Adult: Small flocks (NatureServe, 2015); interspecific flocks (USFWS, 2006)

Site Fidelity

Adult: High (NatureServe, 2015)

Habitat Narrative

Adult: Inhabits wet and mesic forest (mainly ohia or koa), especially in mountains (AOU 1983) on windward slopes. Usually in canopy. Highest densities are in old growth forests with large, canopy-emergent ohia or koa trees. Occurs in high densities in some disturbed forests and woodlands where sufficient numbers of large trees survive to provide nesting cavities (e.g., Hakalau Forest National Wildlife Refuge). Formerly found in lowland wet and mesic forests on Kilauea (Perkins 1903, Richards and Baldwin 1953). Many appear to be strongly philopatric (Ralph and Fancy 1994). Often occurs in small flocks (Pratt et al. 1987) (NatureServe, 2015). Adults and juveniles frequently join interspecific foraging flocks. Large `ohi`a trees provide both cavities for nest-sites and the preferred foraging substrate, whereas large koa trees provide mainly cavities (Freed 2001) (USFWS, 2006).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Non-migratory. Mean home range size is 3.94 ha; home ranges overlap extensively (Ralph and Fancy 1994) (NatureServe, 2015).

Population Information and Trends

Population Trends:

Not available

Species Trends:

Stable (USFWS, 2015)

Resiliency:

Low (inferred from USFWS, 2015; see current range distribution)

Redundancy:

Low (inferred from USFWS, 2015)

Number of Populations:

4 (USFWS, 2015)

Population Size:

~12,000 (USFWS, 2015)

Population Narrative:

The total population of Hawaii akepa is approximately 12,000 birds in 4 populations (Gorresen et al. 2009). Recent surveys confirm that the Hawaii akepa population is stable overall and possibly increasing in Hakalau Forest NWR (USFWS, 2015).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. Hawaiian bird

populations and expect high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for Hawaii akepa as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Disease (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Hawai`i `akepa are not found below 1,300 meters (4,300 feet) asl, presumably because of the distribution of the introduced mosquito (Culex quinquefasciatus) that transmits avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) (van Riper et al. 1986). Both the mosquito and malaria parasite are limited in elevation by temperature (LaPointe 2000) (USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The existing Hawai`i `akepa populations are threatened with extinction because of their small size and restricted distribution making them vulnerable to a variety of natural processes, including reduced reproductive vigor caused by inbreeding depression, loss of genetic variability and evolutionary potential over time due to random genetic drift, stochastic fluctuations in population size and sex ratio, and natural disasters such as hurricanes and fires (USFWS, 2010).

Stressor: Habitat loss (USFWS, 2006)
Exposure:
Response:
Consequence:
Narrative: Clearing of forest by logging and ranching has been extensive, greatly reducing the amount of suitable habitat for Hawai`i `akepa and other forest birds, and resulting in fragmentation of the remaining forest habitat. Hawai`i `akepa are especially sensitive to the loss of old growth forest due to their dependence on large trees with cavities for nesting (Freed 2001). Much old-growth forest has been cleared for pasture at upper elevations (Tomonari-Tuggle 1996) (USFWS, 2006).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species, and viable populations exist in Hamakua, Kulani/Kilauea/Keauhou, Ka`u, south Kona, and Pu`u Wa`awa`a/Hualalai (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average

growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery area is protected and managed to achieve criteria 1 and 2 above (USFWS, 2010).

4. The threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:
All four of the criteria above have been met for a 30-year period (USFWS, 2010).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories – Continued monitoring of Hawaii akepa is important to determine species response to management actions and effects of climate change (USFWS, 2015).
- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. We encourage continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).
- Habitat and natural process management and restoration – o Continued habitat management in areas where the species currently exists is recommended (USFWS 2006). o Hawaiian forest birds

susceptible to avian disease may become extinct following a drastic reduction in disease free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Acquisition and management of transmission-free high-elevation habitat is crucial to the preservation and restoration of native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, we recommend securing deforested and pasture lands on Hawaii at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for Hawaii akepa and other Hawaiian forest birds (USFWS, 2015).

- Captive propagation for reintroduction and genetic storage – Recovery of Hawaii akepa may be achieved most effectively through in situ management techniques such as habitat management. However, captive propagation technology has been developed for the Hawaii akepa in case it is needed to help reestablish wild populations in the future (USFWS, 2015).

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SPECIES ACCOUNT: *Loxops ochraceus (=L. c. ochraceus)* (Maui akepa, `akepeu`ie)

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed for delisting

Physical Description

Small songbird with a short conical and slightly skewed bill. About 10 cm long, with a long, notched tail and a short, conical, slightly skewed bill; colors are somewhat variable, adult males generally are dull bronze-yellow, orange, or golden yellow; females greenish-yellow or dull gray-green. From Lepson and Freed (1997): A small, sexually dichromatic Hawaiian honeycreeper. Length is 10 cm, and weight is 10 - 12 g. Males have a color dimorphism that appears unrelated to age, with approximately 45% each of dull orange or ochraceous yellow and 10% intermediate color (Pratt 1989). Females grayish green with some pale yellow on breast. Bill grayish or horn colored, with lower mandible curved to one side (NatureServe, 2015).

Taxonomy

The Maui akepa shares subspecific status with the Hawaii akepa (Loxops coccineus coccineus) and the Oahu akepa (Loxops cocineus rufus). The Oahu subspecies is extinct and the Maui subspecies was last reported as an unconfirmed audio detection in 1995 (Reynolds and Snetsinger 2001) (USFWS, 2015). The scientific name of the species was officially listed as Loxops ochraceus effective May 17, 2016. (USFWS, 2016).

Historical Range

Maui `akepa range probably included wet and mesic forests down to sea level before human settlement (Lepson and Freed 1997) (USFWS, 2010). This bird occupied at least Maui Island, and one might expect that it also inhabited Moloka`i and Lana`i Islands like other forest birds in the Maui Nui group, but there are no fossil records of `akepa from any of these islands (James and Olson 1991) (USFWS, 2006).

Current Range

Occurs on Maui in Hawaiian Islands, if still extant. In the early 1980s, had a patchy distribution of about 20 square kilometers at elevations of 1,100-2,100 m; restricted to the Waikamoi watershed, Hanawi Natural Area Reserve, and the upper Kipahulu Valley. A population possibly may occur above Manawainui Valley (Scott et al. 1986) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores. Probably similar to other subspecies, which eat caterpillars, spiders, and occasionally nectar, and feed among leaves, buds, and flowers of forest canopy (Pratt et al. 1987). Uses bill to pry open plant parts (NatureServe, 2015). Rothschild (1893 to 1990) found Maui `akepa foraging in `ohi`a (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Occurs > 3,000 ft. elevation (USFWS, 2010)

Habitat Narrative

Adult: From Lepson and Freed (1997): Occurs from 1,100 to 2,100 m elevation in montane wet and mesic forests (Scott et al. 1986), primarily ohia montane mesic forest. Perkins (1903) found it in both koa and, more commonly ohia forest, whereas Henshaw (1902) reported it almost exclusively in koa (NatureServe, 2015). Native forested habitats on Maui as result of agriculture, urbanization, and ungulate grazing are now limited to high elevation montane regions above 3,000 – 4,000 feet elevation (USFWS, 2010).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Last confirmed sighting in 1988 (USFWS, 2015); possibly extinct (NatureServe, 2015)

Resiliency:

Very low (inferred from NatureServe, 2015; see current range/distribution)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

0 - 1 (NatureServe, 2015)

Population Size:

1 - 50 individuals (NatureServe, 2015)

Resistance to Disease:

Low (USFWS, 2015; see threats)

Population Narrative:

In the early 1980s occupied approximately 2 per cent of its inferred original range of just over 1000 square kilometers (Scott et al. 1986). This species has experienced a long term decline of > 90%. Scott et al. (1986) estimated a population of 230 +/- 290 based on survey in the early 1980s. This estimate probably "overly optimistic;" only eight individuals were recorded in the formal survey. There is only one possible occurrence; may be extinct. There are 24 known sight/specimen records: 6 recent (1987-1995) and 18 historical (1892-1980). The 1994 and 1995 records are audio detections, not visually confirmed (Hawaii Natural Heritage Program) (NatureServe, 2015). The last well-documented visual detection of this subspecies occurred in 1988 (Englis 1990) (USFWS, 2015). Since the last confirmed sightings of Maui ʻākepa in 1988 (Engilis 1990, p. 69) extensive time has been spent by qualified observers in the same area searching for this species, poʻouli (Melamprosops phaesosoma), and Maui nukupuʻu (Hemignathus affinis). Between September 1995 and October 1996, 700 hectares (1,730 acres) in Hanawī NAR were searched during 318 person-days (Baker 2001, p. 147) including the area of the 1988 sighting. During favorable weather conditions of good visibility and no wind or rain, teams would stop when "chewee" calls given by Maui parrotbill or kiwikiu (Pseudonestor xanthophrys), poʻouli, and Maui nukupuʻu were heard; either kiwikiu or ʻakiapōlāʻau (Hemignathus munroi) calls and songs would be played to attract the bird for identification. Six poʻouli were found but no Maui ʻākepa or Maui nukupuʻu were detected (Baker 2001, p. 147). The Maui Forest Bird Recovery Project (MFBRP) conducted searches from 1997 through 1999 in the area from Hanawī NAR to Koʻolau Gap (west of Hanawi NAR) for total 355 hours searches at 3 three sites; this effort yielded no detections of Maui ʻākepa (J. Vetter, U.S. Fish and Wildlife Service, pers. comm., 2018, p. 4). In total, from October 1995 through June 1999 the Hanawī NAR and nearby areas were searched for over 10,000 person-hours and failed to confirm earlier detections of Maui ʻākepa (Pratt and Pyle 2000, p. 37). MFBRP also searched Kīpahulu on northern Haleakalā from 1997 to 1999, for a total of 320 hours, but no Maui ʻākepa were detected. However, these searches were hampered by bad weather and playback was not used (J. Vetter, USFWS, pers. comm., 2018, p. 4). In addition, from 2006 to 2011 MFBRP biologists spent extensive time in the area of the last Maui ʻākepa sighting while working on kiwikiu recovery. No Maui ʻākepa were detected. The MFBRP project coordinator maintained that if Maui ʻākepa, Maui nukupuʻu, or poʻouli were present they would have been detected (H. Mounce, Hawaiʻi Division of Forestry and Wildlife, pers. comm., 2018, p. 1) (USFWS, 2018).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. Benning et al. (2002) used GIS simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by some climate models (e.g., IPCC 2013; ICAP 2010), would result in 100 years in a 50 percent decrease in the land area for Maui akepa where malaria transmission currently is only periodic. Lia et al. (2015) assessed how global

climate change will affect future malaria risk for native Hawaiian bird populations and expect high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for Maui akepa as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Habitat loss and degradation by agriculture, urbanization, cattle grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006). Feral pigs, and goats to a lesser degree, have had a long-term damaging effect upon native forests in the remaining Maui `akepa range by consuming and damaging understory vegetation, creating openings on the forest floor for weeds, transporting weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Predation by alien mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by alien mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006). Impacts of alien birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2010).

Stressor: Avian Disease (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: A recent analytic tool proposes using information on threats to infer species extinction based on an evaluation of whether identified threats are sufficiently severe and prolonged to cause local extinction and extensive in geographic scope to eliminate all individuals (Keith et al. 2017, p. 320). At elevations below 1,500 m (4,921 ft) in Hawaiʻi, the key factor driving disease epizootics of pox virus (Avipoxvirus) and avian malaria (Plasmodium relictum) is the seasonal and altitudinal distribution and density of the primary vector of these diseases, the mosquito Culex

quinquefasciatus (Atkinson and Lapointe 2009a, pp. 237-238, 245-246). The disappearance of many Hawaiian honeycreeper species over the last century from areas below 1,500 m (4,921 ft) points to the effects of avian disease having been sufficiently severe and prolonged and extensive in geographic scope to cause widespread species range contraction and possible extinction. It is highly likely avian disease is the primary causal factor for the disappearance of several species of Hawaiian honeycreepers from forested areas below 1,500 m (4,921 ft) on the islands of Kauaʻi, Oʻahu, Molokaʻi, and Lānaʻi and the retreat by Hawaiian honeycreepers to forest above 1,500 m (4,921 ft) on the higher islands of Maui and Hawaiʻi (Scott et al. 1986, p. 148; Banko and Banko 2009, pp. 52-53; Atkinson and Lapointe 2009a, pp. 237-238). Of historical sightings of Maui ʻākepa, all but one are above 1,500 m (4,921 ft) (USFWS 2006, p. 2-94) and there is a large area of native forest habitat at elevations above this where other species of Hawaiian honeycreepers still persist. 4 This suggests avian disease is not sufficiently persistent or extensive in geographic scope to be the sole or primary causal factor for the disappearance of Maui ʻākepa (USFWS, 2018).

Stressor: Small Populations (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: It is widely established that small populations of animals are inherently more vulnerable to extinction because of random demographic fluctuations and stochastic environmental events (Mangel and Tier 1994, p. 607; Gilpin and Soulé 1986, pp. 24- 34). Formerly widespread populations that become small and isolated often exhibit reduced levels of genetic variability, which diminishes the species' capacity to adapt and respond to environmental changes, thereby lessening the probability of long-term persistence (e.g., Barrett and Kohn 1991, p. 4; Keller and Waller 2002, p. 240; Newman and Pilson 1997, p. 361). As populations are lost or decrease in size, genetic variability is reduced resulting in increased vulnerability to disease and restricted potential evolutionary capacity to respond to novel stressors (Spielman et al. 2004, p. 15261; Whiteman et al. 2006, p. 797). With an estimated population in 1980 of only 230 birds (Scott et al. 1986, p. 154), and this potentially an over-estimation because, based on audio detections, effects of small population size are likely to have negatively impacted Maui ʻākepa, reducing its potential for long-term persistence (USFWS, 2018).

Stressor: Climate change and temperature increase (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: Climate change and temperature increase presents an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs. In Hawaiʻi, the threshold temperature for transmission of avian malaria is estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak Plasmodium relictum prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Atkinson and Lapointe 2009b, p. 58-59). Benning et al. (2002, p. 14248) used Geographic Information System simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by different climate models, in 100 years will result in a 57 percent reduction in the forest area with low risk of malarial infection for Hanawi NAR on Maui. Prevalence of malaria infection in forest birds increased significantly on Kauaʻi between the periods of 1994 to 1997

and 2007 to 2013 at elevations between 1,100 and 1,350 m (3,609 and 4,429 ft) in conjunction with increased air temperatures, declining precipitation, and changes in stream flow that improved conditions for mosquito breeding (Atkinson et al. 2014, p. 2427) A similar increase in malaria infection in forest birds would be expected on Maui for the same elevation range, given that surface air temperatures are increasing across all of the Hawaiian Islands (Giambelluca et al. 2008, p. 1). Hawaiian honeycreepers are highly vulnerable to avian malaria; for example, the ʻiʻiwi (Vestiaria coccinea) suffers high mortality with infection (Atkinson et al. 1995, p. S59) and sharp population declines have been observed (92 percent decline on Kauaʻi and 34 percent decline for the northeastern region of East Maui over 25 years) (Paxton et al. 2013, p. 5). The Maui ʻākepa is expected to have been similarly vulnerable to malaria. Liao et al. (2015, p. 3486) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and predicted even high elevation forest bird habitat (above 1,500 m) (4,921 ft) will remain relatively mosquito free only to the mid-21st Century (USFWS, 2018).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2010).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2010).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).

- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:

- Surveys / inventories: One of the most important recovery actions for the Maui akepa is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006). Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 1986) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, the Service recommends that an intensive search for Maui akepa be conducted on Maui using similar methodologies as those employed during the Hawaii Rare Bird Search 1994- 1996 (Reynolds and Snetsinger 2001). In addition, it is recommended that autonomous recording units, or ARUs (Fitzpatrick 2002; Wallace 2010), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2015).
- Threats – disease control research: Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. The Service encourages continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).
- Habitat and natural process management and restoration: Maui akepa would benefit in the long-term from habitat restoration to assist other endangered birds on Maui. The Service therefore recommend continued habitat management in areas where the species may still exist (USFWS 2006). Hawaiian forest birds susceptible to avian disease may become extinct following a drastic reduction in disease free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Acquisition and management of transmission-free high-elevation habitat is crucial to the preservation and restoration of native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, the Service recommends securing deforested and pasture lands on Maui at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for Maui akepa and other Hawaiian forest birds (USFWS, 2015).
- Captive propagation protocol development: Should Maui akepa be rediscovered the Service recommends the Rare Bird Discovery Protocol in the revised recovery plan for Hawaiian forest birds

(USFWS 2006) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2015).

- Surveys/Inventories: The number of Maui ʻākepa was estimated at 230 + 290 (Scott et al. 1986, pp. 37 and 154) during variable circular plot (VCP) surveys in 1980; however, this estimate was based on potentially confusing auditory detections, and not on visual observations (USFWS 2006, p. 20-136). VCP surveys are conducted using 8-minute point counts at survey stations spaced 100 to 250 meters (m) (328 to 820 feet (ft)) apart. Survey stations are along transect lines spaced 1.6 to 3.2 kilometers (1 to 2 miles) apart (Scott et al. 1986, pp. 34-40). Using VCP data, Scott et al. (2008, p. 7) estimated that 5,865 8-minute point counts would be needed to determine with 95% confidence the absence of Maui ʻākepa on Maui. However, in 2008, only 84 VCP counts were conducted. A 70-fold increase in VCP survey effort would be needed to determine the species extinction with 95% confidence (USFWS, 2018).
- Surveys/Inventories: Although VCP has been the primary method used to survey birds in Hawaiʻi it is not appropriate for all species and provides poor estimates for extremely rare birds (Camp et al. 2009, p. 92). In recognition of this problem, the Rare Bird Search (RBS) was undertaken from 1994 through 1996 to update the status and distribution of 13 "missing" Hawaiian forest birds (Reynolds and Snetsinger 2001, pp. 134-137). The RBS was designed to improve efficiency in search for extremely rare species using the method of continuous observation during 20- to 30-minute timed searches in areas where target species were known to have occurred historically, in conjunction with audio playback of species vocalizations (when available). Songs identified as Maui ʻākepa were heard on 25 October 1994, in Hanawī Natural Area Reserve (Hanawī NAR), and on 28 November 1995, in Kīpahulu Valley at 1,872 m (6,142 ft), but were not confirmed visually. Auditory detections of Maui ʻākepa require visual confirmation because of possible confusion with similar songs or mimicry by Maui Parrotbill (Pseudonestor xanthophrys) (Reynolds and Snetsinger 2001, p. 140). Reynolds and Snetsinger 2001 (p. 137) defined a "confirmed" sighting as "one sighting of a bird by two observers or at least two separate sightings in the same vicinity by different experienced observers." (USFWS, 2018).
- Surveys/Inventories: Forest bird surveys were conducted on East Maui in 2011-2012 (R. Camp, U.S. Geological Survey, pers. comm. 2015, p. 2) and 2017 (Smith 2018, p. 2). No Maui ʻākepa were detected (USFWS, 2018).
- Captive propagation for reintroduction and genetic storage – There are instances where rare Hawaiian birds have been rediscovered after they were presumed extinct or have been found in larger populations than expected (Reynolds and Snetsinger 2001, p. 142). Should Maui ʻākepa be rediscovered we recommend the Rare Bird Discovery Protocol in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006, pp. 3-17 – 3-21) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2018).

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SPECIES ACCOUNT: *Megapodius laperouse* (Micronesian megapode)

Species Taxonomic and Listing Information

Listing Status: Endangered; 06/02/1970; Pacific Region (R1) (USFWS, 2016)

Physical Description

A medium-sized (38 cm), dark megapode with paler head. Mostly brownish-black with short pale grey crest. Yellow bill, red facial skin showing through thin feathers. Unusually large, dingy yellow legs and feet (USFWS, 2016)

Taxonomy

The Megapodiidae are a family within the order Galliformes (chicken-like birds) found only in the Australasian region. Presently 22 extant species are recognized and, of these, 13 are in the genus Megapodius, often called "scrub fowl" (Jones et al. 1995) (USFWS, 1998). Other names include sasangat in Chamorro and sasangal in Carolinian (USFWS, 2016).

Historical Range

The Micronesian megapode was historically widespread in the Mariana Islands and has been recorded on all of the islands (USFWS, 1998).

Current Range

Relatively large populations are thought to occur on only a few of the uninhabited northern islands (Sarigan, Guguan, and Asuncion). It has been extirpated from several of the large southern Mariana islands (Guam, Rota, and possibly Tinian). Recent surveys indicate that megapodes have recolonized Anatahan (USFWS, 2010 unpublished data) (USFWS, 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

<u>Adult:</u> The Micronesian megapode seems to be an omnivore taking a variety of plant and animal foods available on the forest floor, including seeds, beetles, ants, other insects, and plant matter (Stinson 1993). Feeding observations reported include ants and ant larvae (Glass and Aldan 1988), and a centipede (D. Stinson, 1990 field notes). Glass and Aldan (1988) reported that foraging usually consists of vigorous digging under ferns, branches, and leaf litter. They also saw birds foraging in trees, usually in bird's nest ferns (Asplenium nidus) (USFWS, 1998).

Reproduction Narrative

<u>Adult:</u> Megapodes primarily select nest sites in sun-warmed cinder fields or areas warmed by geothermal heat, but secondarily will nest in the roots of rotting trees, logs, and in patches of rotting sword grass. Baker (1951) stated that the breeding season for both Megapodius laperouse senex and M l. laperouse appeared to be January to August. However, Glass and

Aldan (1988) observed a high level of vocalization and nesting activity on Guguan in September and a reduced level the following May. Oustalet (1896) reported that chicks emerged from nests from January or February to June. In recent years, chicks of all sizes have been seen in May and August on Guguan (Glass and Aldan 1988, Rice and Stinson 1992, Clapp 1983) and in September on Sarigan (Rice et al. 1990). Nesting on some islands may occur year-round. Megapodes are sometimes called "incubator birds" because they rely on solar energy, volcanic activity, or microbial decomposition as a heat source for incubation (Clark 1964). Micronesian megapodes lay a very large egg. There is no information on the number of eggs laid in a season by M. laperouse laperouse. The chicks are super-precocial (fully active), being completely independent and able to fly upon emergence (USFWS, 1998).

Habitat Narrative

Adult: Micronesian megapodes are generally dependent on native limestone forest, but may occasionally use native and non-native secondary forest adjacent to limestone forest (USFWS, 1998).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 1998)

Dispersal

Adult: Moderate (inferred from USFWS, 2010)

Dispersal/Migration Narrative

Adult: The territory size in limestone forest for megapodes on Aguiguan island was recently estimated at 3.76 ha (Kessler and Amidon 2009) (USFWS, 2010). Based on the distribution of the Megapodiidae, Olson (1980) stated that megapodes are quite capable of dispersing by flying over water for considerable distances (USFWS, 1998).

Population Information and Trends

Population Trends:

Not available

Resiliency:

Low (inferred from USFWS, 2010; see current range/distribution)

Population Size:

1,440 - 1,975 (USFWS, 1998). New in 2016: The most recent population estimate for the Micronesian Megapode in the Mariana Islands is over 10,500 individuals on 12 islands with the majority of the population found on Sarigan, Guguan, and Asuncion (Amidon et al. 2011; Table 1). (USFWS, 2016).

Population Narrative:

The total number of individuals throughout the Marianas archipelago is estimated to be 1,440 to 1,975 birds (USFWS, 1998).

Threats and Stressors

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Sightings of the brown treesnake on Saipan suggest it may be in the process of becoming established there (Rodda and Savidge 2007). The brown treesnake was accidentally introduced to Guam around 1949 causing the extirpation or extinction of 13 of Guam's 22 native breeding birds (Rodda and Savidge 2007), including the Micronesian megapode. The establishment of a breeding population of the brown treesnake on Saipan would likely eventually lead to the extirpation of megapodes there as occurred on Guam. Other predators of concern include monitor lizards (Varanus indicus) dogs, cats, and pigs (Sus scrofa). The possibility of avian flu or West Nile virus reaching the Mariana Islands from Asia or the U.S. mainland is a recent concern. The impact these two diseases may have on the Micronesian megapode is not known at this time, but both diseases have had deleterious impacts to many avian species elsewhere, and could negatively affect the Micronesian megapode if they reach the Mariana Islands (USFWS, 2010).

Stressor: Habitat loss and degradation (USFWS, 2010 and 1998)
Exposure:
Response:
Consequence:
Narrative: The main threat to the Micronesian megapode continues to be the loss and degradation of habitat mainly due to clearing and feral ungulates. An additional concern is that the proposed expansion of military training on Guam and in the CNMI may result in the loss, degradation, or fragmentation of megapode habitat (occupied or unoccupied). In addition, increased training on Guam and in the CNMI may increase the chance of brown treesnake introductions to other islands (USFWS, 2010). High prehistoric human populations, and later, large numbers of cattle and pigs, particularly on Tinian, had a profound effect on the vegetation in the southern islands. Tinian was described in 1742 as having broad open savannahs with thousands of cattle (Barratt 1988). Early in this century, much of the native forest in the Marianas, particularly on Saipan, Tinian, and Aguiguan, was cleared for agriculture. During the Second World War, forests in Micronesia were further damaged by clearing for military operations, bombing and other fighting (Baker 1946). In addition to historical losses, forest habitat on the southern islands is now being converted to golf courses and urban development (USFWS, 1998).

Stressor: Volcanic activity/natural phenomena (USFWS, 2010 and 1998)
Exposure:
Response:
Consequence:
Narrative: Volcanic eruptions likely resulted in the extirpation of megapodes from Anatahan in 2005 and may have reduced the megapode population on Pagan (USFWS 1998). Guguan, Alamagan, and Agrihan Islands have experienced eruptions and megapode populations on these islands are also vulnerable (USFWS, 2010). Drought may affect the ability of birds to dig burrows in cinder soil, and affect food availability (Reichel et al. 1988). Also, typhoons periodically

degrade forest habitat (on Saipan, Glass and Aldan 1988; on Maug, Wiles et al. 1989; and on Rota, Stinson et al. 1992) (USFWS, 1998).

Stressor: Harvest (USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Marche predicted that megapodes would not last long on Rota and Saipan because islanders hunted them intensely (Oustalet 1896). Megapodes were overexploited on the southern islands, and possibly on all inhabited islands. Human exploitation of nests was still a problem when Ludwig visited Agrihan in 1978. Megapodes are now protected by both Federal and local laws, and there have been no recent reports of exploitation. However, megapodes are fairly conspicuous and relatively tame, making them vulnerable to hunting with firearms or pellet guns. Also, concentrated nesting areas in the northern islands are vulnerable to the collection of eggs. The only indication that poaching may be a problem is the apparent increase in birds on Alamagan after the human residents were evacuated in 1990 (USFWS, 1998).

Stressor: New in 2016: Military activities, mortality, and reduced viability – U.S. Department of the Navy's (U.S. Navy) CNMI Joint Military Training CJMT) proposed training on Pagan and Tinian (U.S. Navy 2015) could generate noise levels, increase the chances of invasive species introductions, and increase human presence on the island all of which could negatively impact the Micronesian Megapode on that island. In addition, FDM continues to be used as a bombing target. (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative:

Recovery

Reclassification Criteria:
1. An interdiction and control plan for the brown treesnake (Boiga irregularis) must be in place and implemented throughout the Mariana Islands (USFWS, 2010).

2. Current threats to all extant megapode populations must be assessed and controlled (USFWS, 2010).

3. The comparatively large populations on Anatahan, Sarigan, Guguan, Pagan, and Maug must remain at their current population levels or be increasing for a period of 5 consecutive years (USFWS, 2010).

Delisting Criteria:
1. The total number of Micronesian megapodes in the Mariana Islands should be at least 2,650 birds distributed over 10 islands, including at least 2 populations of 600 birds or greater, 3 populations of 300 or greater, 2 populations of 200 or greater, and 3 populations of 50 or greater (USFWS, 2010).

2. All populations must be stable or increasing for 5 consecutive years after achieving these levels (USFWS, 2010).

Recovery Actions:

- Survey for, protect, and manage existing populations (USFWS, 1998). Refinement in 2016: Develop and implement plans to monitor Micronesian Megapode populations on all islands on a regular basis. (USFWS, 2016).
- Conduct essential research on the ecology and biology of Micronesian megapodes (USFWS, 1998). Refinement for 2016: Conduct a population viability analysis (PVA) to determine the minimum viable population number by island needed for recovery, and Conduct surveys every year for at least 10 years to determine actual status of the species. (USFWS, 2016).
- Promote expansion of megapodes into suitable habitat (USFWS, 1998).
- Monitor megapode populations (USFWS, 1998). Refinement in 2016: remove ungulates from the islands with larger megapode populations, including Aguiguan, Alamagan, and Pagan. (USFWS, 2016).
- Establish a brown tree snake interdication and control plan (USFWS, 1998). New in 2016: Emphasis on Guam "Continue to implement large-scale brown treesnake control and/or eradication efforts on Guam. Continue to work on preventing the establishment of the brown treesnake on other Mariana Islands from Guam. Determine what additional actions or changes are needed to address brown treesnake interdiction/control." (USFWS, 2016).
- "Predator/herbivore control research – Prioritize islands most in need of predator control, implement predator control and utilize improved methods as they become available." (USFWS, 2016).
- Invasive plant monitoring and control – Restore native forest and conduct forest restoration programs. (USFWS, 2016).
- Update the recovery plan (USFWS 1998). Use recent survey data to reevaluate and revise down- and delisting criteria as appropriate. (USFWS, 2016).

Conservation Measures and Best Management Practices:

- Survey, protect, and manage existing populations (USFWS, 2010).
- Conduct essential research on the ecology and biology (USFWS, 2010).
- Assess and control threats (USFWS, 2010).
- Promote expansion of megapodes in suitable habitat (USFWS, 2010).
- Monitor megapode populations (USFWS, 2010).
- Continue implementation of brown treesnake interdiction and control plans and establish new plans as needed (USFWS, 2010).

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SPECIES ACCOUNT: *Melamprosops phaeosoma* (Po`ouli (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed delisting

Physical Description

A small song bird (about 5.5 inches long, 25 g), brown above and pale gray below; black face mask extends from forehead, throat, and chin to a point behind the eye; bill is short and black; wings are short and rounded, and tail is so short the bird appears almost tailless (NatureServe, 2015). Added in 2018: The poʻouli is a medium sized Hawaiian honeycreeper endemic to the island of Maui easily recognized by its brown plumage and characteristic black mask framed by a gray crown and white cheek patch. Fledglings have whitish underparts, a mask smaller than that of the adults, and pale tip to the mandible (USFWS 2006, p. 2-144). (USFWS, 2018).

Taxonomy

Various morphological, vocal, and behavioral characteristics (and odor) indicate that this species is not a member of the Hawaiian honeycreeper subfamily Drepanidinae (Pratt 1992); relationships are unknown (NatureServe, 2015).

Historical Range

Bones tentatively identified as of this species were found in a lava tube on the southwest slopes of Haleakala in 1982 (Matthews and Moseley 1990) (NatureServe, 2015). Fossil evidence shows that the po`ouli once inhabited drier forests at lower elevation on the leeward slope of Haleakala, indicating it once had a much broader geographic and habitat range (USFWS 2006; USFWS, 2011).

Current Range

Known in Hawaii: rare and local in a single locality on northeastern slope of Haleakala, Maui (Pratt et al. 1987), between upper forks of Hanawi stream. Found above 1,360 m in Koolau forest (Casey and Jacobi 1974); elevations of 1,440 - 1,720 m (Matthews and Moseley 1990); in 1995, one was seen nearly 330 m lower in elevation than the previous sightings (Reynolds et al. 1995) (NatureServe, 2015). The large area on East Maui with suitable habitat (approximately 11,715 hectares [28,948 acres]) (USFWS 2012), and the many remote areas within this that are only rarely visited by qualified observers, increase the potential that a small population of poouli could still exist on Maui (USFWS, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores. Creeps over bark of trees (especially ohia, olapa, ohelo, and kanawoa), probes under or tears into moss, lichens, epiphytes, and bark; searches leaves, branches, and trunks, and searches among leaves on the ground; eats "extraordinary numbers" of land snails, various arthropods, and fruit (Pratt et al. 1997). This species exhibits a diurnal phenology (NatureServe, 2015). Based on foraging observations, Mountain spring et al. (1990) believed that po`ouli took proportionately more Lepidoptera and Coleoptera larvae. The most common food items seen delivered to po`ouli chicks were these larvae and Succineid snails (Hawaiian land snails in the family Succineidae) (Kepler et al. 1996) (USFWS, 2006).

Reproduction Narrative

Adult: Nests have been found in the upper branches of ohia trees (Fackelmann 1992) (NatureServe, 2015). Knowledge of po`ouli breeding biology is based on two sequential nestings by the same pair in 1986 (Kepler et al. 1996). Egg-laying took place on about March 10 and April 26 and 27 for the first and second nests, respectively. Clutch size was probably two eggs. The second, successful nest fledged only one of the two young, which spent 21 days in the nest. The female alone incubated the eggs and brooded the chicks, but both parents fed the chicks. The male fed the female at or away from the nest throughout the nesting cycle (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: 4,750 - 7,000 ft. elevation (USFWS, 2006)

Spatial Arrangements of the Population

Adult: Small mixed species flocks (NatureServe, 2015); solitary, pairs, family groups (USFWS, 2006)

Habitat Narrative

Adult: Inhabits humid mountain forest, primarily ohia (AOU 1983). Frequents understory plants in ohia forest, sometimes just below canopy. Associated with closed-canopy ohia forest with dense shrub understory (Matthews and Moseley 1990). The current occupied habitat may be suboptimal, since prehistorically the Po'ouli inhabitant much drier habitats (Mountain spring et al. 1990, cited in Pratt et al. 1997). Often joins small groups that include creeper and parrotbill (Pratt et al. 1987) (NatureServe, 2015). Po`ouli have been observed singly, in pairs, and in family groups with a single young (Pratt et al. 1997b). Po`ouli occur in montane wet forests from timberline at 2,100 meters (7,000 feet) elevation down to a lower limit of 1,440 meters (4,750 feet) (USFWS, 2006).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 10% (NatureServe, 2015)

Species Trends:

Unknown (USFWS, 2015)

Resiliency:

Low (inferred from USFWS, 2015; see current range/distribution)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

1 (NatureServe, 2015)

Population Size:

1 - 50 individuals (NatureServe, 2015)

Resistance to Disease:

Low (USFWS, 2015)

Additional Population-level Information:

From 2006 to 2011, MFBRP biologists spent extensive time in the area of the last poʻouli sightings while working on Maui parrotbill or kiwikiu (Pseudonestor xanthophrys) recovery. No po'ouli were detected. Forest bird surveys were conducted on East Maui in 2011-2012 (R. Camp, U.S. Geological Survey, pers. comm. 2015, p. 2) and 2017 (Smith 2018, p. 2). No po'ouli were detected. (USFWS, 2018).

Population Narrative:

This species has experienced a long term decline of > 10%. Only three individuals known to be alive in 2000; these are two female and one male singletons that occupy isolated home ranges. One female has not been detected in six months (J. Bruch, pers. comm.; Rosa et al. 1998). Pratt et al. (1997) stated that "a population estimate for 1996 of 10 birds may be too large." One small population remains (Pratt et al. 1997; Rosa et al. 1998) (NatureServe, 2015). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). The status of the species is unknown (USFWS, 2015). As late as 2003, three po`ouli were known to still exist in three separate territories within the Hanawi NAR (USFWS 2006; USFWS, 2011).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. Lia et al. (2015) assessed how global climate change will affect

future malaria risk for native Hawaiian bird populations and expect high elevation areas to remain mosquito free only to midcentury due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for poouli as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Habitat loss and degradation by agriculture, urbanization, cattle grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006; USFWS, 2011).

Stressor: Nonnative species (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Feral pigs, and goats to a lesser degree, have had a long-term damaging effect upon native forests in the remaining po`ouli range by consuming and damaging understory vegetation, creating openings on the forest floor for weeds, transporting weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants. Impacts of alien birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2011).

Stressor: Disease and predation (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Predation by alien mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by alien mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2011).

Stressor: Stochastic events (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2011).

Recovery

Reclassification Criteria:

1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2011).

2. Either (a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or (b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2011).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2011).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2011).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2011).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories – One of the most important recovery actions for the poouli is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006). Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 1986) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, the Service recommends that an intensive search for poouli be conducted on Maui using similar methodologies as those employed during the Hawaii Rare Bird Search 1994-1996 (Reynolds and Snetsinger 2001). In addition, the Service recommends that autonomous recording units, or ARUs (Fitzpatrick 2002; Wallace 2010), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer

programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2015).

- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. the Service encourage continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).
- Habitat and natural process management and restoration – Poouli would benefit in the long-term from habitat restoration to assist other endangered birds on Maui. The Service therefore recommends continued habitat management in areas where the species may still exist (USFWS 2006). Hawaiian forest birds susceptible to avian disease may become extinct following a drastic reduction in disease free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Acquisition and management of transmission-free high-elevation habitat is crucial to the preservation and restoration of native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, the Service recommend securing deforested and pasture lands on Maui at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for poouli and other Hawaiian forest birds (USFWS, 2015).
- Captive propagation for reintroduction and genetic storage – Should poouli be rediscovered the Service recommends the Rare Bird Discovery Protocol in the revised recovery plan for Hawaiian forest birds (USFWS 2006) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2015).

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SPECIES ACCOUNT: *Moho braccatus* (Kauai `o`o (honeyeater))

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed for deslisting

Physical Description

An 8-inch blackish bird with yellow leg feathers. Smallest Hawaiian honeyeater; had short tail with no markings, and the least amount of yellow feathering in its plumage (Sykes et al. 2000). Sexes similar in appearance, but female generally smaller; mass unknown, total length 206 - 242 mm for males, 179 -225 mm for females; bill about equal to head in length; slender, sharp, and slightly decurved; head, wings, and tail black, crown feathers stiff and lanceolate; forehead and crown more intensely black than rest of plumage, and slightly glossy (Sykes et al. 2000). Crown sparingly streaked with white, back slaty brown; rump and upper tail-coverts paler brown; bend of wing and under wing coverts white; chin, throat, and upper breast black with transverse subterminal white bars giving scaly appearance; feathered part of leg yellow in adults, black in immatures (Sykes et al. 2000) (NatureServe, 2015).

Taxonomy

The Kaua`i `o`o or `o`o `a`a is one of four known Hawaiian species of the genus Moho and one of five known Hawaiian bird species within the honeyeater family, Meliphagidae (Sykes et al. 2000) (USFWS, 2006).

Historical Range

See current range/distribution.

Current Range

Historically occurred throughout Kauai, Hawaiian Islands, now probably extinct. In the 1970s and 1980s it was known only from southeastern portions of the Alakai Swamp (Sykes et al. 2000) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

<u>Adult:</u> Adults and immatures are invertivores, frugivores, and nectarivores. Eats arthropods, small snails, berries, nectar of lobelia and ohia. This species exhibits a diurnal phenology (NatureServe, 2015).

Reproduction Narrative

<u>Adult:</u> A nest containing two young was found in late May during the early 1970s (Matthews and Moseley 1990) (NatureServe, 2015). The only known nests were located in cavities of large dead `ohi`a snags. There is little information on the extent of the nesting season, but two nestlings

were reported in a single nest in June 1971, and two other nests were monitored in late May and early June (Sincock 1982) (USFWS, 2006).

Habitat Narrative

Adult: Richardson and Bowles (1964) described habitat as thick forest, with `o`o preferring high elevation canyons rather than forested ridges (Sykes et al. 2000). Scott et al. (1986) indicated that `o`o historically used six forest types; arid low elevation woodland, dry lowland forest, mesic lowland forest, mesic montane forest, wet lowland forest, and wet montane forest (Sykes et al. 2000). May defend favored flowering ohia trees (NatureServe, 2015).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015)

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Possibly extinct (NatureServe, 2015); uncertain, last detected in 1987 (USFWS, 2009)

Resiliency:

Very low (inferred from NatureServe, 2015; see historical range/distribution)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

0 - 1 (NatureServe, 2015)

Population Size:

Zero to 50 individuals (NatureServe, 2015)

Adaptability:

Very low (inferred from NatureServe, 2015)

Additional Population-level Information:

Several recent surveys and searches, including the RBS, have been unsuccessful in detecting Kauaʻi ʻōʻō despite intensive survey efforts by wildlife biologists in 1993, 1994, 2000, 2005, and 2011 to 2018 (Hawaiʻi Department of Land and Natural Resources unpubl. data; Reynolds and Snetsinger 2001, Crampton et al. 2017, L. Crampton pers. comm. 2018). Extensive time,,,, has been spent by qualified observers in the historical range of Kauaʻi ʻōʻō searching for puaiohi (Myadestes palmeri), ʻakekeʻe (Loxops caeruleirostris) and ʻakikiki (Oreomystis bairdi). Hawaiʻi

Forest Bird Surveys were conducted in 1981, 1989, 1994, 2000, 2005, 2007, 2008, 2012, and 2018 (Paxton et al. 2016, L. Crampton pers. comm. 2018). The Kauaʻi Forest Bird Recovery Project (KFBRP) conducted occupancy surveys for puaiohi in Kokeʻe State Park, Hono O Na Pali Natural Area Reserve, Na Pali Kona Forest Reserve and the Alakaʻi Wilderness Preserve, from 2011 to 2013 (Crampton et al. 2017) and spent over 1,500 person hours per year from 2015 to 2018 searching for ʻakikiki and ʻakekeʻe nests. Hawaiʻi Forest Bird Surveys (HFBS) in 2012 and 2018, occupancy surveys and nest searches did not yield any new detections of Kauaʻi ʻōʻō. The KFBRP conducted mist netting in various locations within the historical range for Kauaʻi ʻakialoa from 2006 through 2009 and from 2011 through 2018, and no Kauaʻi ʻakialoa or ʻōʻō were caught or encountered (L. Crampton pers. comm. 2018). (USFWS, 2019).

Population Narrative:

Common throughout Kauai in the late 1800s; rare by 1920; total population was estimated at 36 in 1968 - 1973; declined drastically in the 1970s; only one or at most a few individuals survived in the mid-1980s (Pratt et al. 1987, USFWS 1983, Scott and Kepler 1985, Scott 1986, Scott et al. 1988, Sykes et al. 2000). This species has experienced a long term decline of > 90%. Only one individual, a male, was thought to exist in 1988, and this bird was not seen in its usual location in 1989 (Pyle 1990). No detections were made on a 1993 post-Hurricane Iniki survey. There is at most one remaining population in the southeastern portion of Alakai Swamp; probably extinct (Sykes et al. 2000) (NatureServe, 2015). Reevaluation of conclusions regarding extinction probability based on the 1994 to 1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001) and reexamination of data from the Hawaiian Forest Bird Survey (Scott et al. 1986) and surveys by John Sincock from 1968 to 1973 (USFWS 1983) indicates that the species' status is best described as uncertain. The last documented sighting of this species occurred in 1981 when Scott et al. (1986, pages 103 to 105) discovered one pair of Kaua`i `o`o during the Hawaiian Forest Bird Survey, and the last well-documented audio detection of this species occurred in 1987 (Pyle 1988) (USFWS, 2009).

Threats and Stressors

Stressor: Nonnative species (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Habitat degradation resulting from the invasion of nonnative weeds has dramatically changed the forest structure and integrity. Two hurricanes in 1982 and 1992 severely disrupted portions of high quality native forest, and have made space for the germination and expansion of noxious weeds such as Hedychium flavescens (yellow ginger), Erigeron karvinskianus (daisy fleabane), Tibouchina urvilleana (glorybush), Lonicera japonica (Japanese honeysuckle), and others (USFWS 2006). Impacts of nonnative birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2009).

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:

Narrative: Habitat destruction by agricultural development reduced the Kaua`i `o`o's lowland range, but does not explain the sudden decline noted in the interior uplands as well. The use of large old-growth snags for nesting and the paucity of any large-timbered forests after the turn of the century may have limited the Kaua`i `o`o's ability to find suitable nest sites, particularly after two hurricanes struck Kaua`i in 1982 and 1992. Other impacts on their habitat, such as forest damage by feral pigs (Sus scrofa), goats (Capra hircus), and the spread of nonnative invasive plants, likely had a supplemental negative impact on the species (USFWS, 2009).

Stressor: Disease and predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: After the turn of the century, many of the native lowland birds disappeared as a large number of nonnative birds were introduced. Some of these nonnative species may have harbored foreign diseases or parasites for which the Kaua`i `o`o had little or no immunity. The mosquito vector of blood-borne diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) was already well established, and could have brought about a rapid decline of a highly susceptible endemic bird. The fact that other species in the same genus, Moho, on other islands suffered a similar fate during approximately the same period suggests disease as a major limiting factor, coupled with the fact that the last Kaua`i `o`o were found only at higher mosquito-free elevations. The use of cavity nests by this species may also make it more susceptible to foraging rats known to be numerous in Hawai`i's forests. Nonnative Polynesian rats (Rattus exulans) are presumed to have become established in the islands with the arrival of the first Polynesian settlers (Tomich 1969, pages 42 to45). The black rat (Rattus rattus) evidently established itself in Hawai`i after the advent of the European explorers in the late 1700s. The demise of many of Hawai`i's forest birds seemed coincident with the arrivals of various new nonnative fauna, yet the Kaua`i `o`o decline was apparently quite sudden, suggesting a particular susceptibility to a single potent limiting factor (USFWS, 2009).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2009).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2009).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average

intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2009).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2009).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2009).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2009).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Conduct intensive searches for the Kaua`i `o`o on Kaua`i using similar methodologies as those employed during the 1994 to 1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001). Include areas not surveyed during the 1994 to 1996 Hawai`i Rare Bird Search in these surveys (USFWS, 2009).
- Deploy autonomous recording units, or ARUs (Fitzpatrick 2002) in suitable habitats for this species. These field recording units record vocalizations of forest birds. The recordings can then be analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2009).

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SPECIES ACCOUNT: *Myadestes lanaiensis rutha* (Molokai thrush)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/13/1970; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Moloka`i Thrush is about 7 inches in length and has a dark brown top, and gray belly (USFWS, 2016). The olomao is a medium sized solitaire with olive-brown upper parts, grayish white under parts, and a buffy patch at the base of the primaries. The bill and legs are dark. Juveniles exhibit the same scalloped plumage as other young native thrushes; i.e., omao (Myadestes obscurus) and puaiohi or small Kauai thrush (Mydadestes palmeri) (USFWS 2006; USFWS, 2015).

Taxonomy

The oloma`o is a member of the thrush family (Turdidae). Recent changes in the taxonomy of the Hawaiian thrushes have done away with the endemic genus Phaeornis and instead placed them with the New World solitaires, Myadestes, to which they are similar in appearance and song (Pratt 1982, American Ornithologists' Union 1985). The two subspecies, M. l. lanaiensis of Lana`i (now extinct) and M. l. rutha of Moloka`i (more grayish below), cannot be safely distinguished by coloration or measurements (Pratt 1982) (USFWS, 2006).

Historical Range

Oloma`o range historically included forested montane regions of East Moloka`i, Maui, and Lana`i Islands (USFWS, 2009).

Current Range

Very small population is (or was) resident in the Hawaiian Islands on Molokai; upper forests of Mt. Olokui, the Kamakou Preserve, and the Ohialele Plateau (Scott et al. 1986, Pratt et al. 1987) (NatureServe, 2015). The large area on East Molokai with suitable habitat (approximately 2,300 hectares [5,700 acres]) (USFWS 2012), and the many remote areas within this that are only rarely visited by qualified observers, increase the potential that a small population of olomao could still exist on Molokai (USFWS, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

<u>Adult:</u> Adults and immatures are frugivores and invertivores. Eats fruits, insects, and snails taken under the forest canopy. (NatureServe, 2015). insects are taken at all levels in the forest (Rothschild 1893 to 1900, Perkins 1903, Bryan 1908) (USFWS, 2006).

Reproduction Narrative

Adult: Three nests attributed to oloma`o were 8 to 9 meters (26 to 30 feet) up in `ohi`a (Metrosideros polymorpha; two nests) and kolea (Myrsine spp.; one nest) trees; one of the nests was found in May, and the dates of the other two were not recorded (Perkins 1903, Bryan Three nests attributed to oloma`o were 8 to 9 meters (26 to 30 feet) up in `ohi`a (Metrosideros polymorpha; two nests) and kolea (Myrsine spp.; one nest) trees; one of the nests was found in May, and the dates of the other two were not recorded (Perkins 1903, Bryan 1908) (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Occurs > 3,300 ft. elevation (USFWS, 2006)

Spatial Arrangements of the Population

Adult: Solitary or pairs (USFWS, 2006)

Habitat Narrative

Adult: Inhabits wet montane ohia forest with olapa and dense understory of mosses, vines, and tree ferns. Stays beneath forest canopy except for occasional short flights (Pratt et al. 1987) (NatureServe, 2015). Oloma`o live solitarily or in pairs and seldom leave their small home range (Bryan 1908, Ralph and Fancy 1994b). The most recent records have all been from dense rainforest above 1,000 meters (3,300 feet) elevation adjacent to the steep pali (cliff) of Pelekunu (Scott et al. 1986) (USFWS, 2006).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Low (inferred from USFWS, 2006; see habitat narrative)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Unknown; last confirmed sighting in 1980 (USFWS, 2015); possibly extinct (NatureServe, 2015)

Resiliency:

Very low (inferred from USFWS, 2015; see current range/distribution)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

0 - 2 (NatureServe, 2015)

Population Size:
1 - 1000 individuals (NatureServe, 2015)

Resistance to Disease:
Low (USFWS, 2015)

Adaptability:
Very low (inferred from NatureServe, 2015)

Additional Population-level Information:
"Surveys for Hawaiian forest birds using the variable circular-plot method as previously conducted by Scott et al. (1986, pp. 34-40) were conducted in forest areas on Molokaʻi in 2010 in areas with historical occurrence of olomaʻo (R. Camp, U.S. Geological Survey, pers. comm. 2015). Olomaʻo were not detected during these surveys. • In response to the reported sighting in May, 2005 of an olomaʻo near ʻŌhiʻalele just below Puʻu Aliʻi Natural Area Reserve (Puʻu Aliʻi NAR) (Ken Wood, e-mail communication with Fern Duvall, 2005), biologists John Vetter and Kristy Swinnerton spent two to three days in Puʻu Aliʻi NAR, shortly after the reported sighting. Using playback recordings for olomaʻo they covered the Puʻu Aliʻi NAR well, but no olomaʻo were detected (John Vetter, USFWS, pers. comm., 2018). • During a four-day Olokuʻi Plateau biological survey in 2015 there were several sightings of olomaʻo near ʻŌhiʻalele in The Nature Conservancy Pelekunu Preserve by a Hawaiʻi Division of Forestry and Wildlife (DOFAW) employee (Oppenheimer et al. 2015, p. 8). These sightings however were not confirmed by a second observer. • Scott et al. (2008, p. 7) estimated the number of 8-minute variable circular-plot surveys needed to be 8,916 to determine with 95% confidence the absence of olomaʻo on Molokaʻi. In 2008, only 120 variable circular-plot surveys had been conducted on Molokaʻi in areas where olomaʻo might still exist. A 68-fold increase in survey effort using the variable circular-plot survey methodology would be required to determine with 95% confidence the absence of olomaʻo in areas of suitable habitat for the species. (USFWS, 2018)."

Population Narrative:
Formerly common throughout Molokai; declined rapidly in the early 1900s. Presumed extinct by 1930s, but there were a few confirmed sightings 1964 - 1980. No confirmed sightings since that time (Wakelee and Fancy 1999). This species has experienced a long term decline of > 90%. One was recorded during a 1988 Molokai survey (USFWS 1990); however Wakelee and Fancy (1999) stated that there are no confirmed records since 1980. May be extinct; perhaps one or two extant occurrences (Wakelee and Fancy 1999) (NatureServe, 2015). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). The last confirmed detection of olomao was in 1980 (Reynolds and Snetsinger 2001). The status of the species is unknown (USFWS, 2015).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:

Consequence:
Narrative: According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. Benning et al. (2002) used GIS simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by some climate models (e.g., IPCC 2013; ICAP 2010), would result in 100 years in the virtual complete disappearance from Kauai of habitat where malaria transmission currently is only periodic. Kauai is a taller island than Molokai and it is expected effects of climate change will be similar on Molokai. Lia et al. (2015) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and expect even high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for olomao as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Habitat loss and degradation by agriculture, urbanization, cattle (Bos taurus) grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006). Feral pigs (Sus scrofa), and goats (Capra hircus) to a lesser degree, have had a long-term damaging effect upon native forests in the remaining oloma`o range by consuming and damaging understory vegetation, creating openings on the forest floor for nonnative weeds, transporting nonnative weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants (USFWS, 2009).

Stressor: Disease and predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Predation by alien mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by alien mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2009).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2009).

Stressor: Nonnative birds (USFWS, 2009)
Exposure:

Response:
Consequence:
Narrative: Impacts of nonnative birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2009).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2009).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2009).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2009).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2009).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2009).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006). Recommendation for disease control research and habitat management and restoration continued in 2018. (USFWS, 2018).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).
- New in 2018: Surveys/inventories o One of the most important recovery actions for the olomaʻo is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006, p. 3-17). Statewide surveys of Hawaiian forest bird

populations are conducted along widely spaced transects (Scott et al. 1986, p. 37) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, we recommend that an intensive search for olomaʻo be conducted on Molokaʻi using similar methodologies as those employed during the Hawaiʻi Rare Bird Search 1994-1996 (Reynolds and Snetsinger 2001, pp. 134 and 137). o In addition, we recommend that autonomous recording units, or ARUs (Fitzpatrick 2002, pp 1-2; Wallace 2010, p. 26), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species. (USFWS, 2018).

Conservation Measures and Best Management Practices:

- Surveys / inventories: One of the most important recovery actions for the olomao is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006). Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 1986) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, the Service recommends that an intensive search for olomao be conducted on Molokai using similar methodologies as those employed during the Hawaii Rare Bird Search 1994 -1996 (Reynolds and Snetsinger 2001). In addition, the Service recommends that autonomous recording units, or ARUs (Fitzpatrick 2002; Wallace 2010), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2015).
- Threats – disease control research: Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. The Service encourages continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).
- Habitat and natural process management and restoration: Olomao would benefit in the long-term from habitat restoration to assist other native Hawaiian forest birds on Molokai (USFWS, 2015).
- Captive propagation for reintroduction and genetic storage: Should olomao be rediscovered the Service recommends the Rare Bird Discovery Protocol in the revised recovery plan for Hawaiian forest birds (USFWS 2006) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2015).

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SPECIES ACCOUNT: *Myadestes myadestinus* (Large Kauai (=kamao) Thrush)

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed delisting

Physical Description

A 20-centimeter long, brown/gray bird with a short wide bill. Adults are brown above and pale gray below. Throat is gray-brown, breast and face is slightly mottled, forehead is brown. Bill is shorter and broader than that of other Hawaiian thrushes; legs black; sexes alike in plumage (Wakelee and Fancy 1999) (NatureServe, 2015). Additional description in 2019: The kāmaʻo, also known as the large Kauaʻi thrush, is a medium-sized (20 centimeters [7.9 inches] total length) solitaire. Its plumage is gray-brown above, tinged with olive especially on the back, and light gray below with a whitish belly and undertail coverts. The kāmaʻo lacks the white eye-ring and pinkish legs of the smaller puaiohi (small Kauaʻi thrush) (USFWS 2006). (USFWS, 2019).

Taxonomy

It is a member of the thrush family (Turdidae). Originally described as Phaeornis obscura myadestina, Pratt (1982) offered convincing evidence that Phaeornis should be merged with the American solitaire genus Myadestes, and that some Hawaiian taxa formerly treated as subspecies are sufficiently distinct to merit full species status (USFWS, 2006).

Historical Range

It is endemic to the island of Kaua`i (USFWS, 2006).

Current Range

It is now extinct or restricted to the Alakai Wilderness area (Wakelee and Fancy 1999); in the 1980s it was reported occasionally from Pihea Ridge Trail above Kalalau (Pratt et al. 1987) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Stomach contents have included berries and insects. Feeds primarily on fruit and occasionally on insects (Matthews and Moseley 1990) (NatureServe, 2015). The diet of the kama`o is reported to consist of fruits and berries, particularly the bracts of the `ie`ie vine (Freycinetia arborea), as well as insects and snails (Munro 1944) (USFWS, 2006).

Reproduction Narrative

Adult: Nesting likely occurs in the spring (April to July). The eggs are grayish-white with irregular reddish-brown splotches, and the clutch size is one or two (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Occurs > 3,500 ft. elevation (USFWS, 2006)

Habitat Narrative

Adult: Inhabits dense montane forest (wet ohia forest); mesic forest dominated by koa and ohia; wet forest dominated by ohia and ohia ha (Syzygium sandwicensis) and several species of olapa subdominant. Uses dead snags for singing perch (Pratt et al. 1987) (NatureServe, 2015). In the past half century, the kama`o has not been seen below 1,100 meters (3,500 feet) elevation. In recent years, kama`o have been seen most frequently where a healthy open forest canopy existed, primarily of `ohi`a (Metrosideros polymorpha) and `olapa (Cheirodendron spp.) (USFWS, 2006).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Uncertain, last observed in 1989 (USFWS, 2009); possibly extinct (NatureServe, 2015)

Resiliency:

Very low (inferred from NatureServe, 2015)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

0 - 1 (NatureServe, 2015)

Population Size:

Zero to 50 individuals (NatureServe, 2015)

Adaptability:

Low (inferred from NatureServe, 2015)

Additional Population-level Information:

Several recent surveys and searches, including the RBS (Rare Bird Search), have been unsuccessful in detecting kāmaʻo despite intensive survey efforts by wildlife biologists in 1993, 1994, 2000, 2005, and 2011 to 2018 (Hawaiʻi Department of Land and Natural Resources unpubl. data; Reynolds and Snetsinger 2001, Crampton et al. 2017, L. Crampton pers. comm. 2018). (USFWS, 2019).

Population Narrative:

Declined from being the most common forest bird on Kauai in the 1890s to near-extinction or extinction in 1999 (Wakelee and Fancy 1999). This species has experienced a long term decline of > 90%. May be extinct; population is "critically low...if it continues to persist" (Wakelee and Fancy 1999). Only 3 were recorded during a 1989 forest bird survey (USFWS 1990), when the species was last detected. None were detected during post-Hurricane Iniki survey in 1993. At most one remaining population. No detections of this species have been made during recent surveys. If extant, restricted to one population of very few individuals in the Alakai Wilderness area, Kauai (NatureServe, 2015). The species has not been observed since 1989. The species' status is uncertain (USFWS, 1989).

Threats and Stressors

Stressor: Nonnative species (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Habitat degradation resulting from the invasion of nonnative weeds has dramatically changed the forest structure and integrity. Two hurricanes in 1982 and 1992 severely disrupted portions of high quality native forest, and have made space for the germination and expansion of noxious weeds such as Hedychium flavescens (yellow ginger), Erigeron karvinskianus (daisy fleabane), Tibouchina urvilleana (glorybush), Lonicera japonica (Japanese honeysuckle), and others. Introductions of predatory and parasitic invertebrates that compete with native species for food pose a continuing threat throughout the islands. Introduced predatory insects also may reduce or eliminate specialized native insects that are necessary for pollination of certain food plants. Many of the food plants used by kama`o could be negatively affected by herbivorous nonnative insects, such as the two-spotted leafhopper (Sophonia rufofascia), which may reduce their range, fruit set, and eventual survival. Introduced snails that prey on native snails could also reduce food resources of the kama`o. Impacts of nonnative birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2009).

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: One of the primary threats to this species and to other Hawaiian forest birds is habitat loss and degradation by agriculture, urbanization, cattle (Bos taurus) grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities (USFWS 2006). Feral pigs (Sus scrofa), and goats (Capra hircus) to a lesser degree, have had a long-term damaging effect upon native forests in the remaining kama`o range by consuming and damaging understory vegetation, creating openings on the forest floor

for nonnative weeds, transporting nonnative weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants.

Stressor: Disease and predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Predation by nonnative mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by nonnative mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2009).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2009).

Stressor: Climate Change (USFWS, 2019)
Exposure:
Response:
Consequence:
Narrative: Climate change and temperature increase present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs. In Hawaiʻi, the threshold temperature for transmission of avian malaria is estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak Plasmodium relictum prevalence in wild mosquitoes occurs in mid-elevation forests where the mean ambient summer temperature is 17 degrees Celsius (63 degrees Fahrenheit) (Atkinson and LaPointe 2009b, pp. 58-59). The mid- to high-elevation forests with temperatures between 13 and 17 degrees Celsius (55 and 63 degrees Fahrenheit) are considered a transition zone where some transmission is possible but limited. (USFWS, 2019) Prevalence of malaria infection in forest birds increased significantly on Kauaʻi from 1994 to 1997 and from 2007 to 2013 at elevations between 1,100 and 1,350 meters (3,609 and 4,429 feet) due to increased air temperatures, declining precipitation, and changes in stream flow that improved conditions for mosquito breeding (Atkinson et al. 2014, p. 2427). Another forest bird, the Hawaiian honeycreeper ʻiʻiwi (Drepanis coccinea), is known to be highly vulnerable to avian malaria (Atkinson et al. 1995, p. S59). The ʻiʻiwi has experienced sharp declines with a projected trend over 25 years of a 92% decline on Kauaʻi and a 34% decline within the northeastern region of East Maui (Paxton et al. 2013, p. 12). Liao et al. (2015, p. 3486) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and predicted even high-elevation forest bird habitat (above 1,500 meters; 4,921 feet) will remain relatively mosquito-free only until about the middle of this century. (USFWS, 2019).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2009).

2. Either (a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or (b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2009).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2009).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2009).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2009).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006). Captive propagation continued to be the recommended action in 2019. (USFWS, 2019).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Conduct intensive searches for the kama`o on Kaua`i, using similar methodologies as those employed during the 1994 to 1996 Hawai`i Rare Bird Search (Reynolds and Snetsinger 2001). Specifically, studies should include areas not surveyed during the 1994 to 1996 Hawai`i Rare Bird Search in these surveys (USFWS, 2009).
- Deploy autonomous recording units, or ARUs (Fitzpatrick 2002) in suitable habitats for this species. These field recording units record vocalizations of forest birds. The recordings can then be analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2009).

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SPECIES ACCOUNT: *Myadestes palmeri* (Small Kauai (=puaiohi) Thrush)

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Puaiohi is a medium-sized (37-43 g) thrush endemic to Kaua'i. Adults are olive-brown above, gray below, with a diagnostic white-eye-ring and outer rectrices (tail feathers). Legs are light pink and the bill is black (Snetsinger et al. 1999). Males and females are similar. Juveniles have distinctive spots and scalloping on their breast and wings. The song is simple and consists of a preparatory whistle and a prolonged trill, followed by several sharp descending notes; the call note is a simple, dry, raspy hiss (Snetsinger et al. 1999). The Puaiohi was the last Hawaiian bird to be discovered by western naturalists and historically was considered very rare; it is now restricted to the Alaka'i Wilderness Preserve on Kaua'i.

Current Range

RESIDENT on Kauai in Hawaiian Islands. Formerly more widespread in uplands, now only in the Alakai Swamp area, a range of less than 20 square kilometers (Snetsinger et al. 1999). The breeding population is restricted to an area of < 20 km2 on the Alaka'i Plateau, and 75% of the population is estimated to occur in 10 km2 (KFBRP unpubl. data). Density across the species' range varies from 0.5 to 11.0 pairs per km of stream (KFBRP unpubl. data) and is related to elevation (with higher densities at higher elevations).

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Puaiohi feed on insects and fruits of native plants (Snetsinger et al. 1999). The non-fruit portion of their diet consists of a wide variety of invertebrates (Berger 1981, Snetsinger et al. 1999). Puaiohi forge primarily in the lower canopy often on terminal fruit or leaf clusters; rarely on the ground.

Reproduction Narrative

Adult: Puaiohi nest in cavities or ledges on cliff faces associated with streams that are concealed by mosses and ferns, or rarely in trees (Snetsinger et al. 2005) or artificial nest sites. Nesting occurs from March to September, with a peak from April to June (Snetsinger et al. 2005). Females build nests and incubate and brood young. Clutch size is almost always two. Both males and females provision nestlings, but males usually feed fledglings while females frequently initiate another nesting attempt. Second-year and hatch-year birds occasionally assist in nest defense and feeding nestlings and fledglings (Snetsinger et al. 1999). Young often remain near the ground for two to four days after fledging, where they may be vulnerable to predation. Annual productivity is variable, ranging from 0.4 to 4.9 fledglings/pair/year (Snetsinger et al. 2005, KFBRP, unpubl. data). Estimated survival of adult males was 71%, of adult females was 46%, and of juveniles was 23% (VanderWerf et al. 2014), which is similar to the findings of Snetsinger et al. 2005.

Habitat Narrative

Adult: Puaiohi occur along streams and associated ridges above 1,050 m elevation in the southern and central Alakaʻi Plateau (Scott et al. 1986, Snetsinger et al. 1999). Puaiohi use wet native montane forest dominated by ʻohiʻa, ʻolapa, lapalapa (C. platyphyllum), ʻohia ha (Syzygium sandwicensis), kawaʻu, and kolea, with a diverse understory of native plants including ʻohelo and kanawao.

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Population Information and Trends

Population Growth Rate:

A rare species living in a very restricted range when discovered in 1893, its range contracted around the turn of the twentieth century; went unreported for 45 years until 1941 (Snetsinger et al. 1999). Decline of >50% (NatureServe, 2015)

Number of Populations:

1 - 5 (NatureServe, 2015)

Population Size:

~500

Additional Population-level Information:

Since 2009, the overall trend of puaiohi within its restricted range in the Alakaʻi Wilderness Preserve is stable. The 2009 5-year review estimated the total population of puaiohi to be approximately 300 to 500 individuals (USFWS 2006, page 2-35). Crampton et al. (2017) estimate the current population of puaiohi at approximately 494 (95% CI 414–580) individuals. The current breeding population is restricted to an area of < 20 km2 (4942 acres) and 75% occurs in 10 km2 (247 acres). Puaiohi occur in high densities (up to 11 pairs / km of stream) in three adjacent drainages: the Upper Mōhihi, Upper Waiakoali, and the northeastern upper Kawaikōī, but density declines with elevation (Snetsinger et al. 1999, Crampton et al., 2017). The upper reaches of the Halehaha and Halepāʻākai drainages support a medium-density population of about 5 pairs / km of stream and low-density populations occur in the lower Waiealae / unnamed drainage (1.25 pairs / km; Pratt et al. 2002; Crampton et al. 2017) and lower Kawaikōī / Kauaikinanā (0.5 pair / km). In 1994, two small, low-density populations were detected on private lands along the Halekua and Waiau streams at the southern edge of the species' range, but neither population was detected during surveys in March 2000 (Telfer pers. comm.). Surveys in March 2000 and spring 2012 confirmed the existence of a small population along an upper tributary of the Koaiʻe Stream, although its size and extent are unknown (Foster, unpubl. data; Crampton et al. 2017). The best predictor of puaiohi occupancy is the number and size of the cliffs along a stream (Crampton et al., 2017). (USFWS, 2018).

Population Narrative:

At the turn of the last century, Perkins (1903) considered the Puaiohi to be exceedingly rare. The first population estimate was based on 866 half-hour counts conducted from 1968-1973, which indicated an island-wide population of 177 ± 96 birds (Service 1983, Snetsinger et al. 1999). Most individuals were found on the Alakaʻi Plateau at elevations ranging from 1,100 to 1,250 m elevation. In 1981, the number of Puaiohi estimated to occur in a 25 km2 area of the southeastern Alakaʻi Wilderness Preserve was 20 ± 17 (Scott et al. 1986). Comparing these surveys to those conducted by the Service is problematic because of differences in sampling locations and methods. Surveys conducted in the spring of 1996 yielded 55 to 70 individuals and found birds widely distributed across the plateau between 1,060 and 1,280 m elevation. These surveys and demographic research suggested a population exceeding 200 birds (Reynolds and Snetsinger 2001). The current population of the Puaiohi is estimated at about 500 birds (range: 200 – 1,000; KFBRP unpubl. data), which likely reflects locating additional birds versus an increase in the population.

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Prior to the arrival of humans, the Hawaiian archipelago supported a remarkable avifauna comprised of at least 107 endemic species, including flightless geese, ibis, and rails and a radiation of at least 59 species in the subfamily Drepanidinae (Olson and James 1991, James and Olson 1991, James 2004). In the years since human colonization, 67 bird species have been confirmed lost, 46 prior to the arrival of Europeans and 23 since 1778 (Olson and James 1991, James and Olson 1991, Pyle 1997, Banko et al. 2001). Of the 42 extant endemic taxa, 31 are federally listed (29 species and 2 sub-species). Ten of these taxa have not been observed in as many as 40 years and their status is unknown (Service 2006). Habitat destruction, non-native diseases and predators, and habitat degradation by introduced ungulates and invasive plants are the main threats now facing Hawaii's remaining endemic birds (van Riper and Scott 2001, Service 2006).

Stressor: Habitat Loss and Degradation
Exposure:
Response:
Consequence:
Narrative: The loss, fragmentation, and degradation of native Hawaiian Island habitats began over 700 years ago when Polynesians settled the archipelago, and accelerated with the arrival of Europeans in 1778. As a result, all native Hawaiian birds have been adversely affected. European settlement not only caused the further loss and degradation of native forest but also initiated a long history of alien species introductions, including invasive plants, goats (Capra hircus), cattle, sheep (Ovis aries), and pigs (Sus scrofa) all of which have degraded native forest for centuries. Introduced ungulates have devastated Hawaiian forests which evolved without mammalian browsers and grazers and have no defenses against them. Ungulates also contribute to soil erosion, prevent regeneration of native plants, facilitate the invasion of alien plants, and create breeding habitat for mosquitoes (Service 2009). Non-native, invasive plants have profoundly altered native habitats in Hawaiʻi. The loss of native food plants to the frugivorous Puaiohi is

particularly detrimental and invasive plants have drastically changed the structure of native forests. Daisy fleabane (Erigeron karvinskianus) can cover nesting cliffs, reducing their suitability as nest sites for the Puaiohi (Woodworth et al. 2009).

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Hawaiian birds evolved in the absence of mammalian predators and have little to no adaptive behavioral responses to their presence. The nests, adults, and fledglings of all Hawaiian bird species are vulnerable to feral cats (Felis catus), rats (Rattus spp.), small Indian mongoose (Herpestes auropunctatus), dogs (Canis familiaris), and feral pigs (Service 2009). Fledglings of the Puaiohi often remain on or near the ground for several days after leaving the nest, where they are very vulnerable to a range of introduced and native predators. Of all the species considered herein, predation by rats is likely most problematic for the Puaiohi. Although their habit of nesting on steep cliffs may provide some protection, nest predation can be as high as 38% (Tweed et al. 2006). Annual variation in the effectiveness of efforts to protect Puaiohi nests from rats (Snetsinger et al. 2005, Tweed et al. 2006) was likely due to annual or spatial variation in rat abundance.

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: Avian malaria (Plasmodium relictum) and avian pox virus (Poxvirus avium) carried by the alien southern house mosquito (Culex quinquefasciatus) resulted in the extinction of many Hawaiian birds and currently limits the distribution of most extant native forest birds to high elevation forests where cool temperatures limit mosquitoes (van Riper et al. 1986, Atkinson et al. 1995, Atkinson and LaPointe 2009). The Puaiohi appears to have greater immunity to alien diseases than many Hawaiian honeycreepers, but their absence from lower elevations suggests some sensitivity. The prevalence of malaria in the Puaiohi has been 15-20% for the past 15 years, and there is evidence that some affected Puaiohi may survive the infection (Atkinson et al. 2001, Atkinson and Utzurrum 2010, Atkinson and Utzurrum 2014). Toxoplasmosis is a widespread disease caused by a protozoan parasite, Toxoplasma gondii, and can affect all birds and mammals (Elmore et al. 2010, Innes 2010). Cats are the primary reservoir of infection and one cat can shed millions of oocytes that can persist for months in damp soil (Elmore et al. 2010, Innes 2010). West Nile virus is another mosquito-borne pathogen that infects a wide range of birds, including corvids (Kilpatrick et al. 2006). West Nile virus spread rapidly across North America from 2000 to 2005 (Marra et al. 2004), but it has not been recorded in Hawaiʻi.

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: Increasing air temperatures associated with climate change are likely to exacerbate the threat of disease to native Hawaiian birds by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning et al. 2002, Harvell et al. 2002, Hay et al. 2002, Giambelluca and Luke 2007, Giambelluca et al. 2008, Loiseau

et al. 2012). A 2°C temperature increase would allow regular disease transmission in 85% of the area on Kauaʻi where it is now only periodic (Benning et al. 2002). Drought reduces mamane seed production and likely contributes to the mortality of mature trees (Juvik et al. 1993), especially those stressed by browsing (Banko et al 2013), pathogens (Gardner and Trujillo 2001), and competition from invasive grasses and weeds (Banko et al. 2009). Drought conditions have persisted on Mauna Kea since 2000 but have been most severe since 2006 (Banko et al. 2014).

Stressor: Small Populations
Exposure:
Response:
Consequence:
Narrative: Small populations are more vulnerable to extinction than large populations because of the higher risks posed by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002).

Stressor: Hurricanes
Exposure:
Response:
Consequence:
Narrative: Major hurricanes struck Kauaʻi in 1983 and 1992 and degraded native forests by destroying large trees, creating gaps into which alien plants could expand, and spreading invasive plants. Because the Puaiohi occupies narrow stream valleys, which presumably offer some protection from high winds, it is difficult to assess the population level effects of hurricanes on this species. However, the Puaiohi was likely extirpated from at least two areas on the edge of its range because of these hurricanes.

Recovery

Recovery Actions:

- 2018 Management action a) Ungulate Control — The Kauaʻi Watershed Alliance constructed a fence in 2011 to protect the southeastern Alakaʻi Wilderness Preserve from ungulates, and has removed all but a handful of pigs. The Hono O Nā Pali Natural Area Reserve (NAR) fence was completed in 2014, and ungulate and predator control is ongoing in this NAR. Fencing of the approximately 500 hectares (ha) (1,236 acres (ac)) Halehaha Unit, which includes Halepāʻākai, was completed in 2016, and ungulate and rat control is ongoing in this unit. Fences around the Drinking Glass and Koaiʻe Units are planned for the next five years. Extensive pre- and post- fence construction forest bird surveys and vegetation data collection were conducted to assess the immediate impact of the southeastern Alakaʻi fence on birds and plants; no differences were detected. (USFWS, 2018).
- "2018 Management action b) Predator Control — o By the end of the 2016 breeding season more than 300 self-resetting A24 Goodnature rat traps were deployed across puaiohi primary habitat at Halepāʻākai, in attempt to minimize the amount of rodent nest predation, with preliminary results suggesting rat numbers have declined (L. Crampton et al. in litt. 2015, Else 2016). o Kauaʻi Forest Bird Recovery Project (KFBRP) and partners have experimented off and on since 2000 with rat proof nest boxes to increase the availability of nest sites, provide predator-proof nesting options, and expand range. Puaiohi have occasionally nested in nest boxes of different styles, most recently in 2012. Efforts in 2011

and 2012 succeeded in making nest boxes rat proof, and in 2013, KFBRP developed a means of remotely surveying nest box use with passive infrared sensor (PIR) sensors and microcontrollers. Data from temperature and humidity data loggers in both nest boxes and nest cavities suggest that the primary barrier to widespread adoption of next boxes may be their more variable temperature and humidity (KFBRP, unpubl. data). Attempts to insulate nest boxes have been attempted but are currently on hold. (USFWS, 2018)."

- 2018 Management action c) Mosquito Control — An experimental larval mosquito control program was initiated in Kawaikōī Stream of the NAR in 2016 (L. Crampton, pers. comm).
- 2018 Management action d) Conservation Breeding— A captive propagation and release program was implemented for the puaiohi by the Hawaiʻi Endangered Bird Conservation Program (HEBCP). Between 1999 and 2017, 240 birds were released at three sites (Kuehler et al. 2000, Woodworth et al. 2009, Lieberman and Kuehler 2009, San Diego Zoo Global, unpubl. data). Despite this effort, no known new subpopulations have been permanently established even though a few released puaiohi have fledged young with both wild and captive-bred mates (Switzer et al., 2013). This may indicate that suitable habitat is saturated. Recruitment of captive birds into the breeding population appears to be related to the local density of the wild birds. In the low density Kawaikōī drainage 13.8% of captive birds have bred, while in the higher density Halepāʻākai drainage only 1.4% have bred (KFBRP, unpubl. data). However, even in the Kawaikōī, birds only breed in one year if at all, and are not seen in subsequent years. Furthermore, retention of captive bred birds decreased over time (Switzer et al., 2013). Between 2005 and 2011, captive-bred birds released when less than1 year old had similar survival (0.26 + 0.21) to that of wild juveniles, but captive-bred birds released as adults old had very low survival (0.05 + 0.06). Only 8 of 123 (7%) captive-bred birds released between 2005 and 2011 were re-sighted in the wild beyond the 40-day period of telemetry monitoring (VanderWerf et al., 2014). These data, and those suggesting that the wild puaiohi population is stable, led the Hawaiʻi Endangered Bird Conservation Program to decide to terminate the puaiohi breeding program in 2015. Most of the remaining captive individuals (15 birds in 2016 and three in 2017) were then released at Halepāʻākai (KFBRP, unpubl. data). (USFWS, 2018).
- 2018 Management action e) Occupancy Surveys — Kauaʻi Forest Bird Recovery Project conducted occupancy surveys for puaiohi at 241 stations on 12 streams from 2011-2013 on the Alaka`i Plateau. Puaiohi were detected at 149 stations (62%), during 679 of 3009 (23%) survey periods (pre- and post-playback counted separately). Minimum and maximum elevations at which puaiohi were detected were 1141 m (3743 ft) and 1339 m (3736 ft), respectively. No puaiohi were detected on two streams, with the remaining streams having 2 to 18 stations with detections per survey period. Mean estimated occupancy rates of surveyed streams ranged from 0.17 to 0.82, with mean estimated occupancy of all surveyed stations being 0.49 (95% CI 0.45–0.53). Slightly more detections occurred during playback periods: puaiohi were detected in 381 of 1,516 playback periods (25%) and only 298 of 1,493 passive periods (20%) (Crampton et al. 2017). (USFWS, 2018).
- 2018 Recommended Action a): Surveys / inventories — Continued monitoring of puaiohi is important to determine species response to management actions and effects of climate change. (USFWS, 2018).
- "2018 Recommended Action b): Habitat management and restoration — o We recommend continued habitat management in areas where the species currently exists (USFWS 2006). o Invasive plants such as Hedychium gardnerianum (Kāhili ginger) and Sphaeropteris cooperi (Australian tree fern) and non-native ungulates (feral pigs, goats and black-tailed deer) are

degrading puaiohi habitat areas at Mōhihi, Koaie and Kawaikōī. Weed control, fencing and ungulate removal are recommended for these areas. (USFWS, 2018)."

- "2018 Recommended Action c): Predator / herbivore control — o Control rodents over a larger area. Rodent control programs should be continued and expanded by whatever methods are available. o Evaluate the efficacy of current rodent control efforts and response in puaiohi nesting success. o Prevention of additional introductions of exotic plants, insects, mammals (especially the mongoose [Herpestes auropunctatus], currently a resident on other Hawaiian islands) and nonnative birds that may act as predators, on or competitors with, native birds is necessary. (USFWS, 2018)."
- "2018 Recommended Action d): Biosecurity. Implement a statewide interagency biosecurity plan to prevent Rapid ʻŌhiʻa Death and other detrimental non-native species from becoming established on Kauaʻi (Hawaiʻi Department of Agriculture, 2017). An effective biosecurity plan requires a comprehensive approach that includes: o Pre-border policies and processes to prevent invasive species from making their way to the state of Hawaiʻi o Border policies and processes that support inspecting incoming items to ensure minimal risk of pest entry into the state o Post-border policies and processes that support detecting and responding to new incursions of invasive species and controlling established invasive species wherever possible. (USFWS, 2018)."
- 2018 Recommended Action e): disease control research — Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Classical vector control tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent advancements and understanding in biotechnology have allowed traditional Sterile Insect Techniques used in controlling agricultural insect pests to be applied towards mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance in the near future. A current focus for conservation in Hawaiʻi is the development of a mass rearing pipeline for C. quinquefasciatus infected with Wolbachia, a bacterium known to cause cytoplasmic incompatibility (i.e. sterility after mating). Releases of these mass reared mosquitoes can be used to reduce populations of wild C. quinquefasciatus in forest bird refugia using an integrated pest management approach with emphasis on the Insect Incompatibility Technique (ITT Wolbachia). Alternatively, another approach utilizing Wolbachia is with its unique ability to inhibit pathogen replication within a mosquito. Although capacity will be developed for the mass rearing and release of Wolbachia infected C. quinquefasciatus, management can be modified easily to incorporate more efficient technologies for mass rearing and release as they are developed and approved. We encourage continued research and capacity building in the fields of genomic technologies and novel vector control strategies for disease control and their field application as a conservation strategy for Hawaiian forest bird recovery. (USFWS, 2018).

Conservation Measures and Best Management Practices:

- Life history and demographic studies of the Puaiohi were conducted from 1996 to 2000 by the USGS and have been ongoing since by the Kauaʻi Forest Bird Recovery Project (KFBRP) under the direction of DOFAW. Invasive alien plants are controlled in the Alakaʻi and Kokeʻareas by TNC and the Kokeʻe Resource Conservation Program. In 2010, the Kauaʻi Watershed Alliance (KWA) completed fencing to protect 810 ha of Puaiohi habitat in the southeastern Alakaʻi Wilderness Preserve. The KWA has plans to fence an additional 1,215 ha in the core of the Puaiohi's range and additional fencing is being planned for State lands. A recovery outline for the Kauaʻi Ecosystem was prepared in 2010 for the Puaiohi. The outline covers all federally listed species on Kauaʻi, including 145 plants and 28 animals (Service 2010). A captive breeding and release program for the Puaiohi has been implemented by the HEBCP. From 1999 to 2012, 222 Puaiohi were released along three streams in the Alakaʻi (Kuehler et al. 2000, Woodworth et al. 2009, Lieberman and Kuehler 2009). Released, captive-bred Puaiohi have fledged young with wild and captive-bred mates (Tweed et al. 2003, 2006). However, the efficacy of captive releases is low (VanderWerf et al. 2014), although, based on movement patterns of released birds (Tweed et al. 2003), some birds, may be recruiting into the breeding population after dispersing and going undetected. In any event, no new sub-populations have been permanently established to date. Based on this, the decision was made to postpone further releases after the spring of 2012. Artificial nest structures have been explored as a means of increasing nest site availability, decreasing nest predation, and expanding the range of Puaiohi, but few structures have been used thus far. Thirty-three artificial nests were installed in 2002 by DOFAW, but only one was known to be used and the design was not rat-resistant. The artificial nest program was expanded in 2007 and 2008 (VanderWerf and Roberts 2008), and several designs were tested in the laboratory for rat-resistance (Pitt et al. 2011). In 2011, two artificial nests were used by Puaiohi and the KFBRP is continuing to investigate artificial nest as a management tool. As of January 2014, there are 21 birds in captivity.

- Alien Ungulate Removal. Fencing and removal of alien ungulates from native habitats and from areas with restoration value are among the highest priority actions with the greatest potential benefit for Hawaiian bird species (Wallace and Leonard 2011). Removing ungulates, especially pigs, improves habitat quality and can reduce mosquito breeding sites (Goff and van Riper 1980). Such efforts will require a considerable influx of new funding and unprecedented outreach to gain the social and political support required for success, as projects will result in fewer hunting opportunities.
- Alien Predator Control. Keeping predators such as rodents, exotic snakes such as the brown treesnake, and cats away from crucial habitats of native Hawaiian birds can boost nesting success and survival of adult and young birds (VanderWerf 2008). Predator-proof fencing would protect critical nesting sites, although set-up costs are very high (e.g., $300 per meter of fencing). A more cost-effective option is use of rodenticides, such as diphacinone, which was recently approved for aerial application in Hawaiʻi. Though diphacinone application poses little threat to human health and most non-target species when applied according to label guidelines, we'll need to engage in education and outreach to gain widespread public approval for this approach. In addition, the federal and state government must be proactive in expanding biosecurity measures to prevent new invasive species from becoming established in Hawaiʻi (Kueffer and Loope 2009).
- Alien Plant Control. There is an urgent need for targeted efforts to reduce the spread of invasive, exotic plants in areas important to native Hawaiian birds. Fountain grass (Cenchrus setaceus), for example, a species indigenous to tropical Africa and Asia, is spreading in dry forest and grasslands where the grass increases wildfire risk.
- Disease Management. Reducing the incidence of avian malaria and avian pox is the greatest Hawaiian bird conservation challenge, as managers currently have few available tools to combat the diseases (Atkinson and LaPoint 2009). Strategies to reduce mosquitoes in discrete areas include: removing pigs to reduce habitat degradation that creates mosquito breeding habitat; insecticide application; and a new technique known as cytoplasmic incompatibility, which uses parasites to

cause a sperm-egg incompatibility between the gametes of infected male and uninfected female mosquitoes. Fortunately, some bird species can evolve resistance to malaria over relatively short periods of time (Atkinson and LaPointe 2009). Captive propagation of disease-resistant individuals may help species weather the epidemics, as will reducing mortality from other factors, such as nest predation from feral cats and other introduced mammalian predators (Kilpatrick 2006).

- Climate Adaptation. To help native Hawaiian bird species avoid an upward-climbing mosquito-disease zone, we might consider planting forests above the current tree line, but this may be complicated by climate change-induced shifts in rainfall patterns (Giambelluca and Luke 2007). Assisted migrations and reintroductions of populations of the most endangered birds are other possibilities. And mitigating threats we can control—such as removing ungulates and controlling predators and weeds—will make birds and their habitats more resilient to climate change (Hunter et al. 2010).

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SPECIES ACCOUNT: *Mycteria americana* (Wood stork)

Species Taxonomic and Listing Information

Listing Status: Threatened; February 28, 1984; Southeast region (R4)

Physical Description

The following description is derived from Robertson (1989): The wood stork is a large, long-legged wading bird, with a head to tail length of 85 - 115 cm and a wingspread of 150 - 165 cm. The plumage is white, except for iridescent black primary and secondary wing feathers and a short black tail. On adults, the rough scaly skin of the head and neck is unfeathered and blackish in color, the legs are dark, and the feet are dull pink. The bill color is also blackish. Immature storks, up to the age of about 3 years, differ from adults in that their bills are yellowish or straw colored and there are varying amounts of dusky feathering on the head and neck.

Taxonomy

The wood stork is one of 17 species of true storks (Ciconiidae) occurring worldwide, and is the only stork that regularly occurs in the United States. Throughout its range of the Americas, wood storks are morphometrically indistinguishable, with no apparent differentiation in plumage or size (Coulter et al. 1999).

Historical Range

The wood stork may have formerly bred in all the coastal southeastern states from Texas to South Carolina. Prior to the 1970s, greater than 75 percent of the population nested in colonies in South Florida south of Lake Okeechobee; by the late 1980s, greater than 50 percent nested from central Florida north through South Carolina (Ogden et al. 1987, Harris 1995, Murphy 1995, Service 1997).

Current Range

The wood stork occurs from northern Argentina, eastern Peru and western Ecuador, north to Central America, Mexico, Cuba, Hispaniola, and the southeastern United States. The breeding range of the species extends from the southeastern U.S. south through Mexico and Central America, to Argentina, Brazil, and Uruguay (Bent 1926).

Distinct Population Segments Defined

No, however the original listing of the U.S. breeding population of wood storks likely meets the current standards of the DPS Policy for the following reasons: the population is physically separated from the adjacent population which breeds in southern Mexico, and the loss of the U.S. breeding population would result in a significant gap in the range, as there would no longer be wood storks breeding in the U.S.

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Parents feed young by regurgitating whole fish into the bottom of the nest at a rate of 3 to 10 or more feedings per day.

Adult: Wood storks feed almost entirely on fish between 2 and 25 cm in length (Kahl 1964; Ogden et al. 1976; Coulter 1987). Wood storks also occasionally consume crustaceans, amphibians, reptiles, mammals, birds, and arthropods. Storks forage in a wide variety of shallow wetlands, wherever prey concentrations reach high enough densities, in water that is shallow and open enough for the birds to be successful in their hunting efforts (Ogden et al. 1978; Browder 1984; Coulter 1897). Good feeding conditions occur in relatively calm water, where depths are between 5 - 40 cm, and where the water column is uncluttered by dense patches of aquatic vegetation (Coulter and Bryan 1993). The results of one study strongly suggested that storks were foraging at low tide equally both day and night (Bryan 1995). Kahl (1964) calculated that an average wood stork family requires 443 lbs. of fish during a breeding season.

Reproduction Narrative

Egg: Incubation requires about 30 days.

Juvenile: About 9 weeks are required for fledging, but the young return to the nest for an additional 3 to 4 weeks to be fed.

Adult: Females lay a single clutch of eggs per breeding season. A second clutch is sometimes laid if nest failure occurs early in the season (M. Coulter, IWRB/IUCN/BirdLife International, pers. comm.) Two to five eggs are laid. Wood storks are more likely to return to the same nesting site year after year than other wading birds (Frederick and Ogden 1997). They are seasonally monogamous, probably forming a new pair bond every season. Nest initiation varies geographically. The 3-year average productivity rate for all colonies monitored in the Southeast U.S. for 2004-2006 was 1.5 chicks/nest attempt; 2003-2005 was 1.2; and 4-year average for 2003-2006 was 1.5. Typically storks select patches of medium to tall trees as nesting sites, which are located either in standing water (swamps) or on islands surrounded by relatively broad expanses of open water (Palmer 1962, Rodgers et al. 1987, Ogden 1991). Colony sites located in standing water must remain inundated throughout the nesting cycle to protect against predation and nest abandonment. Storks tend to use the same colony sites over many years. There is documented first breeding for 3 and 4 year old birds, but the average age of first breeding is unknown. It is believed that once storks reach sexual maturity they nest on a yearly basis (J. Ogden, SFWMD, pers. comm.) The oldest known bird in the wild was 11 years 8 months (Hancock et al. 1992, p. 284).

Environmental Specificity

Adult: Moderate

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High

Habitat Narrative

Adult: Wood storks are a wetland dependent species. They require a mosaic of wetlands with varying climatological and seasonal conditions. Freshwater emergent wetlands are particularly essential for wood storks (Service 1997). Wood storks use man-made wetlands for foraging and breeding purposes. Man-made wetlands include, but are not limited to, storm water treatment areas and ponds, golf course ponds, borrow pits, reservoirs, roadside ditches, agricultural ditches, drainages, flow-ways, mining and mine reclamation areas, and dredge spoil sites. Wood storks use a variety of freshwater and estuarine wetlands for nesting, feeding, and roosting. Roosting sites include cypress heads and swamps, pine or hardwood islands in marshes, mangrove islands, expansive willow thickets or dry marshes, or on the ground on levees. Roosts may be used for long periods of time, either seasonally or annually. See reproduction narrative for nesting habitat. See feeding narrative for foraging habitat.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory

Dispersal

Adult: High

Dispersal/Migration Narrative

Adult: During a satellite tracking study of wood storks in Mississippi and Louisiana, extensive inter- and intra-regional movements from both Southeast U.S. and Mexican/Guatemalan populations of wood storks were documented (Bryan, in press). It is believed that storks nesting in north Florida, Georgia, and South Carolina move south during the winter months.

Population Information and Trends

Population Trends:

Increasing

Resiliency:

High

Representation:

Low

Redundancy:

High (see current range/distribution)

Population Size:

7,400 - 8,700+

Population Narrative:

Overall population status is improving. Three-year averages calculated from nesting data from 2001 through 2006 indicate that the total nesting population has been consistently above the 6,000 reclassification threshold for nesting pairs, and the averages have ranged from 7,400 to over 8,700. Stangle et al. (1990) employed starch gel electrophoretic techniques to examine genetic variation in Florida wood stork colonies. The study did not indicate significant allosyme differences within or between colonies.

Threats and Stressors

Stressor: Habitat loss and modification
Exposure:
Response:
Consequence:
Narrative: The decline of South Florida's Everglades and Big Cypress ecosystems is well documented (Davis and Ogden 1994). Prior to 1970, a majority (70 percent) of the wood stork population nested south of Lake Okeechobee and declined from 8,500 nesting pairs in the early 1960s to around 500 pairs in the late 1980s and early 1990s (Service 1997). It is generally accepted that the primary cause of this decline was due to the loss of wetland function of these South Florida ecosystems that resulted in reduced prey availability or loss of wetland habitats (Service 1997).

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Colonies with adequate water levels under nesting trees or surrounding nesting islands deter raccoon predation. Water level manipulation can facilitate raccoon predation of wood stork nests when water is kept too low. In many cases, colonies have a population of alligators that also deter raccoon predation (Coulter and Bryan 1995). Removal of alligators from a nesting colony site could lead to raccoon predation. Human disturbance may cause adults to leave nests, exposing the eggs and downy nestlings to predators (fish crows), sun and rain. Great horned owls have been documented nesting in and near colonies and they likely impact the colony to some degree. A breeding population of Burmese pythons has been documented in the Florida Everglades. If this snake and/or other species of reptiles become established in the South Florida ecosystem, they could pose a significant threat to nesting wood storks.

Stressor: Natural and man-made factors
Exposure:
Response:
Consequence:
Narrative: Other natural or man-made factors affecting the wood stork's continued existence such as contaminants, harmful algal blooms, electrocution, road kill, invasion of exotic plants and animals, disturbance, and stochastic events, are all documented to effect wood storks, but not to a degree to impede recovery.

Recovery

Reclassification Criteria:

There are 6,000 nesting pairs and annual regional productivity is greater than 1.5 chicks per nest/year (both calculated over a 3-year average).

Delisting Criteria:
There are 10,000 nesting pairs calculated over a 5-year period beginning at the time of reclassification and annual regional productivity is greater than 1.5 chicks per nest/year (calculated over a 5-year average).

As a subset of the 10,000 nesting pairs, a minimum of 2,500 pairs must nest successfully in the Everglades and Big Cypress systems in South Florida.

Recovery Actions:
- 1. Protect currently occupied habitat.
- 2. Restore and enhance habitat.
- 3. Conduct applied research necessary to accomplish recovery goals.
- 4. Increase public awareness.

Conservation Measures and Best Management Practices:
- Prepare proposed rule to reclassify wood storks from endangered to threatened status and expand their known range to include Mississippi and North Carolina. The proposed rule will include a DPS evaluation of the listed entity. The Service believes there is sufficient information presented in the original listing and based upon the current knowledge of the biology to consider the application of the DPS criteria by physical separation of the breeding populations and loss of this population would result in a significant gap in the range.
- Protect wood stork foraging, nesting and roosting habitat. Ensure wetland mitigation procedures consider replacing impacted wood stork foraging wetlands with wood stork foraging wetlands of similar or better quality and quantity. Update Wood Stork Habitat Management Guidelines. Draft white paper on wood stork colony habitat protection under current conservation laws.
- Update and revise the recovery plan for the wood stork to reflect the best available and most up-to-date information on the biology of the species and its habitat. Develop recovery criteria to address the relevant listing factors and current known threats to wood storks.
- Develop a long-term program to monitor productivity at fewer selected (index) colonies within the major regions of the breeding range. Develop a systematic design for aerial surveys.
- Continue to support the development of a demographic model. Establish and refine population parameters and other factors, such as adult survival, variance in vital rates, sampling error, and research-induced biases, to improve the model.
- Conduct genetic studies to find additional micro satellite loci and highly variable nuclear loci to better understand genetic diversity in wood stork populations in the Southeast U.S., Caribbean, Latin America and South America. A multi-year study of large-scale movements of all ages of wood storks is needed to determine the frequency and importance to population mixing. Isotope studies on feathers of 1st and 2nd year birds in the mixing areas of Louisiana, Mississippi and Alabama may indicate the sites and environmental conditions where breeding populations are mixing.
- Develop baseline contaminant information. Develop an understanding of how man-made wetland systems affect wood stork health and develop management strategies for these wetlands to benefit the recovery of the wood stork.

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USFWS 2007. Wood stork (Mycteria americana) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region. Jacksonville Ecological Services Field Office, Jacksonville, Florida

SPECIES ACCOUNT: *Numenius borealis* (Eskimo curlew)

Species Taxonomic and Listing Information

Listing Status: Endangered; likely extinct; 03/11/1967; Alaska Region (R7) (USFWS, 2016)

Physical Description

A medium-sized shorebird (about 30 cm long) with a slender, slightly downcurved bill; dark crown and rather indistinct pale crownstripe; cinnamon tone above with whole underparts washed cinnamon; heavy v-shaped black marks and barring on breast and flanks; underwings and axillaries bright cinnamon with brown barrings; and legs bluish-grey with reticulated scales posteriorly (USFWs, 2016).

Taxonomy

The Eskimo curlew is a member of the family Scolopacidae (sandpipers) and tribe Numeniini (godwits and curlews). Eight curlew species comprise the genus Numenius, including the Eskimo curlew. Three other Numenius curlews occur in the Western hemisphere: the whimbrel (Numenius phaeopus), the bristle-thighed curlew (Numenius tahitiensis), and the long-billed curlew (Numenius americanus) (USFWS, 2011).

Historical Range

Eskimo curlews historically nested in tundra in the Northwest Territories, presumably in adjacent Nunavut, and possibly in Alaska. After nesting, they moved to Labrador and eastern Canada to fatten on berries before migrating nonstop across the western Atlantic to South America, where they presumably wintered in the Pampas. In spring, Eskimo curlews moved north overland through the prairies of the United States and Canada before returning to the arctic to breed (USFWS, 2011).

Current Range

See historical range/distribution. The last record confirmed by physical evidence is a specimen collected in Barbados in 1963 (USFWS, 2011).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores and frugivores. Recorded foods include grasshoppers and their eggs, crickets, grubs and cutworms, ants, moths, spiders, small snails, earthworms, freshwater insects, seeds and berries (e.g., crowberry, EMPETRUM) (USFWS 1980, Gollop et al. 1986). Picks items from substrate, probes into sand or mud in or near shallow water, or takes prey from water column (Ehrlich et al. 1992) (NatureServe, 2015). The Rocky Mountain grasshopper (Melanoplus spretus; Lockwood and DeBrey 1990), historically was an extremely numerous and irruptive insect and an important food source for migrating curlews

(USFWS, 2011). Added in 2016: The only confirmed breeding areas for Eskimo curlew were identified as "barren grounds" in the Northwest Territories, Canada (Gollop et al. 1986). Primary foods on the breeding grounds were overwintered berries, particularly crowberries (Empetrum nigrum), and insects. Eskimo curlews may have used vegetated and unvegetated intertidal habitats in western and northwestern Alaska (Murdoch 1885, Nelson 1887; cited in Gill et al. 1998). Post-breeding, Eskimo curlews migrated eastward, foraging in heath-shrub habitats, and staged in large numbers along the coast of Labrador where they fed on berries in nearby uplands and invertebrates in intertidal habitats (Gill et al. 1998). Eskimo curlews wintered in the Pampas and possibly intertidal habitats of South America, feeding primarily on insects and presumably other invertebrates. During their northward spring migration through the midwestern United States, Eskimo curlews preferred burned and disturbed prairie habitats and agricultural fields where they fed primarily on grasshopper egg cases and emerging nymphs (Gill et al. 1998). Localized irruptions of the now extinct Rocky Mountain grasshopper may have been a particularly important food resource for Eskimo curlews in these habitats (Gill et al. 1998). (USFWS, 2016).

Reproduction Narrative

Adult: Lays a clutch of 3 - 4 (usually 4) eggs in late May - June or early July. Nests in open arctic tundra, usually in an open site with a wide view (Harrison 1978). Upland grassy tundra or tundra interspersed with scattered trees (Johnson and Herter 1989); tundra marshes and tidal marshes near Arctic Ocean (Matthews and Moseley 1990) (NatureServe, 2015). New in 2016: Nests were simple depressions on bare ground, usually with four eggs. MacFarlane (in Gollop et al. 1986) described the nest as "a mere hole in the earth, lined with a few decayed leaves, and having a thin sprinkling of hay in the midst of them." Hatching likely occurred in late June and early July. MacFarlane (in Gollop et al. 1986) assumed that only females incubated, although males were noted near nests and broods. Gill et al. (1998) suggest that both parents probably incubated and brooded as in other Numeniini. The time to fledging is unknown. (USFWS, 2016).

Environmental Specificity

Adult: Very narrow (NatureServe, 2015)

Habitat Narrative

Adult: Nonbreeding habitat includes grasslands, pastures, plowed fields, and less frequently, marshes and mudflats (AOU 1983). Favors headlands and hills within a few kilometers of the sea. Roosted on beaches along coast but rarely found near water in midwestern states (Gollop et al. 1986). The environmental specificity is very narrow (specialist or community with key requirements scarce) (NatureServe, 2015).

Dispersal/Migration

Motility/Mobility

Adult: Very high (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: Very high (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Probably began northward migration in late February or March. Arrived in breeding areas beginning in late May in Alaska and Northwest Territories; migrated inland through central prairies of North America (along valleys of the Mississippi, Missouri, and Platte rivers) in spring, arriving in Texas and Louisiana in early March (most likely to be observed in March and April), and migrating through the Great Plains from late March to mid-May; remained in nesting areas until early August; in fall, most migrated eastward from breeding areas and across northern Hudson Bay to Labrador and Newfoundland (most likely present from mid-August to late September), where they fed prior to flight across Atlantic to northern South America (perhaps arriving in October), thence along coast to wintering areas; some birds migrated southward along west shore of Hudson and James bays, then southeastward across Quebec and northeastern states before crossing the Atlantic (Gollop et al. 1986, Johnson and Herter 1989). Storm-blown migrants could appear on the coast of the Canadian Atlantic provinces, New England, or Bermuda from late August to mid-October. Burned over prairies and marshes are particularly attractive during migration (NatureServe, 2015).

Population Information and Trends

Population Trends:

Rare by 1900, last observed in 1987, possibly extinct (NatureServe, 2015)

Species Trends:

Unconfirmed sightings in 2000s - most recent in 2006 (USFWS, 2011)

Resiliency:

Very high (inferred from USFWS, 2011; see current range/distribution)

Population Size:

Zero to 50 individuals (NatureServe, 2015)

Population Narrative:

Declined from a population originally numbering in the hundreds of thousands (Gill et al. 1998). Marked decline began around 1870, began decreasing rapidly in 1880s (Gill et al. 1998); already rare by 1900 and thought to be extinct in 1905. Last specimen taken in Barbados in 1963 (Bond 1965). Now extremely rare or extinct (Gollop et al. 1986, Gill et al. 1998, Morrison et al. 2001). Global population estimated to be less than 50, if the species is still extant (Morrison et al. 2001). Occasional unsubstantiated sightings offer hope that the species is still extant; latest of these was of a bird seen in southwestern Manitoba, May 1996 (Waldon 1966, Gill et al. 1998). Latest records from wintering grounds (again unsubstantiated) were of four birds near Cordoba, Argentina, October 1990 (Michelutti 1991). Four "apparently reliable" sightings in Texas in 1987 (Gollop 1988). Most recent reliable sightings were at three separate locations in 1987: Mormon Island, Nebraska; Lac Rendezvous, Northwest Territories; and North Haven Island, Maine; only single birds were observed. A flock of 23 was observed on Atkinson Island, Texas in 1981. See Johnson and Herter (1989) for account of sightings in 1980s in Beaufort Sea area. See Gollop et al. (1986) for accounts of occurrences in individual states, provinces, and countries. See also Faanes and Senner (1991). Surveys in Argentina and Uruguay in 1992 - 1993 yielded no confirmed sightings, but previously unknown suitable habitat was found (Blanco et al. 1993;

Castro et al. 1994, Endangered Species Update 11(3&4):5) (NatureServe, 2015). Virtually no additional information on the species has become available since Gill et al.'s (1998) review, although there were a handful of unconfirmed sightings in the 2000s. Since 1963 there have been only 39 potential sightings, most recently in 2006. However, the Service is unabel to conclude with reasonable certainty that the species is extinct (USFWS, 2011). New in 2016: Recent surveys of the Eskimo Curlew's historic and potential breeding areas (Gollop et al. 1986, J. Rausch, pers. comm. 2008 in COSEWIC 2009), including remote areas of Alaska (e.g., Whitman 2007); fall staging habitat (McCaffery 1991); wintering areas (Blanco et al. 1993); and spring migration stopovers (Eubanks and Collins 1992) have not detected the species. (USFWS, 2016).

Threats and Stressors

Stressor: Habitat loss and modification (NatureServe, 2015).
Exposure:
Response:
Consequence:
Narrative: The spring migration route is through tallgrass and to a lesser extent mixed-grass prairies; only 4 percent of the former ecosystem remains (Samson and Knopf 1994). Fire suppression has further altered remnant prairie ecosystems. Agricultural conversion also apparently caused the demise of what may have been a key prey species during spring migration, the Rocky Mountain grasshopper, Melanoplus spretus (Gill et al. 1998), and probably resulted in declines in other grasshopper species as well (Lockwood and DeBrey 1990, Gill et al. 1998). The recent expansion of diamond exploration activities and establishment of diamond mines within the known breeding range of this species may put additional pressure on any remnant population (Gill et al. 1998) (NatureServe, 2015). Future mining and oil and gas development may occur within Arctic breeding habitat (USFWS, 2011). New in 2016: Conversion of tallgrass prairie and eastern mixed-grass prairie to agriculture in the late 1800s probably contributed to the decline of Eskimo curlews. These habitats were important stopovers for the curlews on their northward spring migration. Remaining prairie ecosystems were also altered by fire suppression, reducing the amount of preferred disturbed prairie habitat available to curlews (Gill et al. 1998). Fire regimes can significantly affect the community structure and productivity of grasshoppers (Meyer et al. 2002, Evans 1984, 1988) in tallgrass prairie ecosystems through effects on plant communities. The limited availability of suitable habitat and key food resources in the Midwestern States during the Eskimo curlews' spring migration may impede potential recovery of the species. (USFWS, 2016)

Stressor: Competition (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Former breeding range has now apparently been taken over by the slightly larger Whimbrel, which may displace the few remaining individuals (Gollop et al. 1986) (NatureServe, 2015).

Stressor: Specific life history requirements (NatureServe, 2015)
Exposure:
Response:
Consequence:

Narrative: Any recovery has been hampered by this species' former reliance on shifting, patchy, fire-dependent habitats during spring migration, its conservative life history (e.g. long migration with few, but strictly traditional stopover sites), and its highly social behavior (Gill et al. 1998) (NatureServe, 2015).

Stressor: Climate change (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Global climate change is likely to result in ecosystem level effects on historical Eskimo curlew habitats, particularly in Arctic breeding grounds. For the last several decades, surface air temperatures in the Arctic have warmed at a rate that exceeds the global average and they are projected to continue on that path (IPCC 2007). Although the altered hydrology and temperature regimes associated with climate change is expected to affect the habitats in which Eskimo curlews breed, stage during migration, and winter, the limited information available on their biology makes it difficult to assess the potential vulnerability of the species to these changes (USFWS, 2011).

Stressor: Contaminants (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: The role of pesticides in the decline of the Eskimo curlew and their potential as a continued threat to the species is unknown. Gill et al. (1998) indicate that use of strychnine in the late 1800s may have affected curlews in the midwestern United States and suggest the examination of tissue from existing specimens may provide additional information on contaminant levels in Eskimo curlews (USFWS, 2011).

Stressor: Hunting and research (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Intensive market and sport hunting has been identified as a major contributing factor in the decline of the Eskimo curlew in the late 19th century (e.g., Banks 1977, Gill 1986, Gollop et al. 1986, Gill et al. 1998). However, regulatory protection of the Eskimo curlew and other migratory birds has eliminated market hunting as a current threat to the species in North America. Sport hunting of shorebirds still occurs in Barbados where the last Eskimo curlew specimen was shot in 1963 (Hutt 1991 in Blanco and Canevari 1995) and other countries in the Carribean (R. Lanctot, pers. com. 2011); subsistence hunting of shorebirds may still occur in Guyana (Blanco and Canevari 1995). If an extant population of Eskimo curlews is found, efforts by researchers and naturalists to observe, photograph, or otherwise study the species may potentially disturb individual birds. The sensitivity of Eskimo curlews to disturbance is unknown. Such activities could potentially displace curlews from preferred habitat and have unknown physiological and reproductive consequences resulting from altered behavior patterns. Because the population of Eskimo curlews, if extant, is estimated to be in the tens of individuals, investigator disturbance within or near breeding habitat could result in population-level impacts to the species (USFWS, 2011).

Stressor: Storms (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Severe storms during transoceanic migration over the Atlantic in fall, or storms on the wintering grounds are potential threats (Gill et al. 1998). The susceptibility of the species to these storms is unknown (USFWS, 2011).

Recovery

Reclassification Criteria:
Not available - the Service has not developed a recovery plan for Eskimo curlew.

Delisting Criteria:
Not available - the Service has not developed a recovery plan for Eskimo curlew.

Recovery Actions:
- Not available - the Service has not developed a recovery plan for Eskimo curlew.

Conservation Measures and Best Management Practices:
- Because the likelihood that the Eskimo curlew remains extant to be extremely low, further conservation or management actions are not recommended at this time. However, efforts to conserve other shorebirds (e.g. Donaldson et al. 2000, Brown et al. 2001) with similar life history characteristics would help to address current threats to the Eskimo curlew and support their recovery if an extant population exists. If the continued existence of the Eskimo curlew is confirmed in the future, development and implementation of a recovery plan would be warranted (USFWS, 2011).

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SPECIES ACCOUNT: *Oceanodroma castro (Hawaii DPS)* (Band-rumped storm petrel)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/31/2016; Pacific Region (R1) (USFWS, 2017)

Physical Description

Approximately 7.5 - 9" (19-23 cm) wide; 16 1/2-18" (42-45 cm) long. Intermediate in many respects between Wilson's and Leach's storm-petrels, although larger than Wilson's. Blackish-brown overall with pale wing bars and a clear, curved white band across rump; white on rump more extensive than on Leach's but less than on Wilson's (where white extends fully onto undertail coverts). Tail slightly forked, but this feature is difficult to discern at sea; legs do not extend beyond tail in flight. Wings thinner and more angular than Wilson's, but thicker and less angular than Leach's. Difficult to identify reliably at sea.

Taxonomy

Band-rumped storm-petrel specimens were collected by naturalists visiting Hawaii during the 1800s, but were not recognized as Oceanodroma castro until the early 1900s (Henshaw 1902). Prior to 1900, the Hawaiian bird had been described as an unnamed petrel in the genus Thalassidroma (Dole 1869, 1879), as Cymochorea cryptoleucura (Ridgeway 1882), and as Oceanodroma cryptoleucura (Stejneger 1888). After Henshaws 1902 publication, the Hawaiian population was commonly known as O. castro cryptoleucura, the Hawaiian storm-petrel (Harrison et al. 1990). Other common names for this species are the Harcourts or Madeiran storm-petrel. Native Hawaiian names for the bird include oeoe, oweowe, and akeake (Harrison et al. 1990). The American Ornithologists Union (AOU) currently regards the species as monotypic with no recognized subspecies (AOU 2007).

Historical Range

The band-rumped storm-petrel probably was common on all of the main Hawaiian Islands when aboriginal Polynesians arrived about 1,500 years ago (Berger 1972; Pyle 1984; Harrison et al. 1990). As evidenced by abundant storm-petrel bones found in middens on the island of Hawaii (Harrison et al. 1990) and in excavation sites on Oahu and Molokai (Olson and James 1982), band-rumped storm-petrels once were very numerous and nested in sufficiently accessible sites, including coastal areas, to be used as a source of food and possibly feathers (Harrison et al. 1990). They were also known from French Frigate Island (Henshaw 1902).

Current Range

Range-wide, the band-rumped storm-petrel is found in several areas of the subtropical Pacific and Atlantic Oceans (Harris 1969). In the Pacific, there are three widely separated breeding populations: one in Japan, one in Hawaii (this DPS), and one in the Galapagos (Richardson 1957; Harris 1969). In Hawaii, band-rumped storm-petrels currently are known to nest primarily in remote cliff locations on Kauai and Lehua Islet, and in high-elevation lava fields on Hawaii (Wood et al. 2002; Hu 2005, pers. comm.; VanderWerf et al. 2007). Vocalizations of the species were heard in Haleakala Crater on Maui in 1992 (Johnston, in litt. 1992a) and more recently in 2006 (Ackerman 2006, pers. comm.). The majority of the breeding colonies are located on State-owned lands on the island of Kauai. Another breeding colony likely exists on Lehua Islet, which is federally owned by the U.S. Coast Guard. Other, smaller colonies possibly exist on Federal land on Maui; and on State, Federal, and private lands on the islands of Hawaii, Lanai, and Kahoolawe.

Distinct Population Segments Defined

Hawaii, Kauai, and Maui Counties, Hawaii

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: When not at nesting sites, adult band-rumped storm-petrels spend their time foraging on the open ocean(Crossin 1974; Ainley 1984). Food is taken from the ocean surface and consists mostly of small fish, squid, crustaceans, oily scraps of marine animal carcasses, and garbage remnants (King 1967; Harris 1969).

Reproduction Narrative

Adult: Nests are found on remote cliffs, high-elevation lava fields, crevices, holes, protected ledges along cliff faces in colonial breeding areas. Nesting season occurs during summer months, with adults establishing nesting sites in April or May. In Hawaii, the nesting season occurs during the summer months, with adults establishing nesting sites in April or May. The incubation period averages 42 days (Harris 1969), and the young reach fledging stage in 64 to 70 days. Breeding is annual and begins at year 3. Lifespan is 15 to 20 years.

Geographic or Habitat Restraints or Barriers

Adult: Predators

Spatial Arrangements of the Population

Adult: Along ocean coasts

Environmental Specificity

Adult: High

Tolerance Ranges/Thresholds

Adult: Low

Site Fidelity

Adult: High fidellity to nest chambers

Dependency on Other Individuals or Species for Habitat

Adult: No information.

Habitat Narrative

Adult: This species is pelagic, resting in rafts off-shore awaiting nightfall before coming ashore to the breeding colonies. They nest in colonies along remote cliff faces in small caves, crevices, holes, and protected ledges. On the island of Hawaii, band-rumped storm-petrels likely nest in barren lava fields above 7,000 ft (2,130 m) elevation; on Kauai and Lehua Islet they likely nest on rocky cliffs (Wood et al. 2002, VanderWerf et al. 2007).

Dispersal/Migration

Motility/Mobility

Adult: High

Dispersal

Juvenile: Disperse upon fledging at 64-70 days after hatching

Adult: Limited and restricted mostly to pre-breeding young.

Immigration/Emigration

Adult: No information

Dependency on Other Individuals or Species for Dispersal

Adult: No information

Dispersal/Migration Narrative

Adult: A limited amount of dispersal, restricted mostly to pre-breeding young, may occur. Harris (1969) states that populations are probably distinct with little mixing. Investigation of the genetic relationships of the Hawaiian dark-rumped petrel (Pterodroma phaeopygia sandwichensis), a related species with similarly disjunct breeding populations in the Galapagos and Hawaii, has shown no genetic interchange between the two locations (Browne et al. 1997). Browne et al. (1997) concluded that if one of the Pacific populations is lost, natural recolonization following from the other population is unlikely.

Population Information and Trends

Population Trends:

Unknown

Species Trends:

Unknown

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Growth Rate:

Low

Number of Populations:

Unknown

Population Size:

Kauai: 171-221 nesting pairs on Kauai (Wood et al. 2002); Hawaii: unknown, but likely very small population; Maui: unknown, but likely very small population.

Minimum Viable Population Size:

Unknown

Resistance to Disease:

Low

Adaptability:

Low

Population Narrative:

Hawaiian birds represent a small, remnant population of possibly only a few hundred pairs (Harrison et al. 1984; Harrison et al. 1990). It is the only band-rumped storm-petrel population within U.S. borders or under U.S. jurisdiction. Evidence of extant nesting populations of band-rumped storm-petrels in the Hawaiian Islands is based on auditory detection of adult birds during breeding season surveys and by retrieval of fledglings in the fall. Band-rumped storm-petrels, as with other storm-petrels, make very distinctive calls during the breeding season as they approach their nesting colonies. These calls can be detected during nocturnal surveys and used to locate and identify nesting colonies. Fledglings have been retrieved on the islands of Hawaii and Kauai, and provide additional evidence of nesting colonies within the Hawaiian archipelago (Harrison et al. 1990). Band-rumped storm-petrels are regularly reported in coastal waters around Kauai, Niihau, and Hawaii, including reports of regular concentrations of storm-petrels at various distances offshore from possible nesting colonies (Harrison et al. 1990; VanderWerf et al. 2007; Kuhn 2007, pers. comm.). These rafts, which range in number from a few birds to perhaps a hundred, may be birds awaiting nightfall before coming ashore to the breeding colonies. A database of bird observations maintained at the Bishop Museum in Honolulu contains 39 reports of the species in Hawaii since 1995, with 30 of them from Kauai (Pyle 2005, pers. comm.). The largest number reported was 27 birds on July 28, 1993, from the Kaulakahi Channel between Kauai and Niihau. An individual who takes regular boat trips across the Kaulakahi Channel to Lehua Islet reported seeing the species on 19 occasions between April 1998 and August 2005. The highest number of individuals seen at one time was 18, which was observed in June 2000 and June 2005 each (Kuhn 2007, pers. comm.). Concentrations of birds found near the equator south of the Hawaiian Islands and in the Marshall Islands (Spear et al. 1994) may be part of the Hawaiian population, but assignment of these birds to an exact breeding location is speculative. Kauai likely has the largest population of band-rumped storm-petrels in the Hawaiian Islands (Harrison et al. 1990). A limited amount of dispersal, restricted mostly to pre-breeding young, may occur. Harris (1969) states that populations are probablydistinct with little mixing. Investigation of the genetic relationships of the Hawaiian dark-rumped petrel (*Pterodroma phaeopygia sandwichensis*), a related species with similarly disjunct breeding populations in the Galapagos and Hawaii, has shown no genetic interchange between the two locations (Browne et al. 1997). Browne et al. (1997) concluded that if one of the Pacific populations is lost, natural recolonization following from the other population is unlikely.

Threats and Stressors

Stressor: Introduced predators
Exposure: Not assessed.
Response: Not assessed
Consequence: Not assessed.
Narrative: Introduced predators are the most serious threat facing the band-rumped storm-petrel. The Polynesian rat (Rattus exulans) was introduced to the Hawaiian Islands by Polynesians prior to the arrival of Europeans, anda number of additional predators have been introduced since the arrival of Europeans, including the domestic cat (Felis catus), small Indian mongoose (Herpestes auropunctatus), common barn owl (Tyto alba), black rat (R. rattus) and Norway rat (R. norvegicus). These predators are found throughout the main Hawaiian Islands,with the exception of the mongoose, which is not established on Kauai (Scott et al. 1986; Tomich 1986; Harrison et al. 1990; Slotterback 2002; Wood 2005, pers. comm.). Rat populations also are very high on Lehua and likely preclude a stable breeding population (Conry, in litt. 2012).

Stressor: Artificial lighting
Exposure: Not assessed.
Response: Not assessed
Consequence: Not assessed.
Narrative: A significant impact to the band-rumped storm-petrel results from the effects of artificial lights on fledgling young and, to a lesser degree, adults. Artificial lighting of roadways, resorts, ballparks, residences, and other development in lower elevation areas, as well as cruise ships out at sea, both attracts and confuses night-flying storm-petrel fledglings and other seabirds, resulting in fall-out (Harrison et al. 1990; Reed et al. 1985; Telfer et al. 1987; Planning Solutions 2003; Duvall2008, pers. comm.) and collisions with buildings and other objects (Banko et al. 1991). Artificial lights modify the night sky through which the fledgling birds must navigate after leaving the nest to reach the open sea. The actual extent of such loss and its overall impact on the population is not known because scavengers prevent the majority of fall-outs from being detected, but any loss in such a small population is significant.

Stressor: Communication towers and utility lines
Exposure: Not assessed.
Response: Not assessed
Consequence: Not assessed.
Narrative: Several seabird species that nest in the Hawaiian Islands, including Newells shearwater, Hawaiian petrel, and band-rumped storm-petrel, regularly commute between inland nest sites and the ocean. These birds commute at night when unnatural obstacles such as communication towers and utility lines are difficult to see. Birds may strike these unseen obstacles, often resulting in injury and death. The impact from artificial lighting and collisions with communication towers, utility wires, and other structures is expected to increase as the human population grows and development continues on Kauai and other Hawaiian Islands.

Stressor: Demographics
Exposure: Not assessed.

Response: Not assessed
Consequence: Not assessed.
Narrative: A limited amount of dispersal, restricted mostly to pre-breeding young, may occur. Harris (1969) states that populations are probablydistinct with little mixing. Investigation of the genetic relationships of the Hawaiian dark-rumped petrel (Pterodroma phaeopygia sandwichensis), a related species with similarly disjunct breeding populations in the Galapagos and Hawaii, has shown no genetic interchange between the two locations (Browne et al. 1997). Browne et al. (1997) concluded that if one of the Pacific populations is lost, natural recolonization following from the other population is unlikely.

Stressor: Habitat degradation (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: Erosion and landslides at nest sites caused by the actions of nonnative ungulates is a threat in some locations on the island of Kauai (Raine 2015, in litt.). Nonnative plants outcompete native plants and can also affect nesting sites of the band-rumped storm-petrel by accelerating erosion, leading to landslides and rockfalls (Wood et al. 2002, pp. 7–19). Commercial fisheries and ocean pollution have negative impacts to seabirds, and also are likely to have negative impacts to the band-rumped storm petrel, although the information about the impacts of fisheries and plastics on storm-petrel species is limited (USFWS, 2016).

Stressor: Small population size (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: The small population size and limited distribution of the band-rumped stormpetrel in Hawaii is a threat to this population (Soule´ 1987, p. 8; Lande 1988, pp. 1455, 1458–1459; Harrison et al. 1990, p. 50; Furness 2003, p. 33) (USFWS, 2016).

Recovery

Reclassification Criteria:
No information

Delisting Criteria:
No information

Recovery Actions:
- Conduct intensive surveys for breeding colonies.
- Conduct at-sea surveys.
- Control predators (rats, cats, barn owls, mongoose) at known colonies.
- Shield and/or reduce human-made light sources.
- Control feral ungulates at known colony sites.

Conservation Measures and Best Management Practices:
- See recovery actions

Additional Threshold Information:

- Status of the Species: Oceanodroma castro (Band-rumped storm petrel) Taxonomy and Species Description The Band-rumped storm petrel is an intermediate in many respects between Wilson's and Leach's storm-petrels, and is blackish-brown overall with pale wing bars and a clear, curved white band across rump. The tail is slightly forked but this feature is difficult to discern at sea. The Band-rumped storm petrel is approximately 7.5 to 9 inches in length with a 1.5-foot wingspan. Historic and Current Distribution The band-rumped storm-petrel is found in several areas of the subtropical Pacific and Atlantic Oceans. In the Pacific, there are three widely separated breeding populations—one in Japan, one in Hawaii, and one in the Galapagos. Populations in Japan and the Galapagos are comparatively large and number in the thousands, while the Hawaiian birds represent a small, remnant population of possibly only a few hundred breeding pairs (Harrison et al. 1990). Band-rumped storm- petrels are most commonly found in close proximity to their respective breeding habitat on islands. The three populations in the Pacific are separated by long distances across the open ocean where birds are not found. Extensive at-sea surveys of the Pacific have revealed a broad gap in distribution of the band-rumped storm- petrel to the east and west of the Hawaiian Islands, indicating that the distribution of birds in the central Pacific around Hawaii is separated from other nesting areas. The available information indicates that distinct populations of band-rumped storm-petrels are definable and that the Hawaiian population is distinct based on geographic and distributional isolation from other band-rumped storm-petrel populations in Japan, the Galapagos, and the Atlantic Ocean. Loss of the Hawaiian population would cause a significant gap in the distribution of the band-rumped storm-petrel in the Pacific, and could result in the complete isolation of the Galapagos and Japan populations without even occasional genetic exchange. Therefore, the Hawaiian population is both discrete and significant, and constitutes a distinct population segment of the larger band-rumped storm-petrel species. Life History and Habitat Description The Band-rumped storm petrel is a small seabird and both sexes are alike in size and appearance. The species is long-lived (15-20 years) and probably does not breed until its third year (Ainley 1984). When not at nesting sites, adult band-rumped storm-petrels spend their time foraging on the open ocean (Crossin 1974; Ainley 1984). In the Hawaiian Islands, this species has been found to nest in remote cliff locations on the island of Kauai and Lehua Islet and in barren lava fields above 7,000 feet in elevation on the island of Hawaii (Banko et al. 1991; Wood et al. 2002; VanderWerf et al. 2007; Hu 2005, pers. comm.). Vocalizations of the species were heard in Haleakala Crater on Maui as recently as 2006; however, no nesting sites have been located on the island to date. Threats, Recovery Strategies, and Ongoing Conservation Measures The Hawaiian population of Band-rumped storm-petrel was identified as a candidate for listing in 1989 (USFWS 1989). The most recent candidate notice of review for the Hawaiian population of Band-rumped storm-petrel was completed on November 22, 2013 in accordance with Section 4(c)(2) of the ESA. The significant reduction in numbers and range of the band-rumped storm-petrel is due primarily to predation by nonnative species introduced by humans, including the domestic cat (Felis catus), small Indian mongoose (Herpestes auropunctatus), common barn owl (Tyto alba), black rat (Rattus rattus), Polynesian rat (R. exulans), and Norway rat (R.norvegicus). These non-native predators occur throughout the main Hawaiian Islands, with the exception of the mongoose, which is not established on the island of Kauai. Attraction of fledglings to artificial lights, which disrupt their night-time navigation, resulting in collisions with buildings and other objects, and collisions with artificial structures such as communication towers and utility lines, are also threats. Erosion of nest sites caused by the actions of nonnative ungulates is a potential threat in some locations. Efforts are under way in some areas to reduce light pollution and mitigate the threat of collisions, as well as to control some of the nonnative predators in the Hawaiian Islands; however, the threats remain.

- Status of the Species: Oceanodroma castro (Band-rumped storm petrel) Taxonomy and Species Description The Band-rumped storm petrel is an intermediate in many respects between Wilson's and Leach's storm-petrels, and is blackish-brown overall with pale wing bars and a clear, curved white band across rump. The tail is slightly forked but this feature is difficult to discern at sea. The Band-rumped storm petrel is approximately 7.5 to 9 inches in length with a 1.5-foot wingspan. Historic and Current Distribution The band-rumped storm-petrel is found in several areas of the subtropical Pacific and Atlantic Oceans. In the Pacific, there are three widely separated breeding populations—one in Japan, one in Hawaii, and one in the Galapagos. Populations in Japan and the Galapagos are comparatively large and number in the thousands, while the Hawaiian birds represent a small, remnant population of possibly only a few hundred breeding pairs (Harrison et al. 1990). Band-rumped storm- petrels are most commonly found in close proximity to their respective breeding habitat on islands. The three populations in the Pacific are separated by long distances across the open ocean where birds are not found. Extensive at-sea surveys of the Pacific have revealed a broad gap in distribution of the band-rumped storm- petrel to the east and west of the Hawaiian Islands, indicating that the distribution of birds in the central Pacific around Hawaii is separated from other nesting areas. The available information indicates that distinct populations of band-rumped storm-petrels are definable and that the Hawaiian population is distinct based on geographic and distributional isolation from other band-rumped storm-petrel populations in Japan, the Galapagos, and the Atlantic Ocean. Loss of the Hawaiian population would cause a significant gap in the distribution of the band-rumped storm-petrel in the Pacific, and could result in the complete isolation of the Galapagos and Japan populations without even occasional genetic exchange. Therefore, the Hawaiian population is both discrete and significant, and constitutes a distinct population segment of the larger band-rumped storm-petrel species. Life History and Habitat Description The Band-rumped storm petrel is a small seabird and both sexes are alike in size and appearance. The species is long-lived (15-20 years) and probably does not breed until its third year (Ainley 1984). When not at nesting sites, adult band-rumped storm-petrels spend their time foraging on the open ocean (Crossin 1974; Ainley 1984). In the Hawaiian Islands, this species has been found to nest in remote cliff locations on the island of Kauai and Lehua Islet and in barren lava fields above 7,000 feet in elevation on the island of Hawaii (Banko et al. 1991; Wood et al. 2002; VanderWerf et al. 2007; Hu 2005, pers. comm.). Vocalizations of the species were heard in Haleakala Crater on Maui as recently as 2006; however, no nesting sites have been located on the island to date. Threats, Recovery Strategies, and Ongoing Conservation Measures The Hawaiian population of Band-rumped storm-petrel was identified as a candidate for listing in 1989 (USFWS 1989). The most recent candidate notice of review for the Hawaiian population of Band-rumped storm-petrel was completed on November 22, 2013 in accordance with Section 4(c)(2) of the ESA. The significant reduction in numbers and range of the band-rumped storm-petrel is due primarily to predation by nonnative species introduced by humans, including the domestic cat (Felis catus), small Indian mongoose (Herpestes auropunctatus), common barn owl (Tyto alba), black rat (Rattus rattus), Polynesian rat (R. exulans), and Norway rat (R.norvegicus). These non-native predators occur throughout the main Hawaiian Islands, with the exception of the mongoose, which is not established on the island of Kauai. Attraction of fledglings to artificial lights, which disrupt their night-time navigation, resulting in collisions with buildings and other objects, and collisions with artificial structures such as communication towers and utility lines, are also threats. Erosion of nest sites caused by the actions of nonnative ungulates is a potential threat in some locations. Efforts are under way in some areas to reduce light pollution and mitigate the threat of collisions, as well as to control some of the nonnative predators in the Hawaiian Islands; however, the threats remain.

References

USFWS 2014. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Oceanodroma castro (Band-rumped Storm-petrel) 19 p.

USFWS. 2017. Environmental Conservation Online System (ECOS) – Species Profile. http://ecos.fws.gov/ecp0/. Accessed March 2017.

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Endangered Status for 49 Species From the Hawaiian Islands. Final rule. 81 FR 67786 - 67860 (September 30, 2016).

USFWS 2016. Status of the Species and Critical Habitat: Status of the Species: Oceanodroma castro (Band-rumped storm petrel). U.S. Fish and Wildlife Service 2600 SE 98TH Ave., Suite 100. Portland, OR 97266. Provided to FESTF from Chris Mullens 9/30/2016.

SPECIES ACCOUNT: *Oreomystis bairdi* (Akikiki, Kaua'I creeper)

Species Taxonomic and Listing Information

Listing Status: Endangered; 05/13/2010; Pacific Region (R1) (USFWS, 2016)

Physical Description

The ‘Akikiki is a small (12-17 g) insectivorous honeycreeper endemic to Kaua‘i. It is dark gray to olive gray on the head, back, sides and flanks, and off-white on the throat, breast, belly, and under-tail coverts (Pratt et al. 1987, Foster et al. 2000, Pratt 2005). The bill is short, slightly de-curved, and pale pink. Males and females are similar. Juveniles resemble adults, but have white spectacles around the eyes. The song is a short, descending trill. Males and females give a soft “whit” contact call (Pratt et al. 1987, Foster et al. 2000). They are usually found in pairs, family groups, or small flocks of 8 to 12 individuals. The ‘Akikiki is one of the least known extant Hawaiian passerines. New in 2017: The akikiki is 10.9 to 12.2 centimeters (4.3 to 4.8 inches) in length and 11.5 to 17.0 grams (0.39 to 0.58 ounces) in weight. Recent observations of both wild birds and birds in the conservation breeding flock confirm that the facial plumage of all second-year Akikiki is either spectacled or eye-browed, and all third year Akikiki are hooded(USFWS, 2017).

Taxonomy

"At the time of European discovery, each of the six main Hawaiian Islands harbored a small, straight-billed, simple-tongued, insectivorous bird. The akikiki was first described as Oreomyza bairdi by Stejneger in 1887 (the genus was later changed to Oreomystis because Oreomyza had been used previously (USFWS 2006a). Subsequent nomenclature has been problematic (reviewed in Pratt 1992; Foster et al. 2000). It is currently classified as Oreomystis bairdi following Pratt (1992), but its inclusion with the Hawaii creeper in the genus was a matter of ongoing debate (Johnson et al. 1989; Pratt 2001). Hawaii Creeper was changed from Oreomystis mana to Loxops mana in 2013 in the 54th Supplement to the American Ornithologists Union (AOU) Check-list of North American Birds, making Oreomystis bairdi a montypic genus. Additional evidence, particularly molecular, may confirm that the Maui alauahio (P. montana newtoni) is the closest living relative of the akikiki (Foster et al. 2000). (USFWS, 2017)"

Current Range

The ‘Akikiki was considered common at all elevations in native forests in the late 1800s (Perkins 1903), and was locally abundant on and near the Alaka’i Plateau in the early 1960s (Richardson and Bowles 1964. The geographic range of the ‘Akikiki has contracted from 88 km2 in 1973 to 36 km2 (Service 2010) in 2000 to less than 25 km2 today (DOFAW, unpubl. data). New in 2017: The akikiki is a small Hawaiian honeycreeper found only on Kauai, currently in montane-wet ecosystems on the Alakai Plateau (USFWS 2010a; Paxton et al. 2016). Akikiki has experienced rapid range contraction since 2000 and are now limited to 39 square kilometers (15 square miles) on the (Alakai) plateau, a reduction of 57% (Paxton et al. 2016).(USFWS, 2017).

Critical Habitat Designated

Yes; 4/13/2010.

Legal Description

On April 13, 2010, the U.S. Fish and Wildlife Service (Service) determined endangered status for Oreomystis bairdi (Akikiki) on the island of Kauai in the Hawaiian Islands under the Endangered Species Act of 1973, as amended (75 FR 18960 - 19165). There were six critical habitat units determined in Kauai County, Hawaii.

Critical Habitat Designation

The following areas are designated as critical habitat: Unit 1–Montane Mesic, Kauai County, Hawaii; Unit 2–Montane Mesic, Kauai County, Hawaii; Unit 3–Montane Mesic, Kauai County, Hawaii; Unit 4–Montane Wet, Kauai County, Hawaii; Unit 5–Montane Wet, Kauai County, Hawaii; Unit 6–Montane Wet, Kauai County, Hawaii.

Kauai—Montane Mesic—Section 1: Montane Mesic–Section 1 consists of 2,423 ac (980 ha) in the montane mesic ecosystem, including the area above Honopu Valley to Mahanaloa Valley, on State owned land in Kokee State Park, the Na Pali-Kona Forest Reserve, and Kuia NAR. The entire section is within previously designated critical habitat for the plant species, falling within Critical Habitat Unit 11 of 50 CFR 17.99(a)(1), Map 70c, and is occupied by the plants Chamaesyce remyi var. remyi, Labordia helleri, Myrsine knudsenii, Platydesma rostrata, Psychotria grandiflora, Stenogyne kealiae, and Tetraplasandra flynii. This section is also occupied by the akekee and the picture-wing fly; maps of critical habitat for these species can be found at 50 CFR 17.95(b) for the akekee and akikiki (Unit 1–Montane Mesic), and at 50 CFR 17.95(i) for the picture-wing fly (Unit 1–Montane Mesic). This section also contains unoccupied habitat that is essential to the conservation of these nine species by providing the physical and biological features necessary for the expansion of the existing wild populations. This section includes the montane mesic forest, the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane mesic ecosystem (Table 3), as well as species-specific PCEs for the akekee and akikiki (arthropod prey) and picture-wing fly (the larval-stage host plants, Cheirodendron sp. and Tetraplasandra sp.). Although Montane Mesic–Section 1 is not known to be occupied by the species Diellia mannii, Myrsine mezii, and the akikiki, we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historic range. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Kauai—Montane Mesic—Section 2: Montane Mesic–Section 2 consists of 376 ac (152 ha) in the montane mesic ecosystem and includes a portion of the area surrounding a tributary of Nawaimaka Stream east to Kumuwela Ridge. The entire section is State-owned within Kokee State Park, and includes 8 ac (3 ha) of newly designated critical habitat. This section is occupied by Diellia mannii and the picture-wing fly Drosophila sharpi, and includes the montane mesic forest, the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane mesic ecosystem, as well as the larval-stage host plants (Cheirodendron sp. and Tetraplasandra sp.) associated with the picture-wing fly. This section also contains unoccupied habitat that is essential to the conservation of these two species by providing the physical and biological features necessary for the expansion of the existing wild populations. Although Montane Mesic–Section 2 is not known to be occupied by the plants Chamaesyce remyi var. remyi, Labordia helleri, Myrsine knudsenii, Myrsine mezii, Platydesma rostrata, Psychotria grandiflora, Stenogyne kealiae, and Tetraplasandra flynnii, or by the birds the akekee and akikiki, we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historical range, as well as species-specific PCEs for the akekee and akikiki (arthropod prey). Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Kauai—Montane Mesic—Section 3: Montane Mesic–Section 3 consists of 139 ac (56 ha) in the montane mesic ecosystem, including the upper portion of the Nawaimaka Valley up to Kapukapaia Ridge, on State-owned land in the Na Pali-Kona Forest Reserve. This section is not in previously designated critical habitat and includes the only montane mesic forest occupied by the plant Myrsine mezii, and the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane mesic ecosystem (Table 3). This section also contains unoccupied habitat that is essential to the conservation of this species by providing the physical and biological features necessary for the expansion of the existing wild population. Although Montane Mesic–Section 3 is not known to be occupied by the plants Chamaesyce remyi var. remyi, Labordia helleri, Myrsine knudsenii, Myrsine mezii, Platydesma rostrata, Psychotria grandiflora, Stenogyne kealiae, and Tetraplasandra flynnii; by the birds the akekee and akikiki; or by the picturewing fly Drosophila sharpi, we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historic range. It also provides for the species-specific PCEs for the akekee and akikiki (arthropod prey) and the larval-stage host plants (Cheirodendron sp. and Tetraplasandra sp.) associated with D. sharpi. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Kauai—Montane Wet—Section 1: Montane Wet–Section 1 consists of 13,055 ac (5,257 ha) in the montane wet ecosystem, extending across the Alakai Plateau from Hanakoa to Mount Waialeale, on State (12,628 ac, 5,110 ha) and privately owned (427 ac, 173 ha) land in the Na Pali Coast State Park, the Alakai Wilderness Preserve, the Na PaliKona and Halelea forest reserves, and Hono o Na Pali NAR. It is occupied by the plants Astelia waialealae, Chamaesyce remyi var. remyi, Dryopteris crinalis var. podosorus, Dubautia waialealae, Geranium kauaiense, Keysseria erici, K. helenae, Labordia helleri, L. pumila, Lysimachia daphnoides, Melicope degeneri, M. puberula, Myrsine mezii, Phyllostegia renovans, and Platydesma rostrata; by the akekee and akikiki; and by the picture-wing fly. This section also contains unoccupied habitat that is essential to the conservation of these 18 species by providing the physical and biological features necessary for the expansion of the existing wild populations. This section includes the montane wet forest, the moisture regime, and canopy, subcanopy, and understory plant species identified as PCEs in the montane wet ecosystem (Table 3), and the species-specific PCEs including (1) bogs (identified as PCEs for Dubautia waialealae, Geranium kauaiense, Keysseria erici, Keysseria helenae, Labordia pumila) (2) bog hummocks (identified as PCEs for Astelia waialealae and Lysimachia daphnoides); (3) arthropod prey (identified as PCEs for the akekee and the akikiki); and (4) larval-stage host plants, Cheirodendron and Tetraplasandra sp., (identified as a PCE for the picture-wing fly). Although Montane Wet–Section 1 is not known to be occupied by the plants Dubautia kalalauensis, Psychotria grandiflora, and Tetraplasandra flynnii, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historical range. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Kauai—Montane Wet—Section 2: Montane Wet–Section 2 consists of 790 ac (320 ha) in the montane wet ecosystem, extending from Kahuamaa Flat south to the edge of Waimea Canyon, on State-owned land in Kokee State Park. The entire section is within previously designated critical habitat, and is occupied by the plants Chamaesyce remyi var. remyi, Dubautia kalalauensis, Labordia helleri, Melicope puberula, Platydesma rostrata, Psychotria grandiflora, and Tetraplasandra flynii, and by the akekee. This section includes montane wet forest, potentially some small-scale boggy areas, the moisture regime, and canopy, subcanopy and understory plant species identified as PCEs in the montane wet ecosystem (Table 3), and arthropod prey (identified as a speciesspecific PCE for the akekee). Although Montane Wet–Section 2 is not known to be occupied by the plants Astelia waialeale, Dryopteris crinalis var. podosorus, Dubautia waialeale, Geranium kauaiense, Keysseria erici, Keysseria helenae, Labordia pumila, Lysimachia daphnoides, Melicope degeneri, Myrsine mezii, and Phyllostegia renovans; by the akikiki; or by the picture-wing fly, Drosophila sharpi, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historical range. This area also supports the arthropod prey identified as a PCE for the akikiki, and the larval-stage host plants (Cheirodendron and Tetraplasandra spp.) identified as a PCE for the picturewing fly. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Kauai—Montane Wet—Section 3: Montane Wet–Section 3 consists of 413 ac (167 ha) in the montane wet ecosystem, encompasses the summit of Namolokama, on State (156 ac, 63 ha) and privately owned (257 ac, 104 ha) land in the Halelea Forest Reserve. It is entirely within previously designated critical habitat, and is occupied by the plants Keysseria erici and Labordia pumila. This section includes the montane wet forest, the moisture regime, and the canopy, subcanopy, and understory plant species identified as PCEs in the montane wet ecosystem (Table 3), and bogs (identified as a species-specific PCE for K. erici). Although Montane Wet–Section 3 is not known to be occupied by the plants Astelia waialeale, Chamaesyce remyi var. remyi, Dryopteris crinalis var. podosorus, Dubautia kalalauensis, D. waialeale, Geranium kauaiense, Keysseria helenae, Labordia helleri, Lysimachia daphnoides, Melicope degeneri, M. puberula, Myrsine mezii, Phyllostegia renovans, Platydesma rostrata, Psychotria grandiflora, and Tetraplasandra flynnii; by the akekee and akikiki; or by the picture-wing fly, Drosophila sharpi, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the physical and biological features necessary for the reestablishment of wild populations within their historic range. It also supports the arthropod prey identified as a PCE for the akekee and akikiki, and the larval-stage host plants (Cheirodendron and Tetraplasandra spp.) identified as a PCE for the picture-wing fly. Due to the small numbers of individuals or low population sizes of each of these species, each requires suitable habitat and space for expansion or reintroduction to achieve recovery.

Primary Constituent Elements/Physical or Biological Features

Six critical habitat units are depicted for Kauai County, Hawaii. In units 1, 2, and 3, the primary constituent elements of critical habitat for Akikiki (Oreomystis bairdi) are:

(A) Elevation: 3,000 to 5,243 ft (914 to 1,598 m). (B) Annual precipitation: 50 to 75 inches (127 to 190 centimeters). (C) Substrate: Weathered aa lava flows, rocky mucks, thin silty loams, deep volcanic ash soils. (D) Canopy: Acacia, Metrosideros, Psychotria, Tetraplasandra, Zanthoxylum. (E) Subcanopy: Cheirodendron, Coprosma, Kadua, Ilex, Myoporum, Myrsine. (F) Understory: Bidens, Dryopteris, Leptecophylla, Poa, Scaevola, Sophora. (G) Arthropod prey.

In units 4, 5, and 6, the primary constituent elements of critical habitat for Akikiki (Oreomystis bairdi) are:

(A) Elevation: 3,000 to 5,243 ft (914 to 1,598 m). (B) Annual precipitation: Greater than 75 inches (190 centimeters). (C) Substrate: Well-developed soils, montane bogs. (D) Canopy: Acacia, Charpentiera, Cheirodendron, Metrosideros. (E) Subcanopy: Broussaisia, Cibotium, Eurya, Ilex, Myrsine. (F) Understory: Ferns, Carex, Coprosma, Leptecophylla, Oreobolus, Rhynchospora, Vaccinium. (G) Arthropod prey.

Special Management Considerations or Protections

Manmade features and structures, such as buildings, roads, railroads, airports, runways, other paved areas, lawns, and other urban landscaped areas, existing on the effective date of this rule do not contain one or more of the primary constituent elements.

The primary threats to the physical and biological features essential to the conservation of all of these species include habitat destruction and modification by feral ungulates, predation by nonnative species, competition with nonnative species, hurricanes, landslides, flooding, and climate change. The reduction of these threats will require the implementation of special management actions within each of the critical habitat areas.

Life History

Feeding Narrative

Adult: ʻAkikiki forage on trunks, branches, and twigs of live and dead trees, primarily ʻohiʻa and koa and occasionally in subcanopy shrubs (Foster et al. 2000). They feed on insects, insect larvae, and other arthropods taken from bark, crevices, dead wood, and epiphytes by gleaning, probing, and rarely by excavation (Foster et al. 2000, VanderWerf and Roberts 2008).

Reproduction Narrative

Adult: The nesting season of the ʻAkikiki extends primarily from March - June (Foster et al. 2000), but may occur from January to July (VanderWerf and Roberts 2008). Few ʻAkikiki nests have been found, but all have been located in the crowns of ʻohiʻa trees from 4 to 12.5 m above the ground and were composed of moss, small pieces of bark, bits of lichen, and fine plant fibers (Eddinger 1972a, Foster et al. 2000, VanderWerf and Roberts 2008). Both sexes help build the nest and feed the nestlings, but incubation has only been observed by the female; males feed females during nest construction, incubation, and brooding (Eddinger 1972a, Foster et al. 2000, VanderWerf and Roberts 2008). There is no information about nest success, reproductive rates, survival of adults or juveniles, or movements (Foster et al. 2000, Service 2006). A long period of parental dependency makes double brooding unlikely.

Habitat Narrative

Adult: ʻAkikiki is found in mesic and wet native montane forests dominated by ʻohiʻa, koa, ʻolapa, lapalapa, ʻohiʻa ha, kawaʻu, and kolea, with a diverse understory of native plants including ʻohelo and kanawao. As of 2017: Roughly 39 square kilometers (15 square miles) on the Alakai Plateau remains as suitable habitat for 10 akikiki (Paxton et al. 2016). In the eastern edge of the species range, annual rainfall exceeds 13,000 millimeters (512 inches) per year, declining to 2,200 millimeters (87 inches) at the western edge at Na Pali Kona Forest Reserve (Giambelluca et al. 2013). The ground cover consists of various ferns, mosses, herbs and lichens. (USFWS, 2017).

Dispersal/Migration

Population Information and Trends

Population Trends:

Decreasing

Population Size:

~350

Population Narrative:

The first quantitative information on the population size and distribution of the ʻAkikiki was based on extensive surveys conducted from 1968-1973. These surveys yielded an island-wide population estimate of 6,832 ± 966 birds (Service 1983). In 1981, the number of ʻAkikiki estimated to occur in a 25 km2 area of the southeastern Alakaʻi was 1,650 ± 450 (Scott et al. 1986). Between 1968 and 1973, the estimated ʻAkikiki population in this same area was 2,300 ± 700 birds (Service 1983). Surveys in 2000 indicated that the ʻAkikiki population had decreased to 1,472 ± 680 birds and that the species had disappeared from much of the periphery of its range (Foster et al. 2004). The estimated population was 1,364 ± 401 birds in 2005, 1,312 ± 530 birds in 2007, and 3,924 ± 756 birds in 2008 (DOFAW and USGS, unpubl. data). The most current estimate of the ʻAkikiki population is ca. 350 birds (DOFAW unpubl. data). These population estimates should be viewed with caution as it has been difficult to accurately estimate the abundance of the ʻAkikiki. The number of detections during surveys has always been limited and results in large confidence intervals around density estimates which have fluctuated more than any other Kauaʻi bird and it is difficult to know if these fluctuations are real or result from sampling error.

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Prior to the arrival of humans, the Hawaiian archipelago supported a remarkable avifauna comprised of at least 107 endemic species, including flightless geese, ibis, and rails and a radiation of at least 59 species in the subfamily Drepanidinae (Olson and James 1991, James and Olson 1991, James 2004). In the years since human colonization, 67 bird species have been confirmed lost, 46 prior to the arrival of Europeans and 23 since 1778 (Olson and James 1991, James and Olson 1991, Pyle 1997, Banko et al. 2001). Of the 42 extant endemic taxa, 31 are

federally listed (29 species and 2 sub-species). Ten of these taxa have not been observed in as many as 40 years and their status is unknown (Service 2006). Habitat destruction, non-native diseases and predators, and habitat degradation by introduced ungulates and invasive plants are the main threats now facing Hawaii's remaining endemic birds (van Riper and Scott 2001, Service 2006).

Stressor: Habitat Loss and Degradation
Exposure:
Response:
Consequence:
Narrative: The loss, fragmentation, and degradation of native Hawaiian Island habitats began over 700 years ago when Polynesians settled the archipelago, and accelerated with the arrival of Europeans in 1778. As a result, all native Hawaiian birds have been adversely affected. European settlement not only caused the further loss and degradation of native forest but also initiated a long history of alien species introductions, including invasive plants, goats (Capra hircus), cattle, sheep (Ovis aries), and pigs (Sus scrofa) all of which have degraded native forest for centuries. Introduced ungulates have devastated Hawaiian forests which evolved without mammalian browsers and grazers and have no defenses against them. Ungulates also contribute to soil erosion, prevent regeneration of native plants, facilitate the invasion of alien plants, and create breeding habitat for mosquitoes (Service 2009). Non-native, invasive plants have profoundly altered native habitats in Hawai'i. Contractions in the ranges of the 'Akikiki and the 'Akeke'e have occurred at their edges (Foster et al. 2004) where disturbance and the effects of feral ungulates and invasive alien plants are most severe, suggesting degradation of forest habitat has played a role in that range contraction.

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Hawaiian birds evolved in the absence of mammalian predators and have little to no adaptive behavioral responses to their presence. The nests, adults, and fledglings of all Hawaiian bird species are vulnerable to feral cats (Felis catus), rats (Rattus spp.), small Indian mongoose (Herpestes auropunctatus), dogs (Canis familiaris), and feral pigs (Service 2009).

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: Avian malaria (Plasmodium relictum) and avian pox virus (Poxvirus avium) carried by the alien southern house mosquito (Culex quinquefasciatus) resulted in the extinction of many Hawaiian birds and currently limits the distribution of most extant native forest birds to high elevation forests where cool temperatures limit mosquitoes (van Riper et al. 1986, Atkinson et al. 1995, Atkinson and LaPointe 2009). Toxoplasmosis is a widespread disease caused by a protozoan parasite, Toxoplasma gondii, and can affect all birds and mammals (Elmore et al. 2010, Innes 2010). Cats are the primary reservoir of infection and one cat can shed millions of oocytes that can persist for months in damp soil (Elmore et al. 2010, Innes 2010). West Nile virus is another mosquito-borne pathogen that infects a wide range of birds, including corvids (Kilpatrick

et al. 2006). West Nile virus spread rapidly across North America from 2000 to 2005 (Marra et al. 2004), but it has not been recorded in Hawaiʻi.

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: Increasing air temperatures associated with climate change are likely to exacerbate the threat of disease to native Hawaiian birds by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning et al. 2002, Harvell et al. 2002, Hay et al. 2002, Giambelluca and Luke 2007, Giambelluca et al. 2008, Loiseau et al. 2012). An increase in temperature of 2°C, which is a conservative figure based on recent data (IPCC 2007), would allow regular disease transmission in 85% of the area on Kauaʻi where it is now only periodic (Benning et al. 2002). Disease prevalence and the prevalence of mosquitos are increasing across the Alakaʻi (Atkinson and Utzurrum 2010, Atkinson et al. 2014. Drought reduces mamane seed production and likely contributes to the mortality of mature trees (Juvik et al. 1993), especially those stressed by browsing (Banko et al 2013), pathogens (Gardner and Trujillo 2001), and competition from invasive grasses and weeds (Banko et al. 2009). Drought conditions have persisted on Mauna Kea since 2000 but have been most severe since 2006 (Banko et al. 2014).

Stressor: Small populations
Exposure:
Response:
Consequence:
Narrative: Small populations are more vulnerable to extinction than large populations because of the higher risks posed by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002).

Stressor: Hurricanes
Exposure:
Response:
Consequence:
Narrative: Major hurricanes struck Kauaʻi in 1983 and 1992 and degraded native forests by destroying large trees, creating gaps into which alien plants could expand, and spreading invasive plants. The effects of these hurricanes on the ʻAkikiki are unknown.

Recovery

Reclassification Criteria:
Criterion 1: A total population of 5,000 birds throughout 75 percent of the recovery area and the species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species. (USFWS, 2017).

Criterion 2: Quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda λ) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason. (USFWS, 2017).

Criterion 3: Sufficient recovery area is protected and managed to achieve Criteria 1 and 2 above. (USFWS, 2017).

Criterion 4: The mix of threats that were responsible for the decline of the species have been identified and controlled. (USFWS, 2017).

Delisting Criteria:
"Akikiki may be delisted when all four of the criteria (Downlisting/Reclassification Criteria) have been met for a 30-year period and total population is 8,000 adults. (USFWS, 2017)."

Recovery Actions:
- Recommendation a) Avian malaria and pox / mosquito vector control. Implement landscapelevel control of the mosquito vector (Culex quinquefasciatus) by using existing and developing technologies such as Wolbachia to control populations and bio-pesticides to treat larvae. Continue to investigate novel technologies to confront mosquito vectors and mosquito-borne pathogens in the Hawaiian Islands. (USFWS, 2017).
- Recommendation b) Biosecurity. Implement a statewide interagency biosecurity plan to prevent ROD and other detrimental non-native species from becoming established on Kauai (Hawaii Department of Agriculture, 2017). An effective biosecurity plan requires a comprehensive approach that includes: • Pre-border policies and processes to prevent invasive species from making their way to the state of Hawaii • Border policies and processes that support inspecting incoming items to ensure minimal risk of pest entry into the state • Post-border policies and processes that support detecting and responding to new incursions of invasive species and controlling established invasive species wherever possible (USFWS, 2017).
- Recommendation c) Captive Propagation and Reintroduction Programs. Augmentation of natural dispersal and recolonization of recovering habitat through reintroduction of captive-bred akikiki in selected areas is desirable. Such reintroductions may increase the range of the species and the probability that the species will survive future catastrophes such as hurricanes or disease outbreaks. (USFWS, 2017).
- Recommendation d) Habitat Protection and Management. Habitat protection and management should continue to occur in areas in which akikiki occupancy is the highest. Prospects for recovery lie in maintaining and restoring forest habitat by developing, testing, and applying broad-scale habitat restoration measures, including: minimizing populations of feral ungulates through a combination of hunting, fencing, snaring, and possibly development of lethal non-toxicant devices for use in areas inaccessible to hunters or in areas closed to hunters; controlling the encroachment of invasive plants and insects through tested bio-control and where feasible, mechanical and chemical measures; and continuing enforcement of State and Federal laws that protect against destructive human activities and development. (USFWS, 2017).
- Recommendation e) Predator Control. A need exists to develop, test, register, and apply toxicants for control of feral cats and introduced rodents in remote forested habitat. Prevention of additional introductions of exotic plants, insects, mammals (especially the mongoose [Herpestes auropunctatus], currently a resident on other Hawaiian islands) and

nonnative birds that may act as predators, on or competitors with, native birds is necessary. (USFWS, 2017).

- Recommendation f) Population Surveys, Monitoring. Continued monitoring of the status of forest bird populations and their habitats is necessary to measure the effectiveness of management actions such as those listed above. Future research should assess post-fledging, juvenile, and adult survival as potential causes of population declines. Determining which demographic parameters currently have the largest negative impact on the population is imperative for guiding effective management actions to conserve these species. (USFWS, 2017).

Conservation Measures and Best Management Practices:

- Alien Ungulate Removal. Fencing and removal of alien ungulates from native habitats and from areas with restoration value are among the highest priority actions with the greatest potential benefit for Hawaiian bird species (Wallace and Leonard 2011). Removing ungulates, especially pigs, improves habitat quality and can reduce mosquito breeding sites (Goff and van Riper 1980). Such efforts will require a considerable influx of new funding and unprecedented outreach to gain the social and political support required for success, as projects will result in fewer hunting opportunities.
- Alien Predator Control. Keeping predators such as rodents, exotic snakes such as the brown treesnake, and cats away from crucial habitats of native Hawaiian birds can boost nesting success and survival of adult and young birds (VanderWerf 2008). Predator-proof fencing would protect critical nesting sites, although set-up costs are very high (e.g., $300 per meter of fencing). A more cost-effective option is use of rodenticides, such as diphacinone, which was recently approved for aerial application in Hawaiʻi. Though diphacinone application poses little threat to human health and most non-target species when applied according to label guidelines, we'll need to engage in education and outreach to gain widespread public approval for this approach. In addition, the federal and state government must be proactive in expanding biosecurity measures to prevent new invasive species from becoming established in Hawaiʻi (Kueffer and Loope 2009). One of the greatest potential biosecurity threats is the accidental introduction of the brown tree snake (Boiga irregularis), which has already devastated birdlife on Guam.
- Alien Plant Control. There is an urgent need for targeted efforts to reduce the spread of invasive, exotic plants in areas important to native Hawaiian birds. Fountain grass (Cenchrus setaceus), for example, a species indigenous to tropical Africa and Asia, is spreading in dry forest and grasslands, where the grass increases wildfire risk.
- Captive Breeding and Translocation. Captive propagation is critical for several Hawaiian birds. Captive propagation provides individuals to bolster existing wild populations, and, combined with translocation of wild birds, allows managers to establish new populations in protected or restored habitats. Translocation has already been used to create "insurance" populations for species restricted to single sites.
- Disease Management. Reducing the incidence of avian malaria and avian pox is the greatest Hawaiian bird conservation challenge, as managers currently have few available tools to combat the diseases (Atkinson and LaPoint 2009). Strategies to reduce mosquitoes in discrete areas include: removing pigs to reduce habitat degradation that creates mosquito breeding habitat; insecticide application; and a new technique known as cytoplasmic incompatibility, which uses parasites to cause a sperm-egg incompatibility between the gametes of infected male and uninfected female mosquitoes. Fortunately, some bird species can evolve resistance to malaria over relatively short periods of time (Atkinson and LaPointe 2009). Captive propagation of disease-resistant individuals

may help species weather the epidemics, as will reducing mortality from other factors, such as nest predation from feral cats and other introduced mammalian predators (Kilpatrick 2006).

- Climate Adaptation. To help native Hawaiian bird species avoid an upward-climbing mosquito-disease zone, we might consider planting forests above the current tree line, but this may be complicated by climate change-induced shifts in rainfall patterns (Giambelluca and Luke 2007). Assisted migrations and reintroductions of populations of the most endangered birds are other possibilities. And mitigating threats we can control—such as removing ungulates and controlling predators and weeds—will make birds and their habitats more resilient to climate change (Hunter et al. 2010).

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SPECIES ACCOUNT: *Oreomystis mana* (Hawaii creeper)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/28/1975; Pacific Region (R1) (USFWS, 2016)

Physical Description

An olive-green to gray songbird with a white throat and a black eye mask. From Lepson and Woodworth (2002): Small Hawaiian Honeycreeper (Drepanidinae). Total length 11 - 13 cm, weight about 14 g. Slightly sexually dichromatic, with male marginally brighter than female, sometimes noticeable in the field. Adult male plumage olive-green above, creamy white below, with broad dark-gray loral mask extending around eyes. Most females are slightly duller and grayer. Legs and bill are gray. Juveniles are dull gray-green with largely white face and distinctive call (NatureServe, 2015).

Taxonomy

The Hawai`i creeper was first described as Himatione mana by Wilson (1891). Subsequent nomenclature has been problematic (reviewed in Pratt 1992, 2001), and the species has been considered a full species (Perkins 1903), a subspecies of Paroreomyza bairdi (Bryan and Greenway 1944) and a subspecies of Loxops maculata (Amadon 1950). It is currently classified as Oreomystis mana (American Ornithologists Union 1998) following Pratt (1979, 1992), but recent evidence (Olson and James 1995, Fleischer et al. 2001) supports its inclusion as a full species in the genus Loxops (USFWS, 2010).

Historical Range

It was formerly in native forests throughout Hawaii island and common in the Kona and Kau districts and in the forests above Hilo (NatureServe, 2015). In the 1890s, Hawai`i creepers were found in `ohi`a and `ohi`a/koa forests throughout the island of Hawai`i, usually above 1,070 meters (3,600 feet; Perkins 1903) above sea level (asl) (USFWS, 2010).

Current Range

It is now unevenly distributed and uncommon. Occurs above 700 m in Hamakua-Volcano region and Kau Forest Preserve, above 1,000 m on Hualalai and in central Kona. As of the early 1980s, the highest densities occurred at 1,500 - 1,900 m in the Kau Forest and on the eastern slope of Mauna Kea and the northeastern slope of Mauna Loa (Scott et al. 1986) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores. Gleans insects (adults and larvae, especially beetles), spiders, snails, and other invertebrates from bark while creeping along trunks and branches of trees; may also forage among foliage and take nectar (Pratt et al. 1987, Ehrlich et al.

1992, Pratt 1992). This species exhibits a diurnal phenology (NatureServe, 2015). Beetle larvae make up a large part of its diet (Amadon 1950, Conant 1981a), but no detailed information on prey taken is available (USFWS, 2006).

Reproduction Narrative

Adult: Most nesting apparently occurs within ungrazed, unlogged, closed-canopy koa-ohia forest (Ehrlich et al. 1992) (NatureServe, 2015). Females do all or most of the nest building and incubate, brood, and feed the chicks; males assist by feeding the female both on and off the nest and by feeding the young (Sakai and Johanos 1983; VanderWerf 1998b; J. Nelson, U. S. Geological Survey, unpubl. data) (USFWS, 2006). Nests of Hawai`i creepers have been found from January to August (Sakai and Ralph 1980, Scott et al. 1980, Sakai and Johanos 1983, VanderWerf 1998b, Woodworth et al. 2001), but peak breeding occurs from February to May. Most (86 percent) nests are open cup nests but a few (14 percent) are cavity or pseudo-cavity nests. Clutch size is usually two eggs, incubation lasts for 13 to 17 days (Sakai and Johanos 1983, VanderWerf 1998b, Woodworth et al. 2001). Data from marked pairs suggest that Hawai`i creepers readily re-nest after failure, and two pairs have been recorded re-nesting after fledging young earlier in the season (U.S. Geological Survey, unpubl. data). Parent Hawai`i creepers feed fledglings for at least 3 weeks post-fledging, but within 1 month of leaving the nest young are foraging independently for food (although still following parents; VanderWerf 1998b, Woodworth et al. 2001). In general, the reproductive potential of the Hawai`i creeper appears to be low due to its small clutch size, relatively long developmental period, and limited breeding season. This low reproductive potential is exacerbated by the high rate of nesting failures (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: Occurs most often > 5,000 ft. elevation (USFWS, 2006)

Spatial Arrangements of the Population

Adult: Solitary, mixed species flocks, family groups (NatureServe, 2015)

Habitat Narrative

Adult: Inhabits montane wet forests and montane mesic forests; highest densities in old-growth forests with large, canopy-emergent ohia or koa trees; high densities in some disturbed forests and woodlands where sufficient numbers of large trees survive to provide nesting cavities and foraging substrate (Lepson and Woodworth 2002). Ralph and Fancy (1994) found relatively high densities at Hamakaua where the native understory was lacking due to intensive grazing, and they found relatively low densities at Kilauea where koa was relatively common. Often solitary but may form small flocks (Pratt et al. 1987). Thought to travel in family groups. Mixed-species post-breeding flocks may be large (Ehrlich et al. 1992) (NatureServe, 2015). Hawai`i creepers are most common in forests above 1,500 meters (5,000 feet) elevation (Scott et al. 1986) (USFWS, 2006).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory. Mean home range size is 7.48 ha; home ranges overlap extensively (Ralph and Fancy 1994) (NatureServe, 2015).

Population Information and Trends

Population Trends:

Not available

Species Trends:

Stable (USFWS, 2015)

Resiliency:

Low (inferred from NatureServe, 2015; see current range/distribution)

Redundancy:

Low (inferred from USFWS, 2015)

Number of Populations:

4 (USFWS, 2015)

Population Size:

~14,000 (USFWS, 2015)

Resistance to Disease:

Low (USFWS, 2015)

Population Narrative:

The total population of Hawaii creeper is approximately 14,000 birds in 4 populations (Gorresen et al. 2009). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). The species is stable overall (USFWS, 2015).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining

suitable habitat for these species. Benning et al. (2002) used GIS simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by some climate models (e.g., IPCC 2013; ICAP 2010), would result in 100 years in a nearly 100 percent decrease in the land area for Hawaii creeper where malaria transmission currently is only periodic. Lia et al. (2015) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and expect high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for Hawaii creeper as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Many areas of `ohi`a-koa forest have been logged or grazed, severely degrading the quality of remaining habitat (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Hawai`i creepers are rarely found below about 1,500 meters (5,000 feet) asl, probably because of the distribution of mosquitoes that transmit avian malaria and avian pox (Warner 1968, van Riper et al. 1986). Nest success rates for Hawai`i creepers are alarmingly low (11 to 50 percent), which may reflect the invasion of their habitat by alien nest predators, particular black rats (Rattus rattus). Hawai`i creeper nests may be particularly vulnerable to rat predation because of their proximity to the main trunk of nest trees (Woodworth et al. 2001), where rats may be more likely to encounter them (USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The Hawai`i creeper is threatened with extinction because of its small total population size and restricted distribution. These characteristics make the species vulnerable to a variety of natural processes, including reduced reproductive vigor caused by inbreeding depression, loss of genetic variability and evolutionary potential over time due to random genetic drift, stochastic fluctuations in population size and sex ratio, and natural disasters such as hurricanes and fires (USFWS, 2010).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species, and viable populations exist in Hamakua, Kulani/Kilauea/Keauhou, Ka`u, south Kona, and Pu`u Wa`awa`a/Hualalai (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery area is protected and managed to achieve criteria 1 and 2 above (USFWS, 2010).

4. The threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:
All four of the criteria above have been met for a 30-year period (USFWS, 2010).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories – Continued monitoring of Hawaii creeper is important to determine species response to management actions and effects of climate change (USFWS, 2015).
- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. The Service encourages continued research in the fields of genomic technologies and genetically modified

mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).

- Habitat and natural process management and restoration – The Service recommends continued habitat management in areas where the species currently exists (USFWS 2006). Hawaiian forest birds susceptible to avian disease may become extinct following a drastic reduction in disease free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Acquisition and management of transmission-free high-elevation habitat is crucial to the preservation and restoration of native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, the Service recommends securing deforested and pasture lands on Hawaii at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for Hawaii creeper and other Hawaiian forest birds (USFWS, 2015).
- Captive propagation protocol development – Recovery of Hawaii creeper may be achieved most effectively through in situ management techniques such as habitat management. However, captive propagation technology has been developed for the Hawaii creeper in case it is needed to help reestablish wild populations in the future (USFWS, 2015).

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SPECIES ACCOUNT: *Palmeria dolei* (Crested honeycreeper)

Species Taxonomic and Listing Information

Listing Status: Endangered; 3/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The crested honeycreeper (Palmeria dolei) is the largest (0.8 to 1.0 ounces) (7 inches in length) honeycreeper species extant in Maui Nui. It is primarily a black-plumaged bird with lanceolate body feathers tipped with orange-red; throat and breast feathers tipped with gray, silver, or white; and white-tipped wing and tail feathers. The distinctive brush of white feathers curling forward over its bill comprises the crest and is the basis of its English name. Brilliant orange feathers surround the eyes and extend to and cover the nape, feathers on the thighs can be orange or yellowish-white, and the feathers of the epaulettes are white with orange tips. The somewhat curved bill, the feet, and the legs are black. Sexes are identical in plumage pattern and coloration, but males are larger and heavier and can be determined with accuracy by measurements (Simon et al. 1998). Juvenile plumage is drab and cryptic yellow-brown or brown-gray, the body plumage lacks all orange-scarlet or orange and silver colors on the feathers or tips, and both the gray tail and wing feathers lack white tips. The crest of the juveniles is short and not as pronounced; its color is yellowish-white. The feet, legs, and bill of juveniles are gray to black (USFWS, 2016; USFWS, 2006).

Taxonomy

A member of the Hawaiian honeycreeper family (family Fringillidae, subfamily Drepanidinae). There is no geographic variation in plumage, and no subspecies, although they once were found on the two islands of Maui and Molokai. Fleischer et al. (2001) showed that, based on DNA analyses, `akohekohe are most closely related to `apapane (Himatione sanguinea) and `i`iwi (Vestiaria coccinea) (USFWS, 2006).

Historical Range

See current range/distribution.

Current Range

Crested honeycreepers are currently found in 22 square miles of wet and mesic montane forest dominated by ohia on the northeastern slope of the Haleakala Volcano in eastern Maui. Most birds occur from 5,000 to 6,600 feet elevation, though some non-breeding birds have been found further down slope (Scott et al. 1986, p. 170). Crested honeycreepers now inhabit only five percent of their estimated historical range on Maui and none of it on Molokai (USFWS 2006, pp. 2-140) (USFWS, 2016).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 6/11/2012.

Legal Description

On March 30, 2016, the U.S. Fish and Wildlife Service designated or revise critical habitat for 125 listed species on the islands of Maui, Molokai, and Kahoolawe in the State of Hawaii. Critical habitat was designated for 50 plant and animal species, and critical habitat was revised for 85 plant species. In total, approximately 157,002 acres (ac) (63,537 hectares (ha)) on the islands of Molokai, Maui, and Kahoolawe fall within the boundaries of the critical habitat designation. Although critical habitat was proposed on 25,413 ac (10,284 ha) on the island of Lanai, this area was excluded from final designation under section 4(b)(2) of the Endangered Species Act. In addition, under section 4(b)(2), approximately 59,479 ac (24,070 ha) on the islands of Maui and Molokai are excluded from critical habitat designation.

Critical Habitat Designation

The following areas are designated as critical habitat: Unit 1—Lowland Mesic-Maui, Maui County, Hawaii; Unit 2—Lowland Wet-Maui, Maui County, Hawaii; –Unit 3—Lowland Wet-Maui, Maui County, Hawaii; –Unit 4— Lowland Wet-Maui, Maui County; Unit 5—Lowland Wet-Maui, Maui County, Hawaii; –Unit 7—Lowland Wet-Maui, Maui County, Hawaii; Unit 6—Lowland Wet-Maui, Maui County, Hawaii; Unit 8— Lowland Wet-Maui, Maui County, Hawaii; Unit 9—Lowland Wet-Maui, Maui County, Hawaii; –Unit 10— Montane Wet-Maui, Maui County, Hawaii; Unit 11—Montane Wet-Maui, Maui County, Hawaii; Unit 12—Montane Wet-Maui, Maui County, Hawaii; Unit 13— Montane Wet-Maui, Maui County, Hawaii; Unit 14—Montane Wet-Maui, Maui County, Hawaii; Unit 15— Montane Wet-Maui, Maui County, Hawaii; Unit 16—Montane Wet-Maui, Maui County, Hawaii; Unit 18— Montane Mesic-Maui, Maui County, Hawaii; Unit 19—Montane Mesic-Maui, Maui County, Hawaii; Unit 20—Montane Mesic-Maui, Maui County, Hawaii; –Unit 21—Montane Mesic-Maui, Maui County, Hawaii; Unit 22—Montane Mesic-Maui, Maui County, Hawaii; Unit 24— Subalpine-Maui, Maui County, Hawaii; Unit 25—Subalpine-Maui, Maui County, Hawaii; Unit 26—Dry Cliff-Maui, Maui County, Hawaii; –Unit 27— Dry Cliff-Maui, Maui County, Hawaii; Unit 28—Dry Cliff-Maui, Maui County, Hawaii; Unit 29—Dry Cliff-Maui, Maui County, Hawaii; Unit 30—Wet Cliff-Maui, Maui County, Hawaii; Unit 31—Wet Cliff-Maui, Maui County, Hawaii; –Unit 32— Wet Cliff-Maui, Maui County, Hawaii; Unit 33—Wet Cliff-Maui, Maui County, Hawaii; Unit 35—Wet Cliff-Maui, Maui County, Hawaii; Unit 36—Wet Cliff-Maui, Maui County, Hawaii; Unit 37— Lowland Mesic-Molokai, Maui County; Unit 38— Lowland Wet-Molokai, Maui County, Hawaii; –Unit 39—Lowland Wet-Molokai, Maui County, Hawaii; Unit 40—Montane Wet-Molokai, Maui County, Hawaii; Unit 41—Montane WetMolokai, Maui County, Hawaii; Unit 42— Montane Mesic-Molokai, Maui County, Hawaii; Unit 43—Wet Cliff-Molokai, Maui County, Hawaii; Unit 44—Wet Cliff-Molokai, Maui County, Hawaii.

Unit 1— Lowland Mesic: This area consists of 477 ac (193 ha) of State land at Ukumehame on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland mesic ecosystem (see Table 5). Although Maui—Lowland Mesic—Unit 3 is not currently occupied by the plants Asplenium dielerectum, Bidens campylotheca ssp. pentamera, Colubrina oppositifolia, Ctenitis squamigera, Remya mauiensis, Santalum haleakalae var. lanaiense, or Zanthoxylum hawaiiense, or by the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland mesic species because it provides the PCEs for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 2— Lowland Wet: This area consists of 6,616 ac (2,677 ha) of State land, 7,425 ac (3,005 ha) of privately owned land, and 2,038 ac (825 ha) of federally owned land (Haleakala National Park), from Haiku Uka to Kipahulu Valley on the northern and eastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plants Bidens campylotheca ssp. waihoiensis, Clermontia samuelii, Cyanea asplenifolia, C. copelandii ssp. haleakalaensis, C. duvalliorum, C. hamatiflora ssp. hamatiflora, C. kunthiana, C. maritae, C. mceldowneyi, Huperzia mannii, Melicope balloui, and M. ovalis. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 1 is not known to be occupied by the plants Clermontia oblongifolia ssp. mauiensis, C. peleana, Mucuna sloanei var. persericea, Phyllostegia haliakalae, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 3—Lowland Wet: This area consists of 65 ac (26 ha) of State land at Moomoku, on the northwestern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plant Santalum haleakalae var. lanaiense. Although Maui—Lowland Wet—Unit 2 is not currently occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, or Wikstroemia villosa, by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), or by the Newcomb's tree snail (Newcombia cumingi), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 4— Lowland Wet: This area consists of 1,247 ac (505 ha) of State land at Honanana Gulch on the northeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). They are occupied by the plants Bidens conjuncta, Cyanea asplenifolia, and Pteris lidgatei. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 3 is not known to be occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 5— Lowland Wet: This area consists of 864 ac (350 ha) of State land at Kahakuloa Valley on the northeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). They are occupied by the plants Bidens conjuncta and Cyanea asplenifolia. These units also contain unoccupied habitat that is essential to the conservation of this these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 4 is not known to be occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 6— Lowland Wet: This area consists of 30 ac (12 ha) of State land at Iao Valley on the eastern side of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). Although Maui—Lowland Wet—Unit 5 is not known to be occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 7— Lowland Wet: This area consists of 136 ac (55 ha) of State land at Honokowai and Wahikuli valleys on the western slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plant Santalum haleakalae var. lanaiense. These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 6 is not currently occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, Bidens micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 8— Lowland Wet: This area consists of 898 ac (364 ha) of State land at Olowalu Valley, on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plant Alectryon macrococcus. These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 7 is not currently occupied by the plants Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 9— Lowland Wet: This area consists of 230 ac (93 ha) of State land at upper Ukumehame Gulch, on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). Although Maui—Lowland Wet—Unit 8 is not currently occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 10— Montane Wet: This area consists of 1,313 ac (531 ha) of State land and 798 ac (323 ha) of privately owned land, at Haiku Uka on the northern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Cyanea duvalliorum, C. maritae, C. mceldowneyi, Huperzia mannii, Melicope balloui, and Phyllostegia pilosa, and by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 1 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, C. samuelii, Cyanea copelandii ssp. haleakalaensis, C. glabra, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, Cyrtandra ferripilosa, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Melicope ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 11— Montane Wet: This area consists of 4,075 ac (1,649 ha) of State land, 9,633 ac (3,898 ha) of privately owned land, and 875 ac (354 ha) of federally owned land (Haleakala National Park), from Haiku Uka to Puukaukanu and upper Waihoi Valley, on the northern and northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Bidens campylotheca ssp. pentamera, Clermontia samuelii, Cyanea copelandii ssp. haleakalaensis, C. duvalliorum, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, C. mceldowneyi, Geranium hanaense, G. multiflorum, and Wikstroemia villosa, and by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 2 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, Cyanea glabra, C. maritae, Cyrtandra ferripilosa, Diplazium molokaiense, Huperzia mannii, Melicope balloui, M. ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, and Schiedea jacobii, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 12— Montane Wet: This area consists of 2,228 ac (902 ha) of federally owned land (Haleakala National Park) in Kipahulu Valley, on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, C. hamatiflora ssp. hamatiflora, C. maritae, and Melicope ovalis, and by the forest bird, kiwikiu (Pseudonestor xanthophrys). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 3 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Clermontia oblongifolia ssp. mauiensis, C. samuelii, Cyanea duvalliorum, C. glabra, C. horrida, C. kunthiana, C. mceldowneyi, Cyrtandra ferripilosa, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Huperzia mannii, Melicope balloui, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, or by the forest bird, the akohekohe (Palmeria dolei), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 13— Montane Wet: This area consists of 180 ac (73 ha) of State land and 1,653 ac (669 ha) of federally owned land (Haleakala National Park), in Kaapahu Valley on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Clermontia samuelii, Cyanea copelandii ssp. haleakalaensis, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, C. maritae, Cyrtandra ferripilosa, and Huperzia mannii. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 4 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, Cyanea duvalliorum, C. glabra, C. mceldowneyi, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Melicope balloui, M. ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 14— Montane Wet: This area consists of 222 ac (90 ha) of State land, and 165 ac (67 ha) of federally owned land (Haleakala National Park), near Kaumakani on the eastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units area occupied by the plant Bidens campylotheca ssp. pentamera. These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 5 is not currently occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, C. samuelii, Cyanea copelandii ssp. haleakalaensis, C. duvalliorum, C. glabra, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, C. maritae, C. mceldowneyi, Cyrtandra ferripilosa, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Huperzia mannii, Melicope balloui, M. ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 15— Montane Wet: This area consists of 1,113 ac (451 ha) of State land, and 286 ac (116 ha) of privately owned land, at the summit and surrounding areas on west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). They are occupied by the plants Bidens conjuncta, Calamagrostis hillebrandii, Cyanea kunthiana, Geranium hillebrandii, Myrsine vaccinioides, and Sanicula purpurea. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 6 is not known to be occupied by the plants Acaena exigua, Cyrtandra oxybapha, Huperzia mannii, Phyllostegia bracteata, or Platanthera holochila, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 16— Montane Wet: This area consists of 80 ac (32 ha) of State land near Hanaula and Pohakea Gulch on the southeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). They are occupied by the plants Cyrtandra oxybapha and Platanthera holochila, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 7 is not known to be occupied by the plants Acaena exigua, Bidens conjuncta, Calamagrostis hillebrandii, Cyanea kunthiana, Geranium hillebrandii, Huperzia mannii, Myrsine vaccinioides, Phyllostegia bracteata, or Sanicula purpurea, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 18— Montane Mesic: This area consists of 6,593 ac (2,668 ha) of State land, 707 ac (286 ha) of privately owned land, and 3,672 ac (1,486 ha) of federally owned land (Haleakala National Park), from Kealahou to Puualae, nearly circumscribing the summit of Haleakala on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Asplenium dielerectum, A. peruvianum var. insulare, Clermontia lindseyana, Cyanea horrida, C. obtusa, Cyrtandra ferripilosa, C. oxybapha, Diplazium molokaiense, Geranium arboreum, G. multiflorum, Huperzia mannii, Melicope adscendens, and Neraudia sericea. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 1 is not known to be occupied by the plants Alectryon macrococcus, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Cyanea glabra, C. hamatiflora ssp. hamatiflora, C. kunthiana, C. mceldowneyi, Phyllostegia bracteata, P. mannii, Santalum haleakalae var. lanaiense, Wikstroemia villosa, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 19— Montane Mesic: This area consists of 124 ac (50 ha) of State land at Helu and the upper reaches of Puehuehunui on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Lysimachia lydgatei, Remya mauiensis, and Santalum haleakalae var. lanaiense. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 2 is not known to be occupied by the plants Geranium hillebrandii, Huperzia mannii, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 20— Montane Mesic: This area consists of 174 ac (70 ha) of State land at Lihau on the southwestern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plant Geranium hillebrandii, and contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 3 is not known to be occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Huperzia mannii, Lysimachia lydgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 21— Montane Mesic: This area consists of 72 ac (29 ha) of State land at Halepohaku on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). Although Maui—Montane Mesic—Unit 4 is not known to be occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Geranium hillebrandii, Huperzia mannii, Lysimachia lydgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 22— Montane Mesic: This area consists of 170 ac (69 ha) of State land at the upper reaches of Manawainui Gulch on the southeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plants Remya mauiensis and Santalum haleakalae var. lanaiense, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 5 is not known to be occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Geranium hillebrandii, Huperzia mannii, Lysimachia lydgatei, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 24— Subalpine: This area consists of 10,785 ac (4,365 ha) of State land, 1,622 ac (656 ha) of privately owned land, and 3,568 ac (1,444 ha) of federally owned land (Haleakala National Park), from Kanaio north to Puu Nianiau on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the subalpine ecosystem (see Table 5). They are occupied by the plants Bidens micrantha ssp. kalealaha and Geranium arboreum, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui— Subalpine—Unit 1 is not known to be occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Asplenium peruvianum var. insulare, Geranium multiflorum, Phyllostegia bracteata, Schiedea haleakalensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these subalpine species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 25— Subalpine: This area consists of 50 ac (20 ha) of privately owned land, and 9,836 ac (3,981 ha) of federally owned land (Haleakala National Park), from the summit north to Koolau Gap and east to Kalapawili Ridge on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the subalpine ecosystem (see Table 5). They are occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Geranium multiflorum, and Schiedea haleakalensis, and by the forest bird, the akohekohe (Palmeria dolei). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Subalpine—Unit 2 is not known to be occupied by the plants Asplenium peruvianum var. insulare, Bidens micrantha ssp. kalealaha, Geranium arboreum, Phyllostegia bracteata, or Zanthoxylum hawaiiense, or by the forest bird, the kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these subalpine species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 26— Dry Cliff: This area consists of 755 ac (305 ha) of federally owned land (Haleakala National Park), from Pakaoao to Koolau Gap on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). Although Maui—Dry Cliff— Unit 1 is not known to be occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Diplazium molokaiense, Geranium multiflorum, Plantago princeps, or Schiedea haleakalensis, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 27— Dry Cliff: This area consists of 200 ac (81 ha) of federally owned land (Haleakala National Park) near Papaanui on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). It is occupied by the plant Plantago princeps, and contains unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Dry Cliff—Unit 3 is not currently occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Diplazium molokaiense, Geranium multiflorum, or Schiedea haleakalensis, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 28— Dry Cliff: This area consists of 315 ac (127 ha) federally owned land (Haleakala National Park), along Kalapawili Ridge on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). Although Maui—Dry Cliff— Unit 4 is not currently occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Diplazium molokaiense, Geranium multiflorum, Plantago princeps, or Schiedea haleakalensis, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 29— Dry Cliff: This area consists of 1,298 ac (525 ha) of State land, from Helu and across Olowalu to Ukumehame Gulch, on west Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). They are occupied by the plant Tetramolopium capillare, and contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Dry Cliff—Unit 5 is not currently occupied by the plants Bonamia menziesii, Diplazium molokaiense, Hesperomannia arbuscula, Isodendrion pyrifolium, Kadua laxiflora, or Neraudia sericea, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 30— Wet Cliff: This area consists of 290 ac (117 ha) of privately owned land along the wall of Keanae Valley on the northern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). Although Maui—Wet Cliff— Unit 1 is not currently occupied by the plants Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, Cyanea horrida, Melicope ovalis, Phyllostegia bracteata, P. haliakalae, or Plantago princeps, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 31— Wet Cliff: This area consists of 475 ac (192 ha) of State land, 20 ac (8 ha) of privately owned land, and 912 ac (369 ha) of federally owned land (Haleakala National Park), from Kalapawili Ridge along Kipahulu Valley and north to Puuhoolio, on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). They are occupied by the plants Bidens campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, Melicope ovalis, Phyllostegia bracteata, and Plantago princeps. These units also contains unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 2 is not known to be occupied by the plants Bidens campylotheca ssp. pentamera, Cyanea horrida, or Phyllostegia haliakalae, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 32— Wet Cliff: This area consists of 5 ac (2 ha) of State land and 433 ac (175 ha) federally owned land (Haleakala National Park) along the south rim of Kipahulu Valley on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). Although Maui—Wet Cliff— Unit 3 is not currently occupied by the plants Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, C. horrida, Melicope ovalis, Phyllostegia bracteata, P. haliakalae, or Plantago princeps, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 33— Wet Cliff: This area consists of 184 ac (75 ha) of State land along the north wall of Waihoi Valley, on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). They are occupied by the plant Bidens campylotheca ssp. pentamera and B. campylotheca ssp. waihoiensis, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 4 is not known to be occupied by the plants Cyanea copelandii ssp. haleakalaensis, C. horrida, Melicope ovalis, Phyllostegia bracteata, P. haliakalae, or Plantago princeps, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 35— Wet Cliff: This area consists of 1,858 ac (752 ha) of State land, and 253 ac (102 ha) of privately owned land, at the summit ridges of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). They are occupied by the plants Alectryon macrococcus, B. conjuncta, Ctenitis squamigera, Cyrtandra munroi, Remya mauiensis, and Santalum haleakalae var. lanaiense. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 6 is not known to be occupied by the plants Bidens campylotheca ssp. pentamera, Bonamia menziesii, Cyanea glabra, C. lobata, C. magnicalyx, Cyrtandra filipes, Dubautia plantaginea ssp. humilis, Gouania vitifolia, Hesperomannia arborescens, H. arbuscula, Isodendrion pyrifolium, Kadua laxiflora, Lysimachia lydgatei, Plantago princeps, Platanthera holochila, Pteris lidgatei, or Tetramolopium capillare, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 36— Wet Cliff: This area consists of 556 ac (225 ha) of State land along Honokowai ridge on the northwestern side of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). These units are occupied by the plants Cyrtandra filipes and C. munroi, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 7 is not known to be occupied by the plants Alectryon macrococcus, Bidens campylotheca ssp. pentamera, B. conjuncta, Bonamia menziesii, Ctenitis squamigera, Cyanea glabra, C. lobata, C. magnicalyx, Dubautia plantaginea ssp. humilis, Gouania vitifolia, Hesperomannia arborescens, H. arbuscula, Isodendrion pyrifolium, Kadua laxiflora, Lysimachia lydgatei, Plantago princeps, Platanthera holochila, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Tetramolopium capillare, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 37— Lowland Mesic: This area consists of 3,489 ac (1,412 ha) of State land, and 5,281 ac (2,137 ha) of privately owned land, from Waianui Gulch to Mapulehu, in central Molokai. These units are occupied by the plants Alectryon macrococcus, Ctenitis squamigera, Cyanea dunbariae, C. mannii, C. profuga, Cyperus fauriei, Cyrtandra filipes, Gouania hillebrandii, Labordia triflora, Neraudia sericea, Santalum haleakalae var. lanaiense, Schiedea lydgatei, S. sarmentosa, Silene alexandri, S. lanceolata, Spermolepis hawaiiensis, and Zanthoxylum hawaiiense, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland mesic ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Lowland Mesic—Unit 1 is not known to be occupied by Asplenium dielerectum, Bonamia menziesii, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea procera, C. solanacea, Diplazium molokaiense, Festuca molokaiensis, Flueggea neowawraea, Isodendrion pyrifolium, Kadua laxiflora, Melicope mucronulata, M. munroi, M. reflexa, Phyllostegia haliakalae, P. mannii, P. pilosa, Sesbania tomentosa, Stenogyne bifida, or Vigna o-wahuensis, or the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 38— Lowland Wet: This area consists of 2,195 ac (888 ha) of State land, and 754 ac (305 ha) of privately owned land (partly within The Nature Conservancy's Pelekunu Preserve), from Pelekunu Valley to Wailau Valley, in north-central Molokai. These units are occupied by the plant Cyrtandra filipes, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Lowland Wet—Unit 1 is not known to be occupied by Asplenium dielerectum, Bidens wiebkei, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea dunbariae, C. grimesiana ssp. grimesiana, C. solanacea, Lysimachia maxima, Melicope reflexa, Peucedanum sandwicense, Phyllostegia hispida, P. mannii, Plantago princeps, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 39— Lowland Wet: This area consists of 1,356 ac (549 ha) of State land and 594 ac (241 ha) of privately owned land, from Kahanui to Pelekunu Valley, in north-central Molokai. These units are occupied by the plant Lysimachia maxima, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Lowland Wet—Unit 2 is not known to be occupied by Asplenium dielerectum, Bidens wiebkei, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea dunbariae, C. grimesiana ssp. grimesiana, C. solanacea, Cyrtandra filipes, Melicope reflexa, Peucedanum sandwicense, Phyllostegia hispida, P. mannii, Plantago princeps, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 40— Montane Wet: This area consists of 1,545 ac (625 ha) of State land, and 1,851 ac (749 ha) of privately owned land, from the headwaters of Waialelia Stream and above Pelekunu Valley, eastward along the summit area to Mapulehu, in northcentral Molokai. These units are occupied by the plants Bidens wiebkei, Clermontia oblongifolia ssp. brevipes, Cyanea mannii, C. profuga, Phyllostegia hispida, and Pteris lidgatei, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Montane Wet—Unit 1 is not known to be occupied by Adenophorus periens, Cyanea procera, C. solanacea, Hesperomannia arborescens, Lysimachia maxima, Melicope reflexa, Phyllostegia mannii, P. pilosa, Platanthera holochila, Schiedea laui, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 41— Montane Wet: This area consists of 871 ac (353 ha) of State land, and 39 ac (16 ha) of privately owned land, from Honukaupu to Olokui (between Pelekunu and Wailau valleys), in north-central Molokai. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). Although Molokai— Montane Wet—Unit 2 is not known to be occupied by Adenophorus periens, Bidens wiebkei, Clermontia oblongifolia ssp. brevipes, Cyanea mannii, C. procera, C. profuga, C. solanacea, Hesperomannia arborescens, Lysimachia maxima, Melicope reflexa, Phyllostegia hispida, P. mannii, P. pilosa, Platanthera holochila, Pteris lidgatei, Schiedea laui, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 42— Montane Mesic: This area consists of 257 ac (104 ha) of State land, and 559 ac (226 ha) of privately owned land from Kamiloloa to Makolelau in central Molokai. These units are occupied by the plants Alectryon macrococcus, Bidens wiebkei, Santalum haleakalae var. lanaiense, and Spermolepis hawaiiensis, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the

PCEs necessary for the expansion of the existing wild populations. Although Molokai— Montane Mesic—Unit 1 is not known to be occupied by Asplenium dielerectum, Cyanea dunbariae, C. mannii, C. procera, C. solanacea, Cyperus fauriei, Kadua laxiflora, Melicope mucronulata, Neraudia sericea, Plantago princeps, or Stenogyne bifida, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 43— Wet Cliff: This area consists of 1,395 ac (565 ha) of State land, and 212 ac (86 ha) of privately owned land, and encircles the plateau between Pelekunu and Wailau valleys, in north-central Molokai. These units are occupied by the plants Brighamia rockii, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea munroi, and Hibiscus arnottianus ssp. immaculatus, and include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations Although Molokai—Wet Cliff—Unit 1 is not known to be occupied by Cyanea grimesiana ssp. grimesiana, Hesperomannia arborescens, Phyllostegia hispida, Pteris lidgatei, or Stenogyne bifida, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 44— Wet Cliff: This area consists of 462 ac (187 ha) of State land, and 806 ac (326 ha) of privately owned land (partly within The Nature Conservancy's Pelekunu Preserve), along the rim of Pelekunu Valley from Kipapa Ridge to Mapulehu, in central Molokai. These units are occupied by the plants Clermontia oblongifolia ssp. brevipes and Phyllostegia hispida, and include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai—Wet Cliff—Unit 2 is not known to be occupied by Brighamia rockii, Canavalia molokaiensis, Cyanea grimesiana ssp. grimesiana, C. munroi, Hesperomannia arborescens, Hibiscus arnottianus ssp. immaculatus, Pteris lidgatei, or Stenogyne bifida, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Maui County, Hawaii. (i) In units 1 and 37, the primary constituent elements of critical habitat for the Akohekohe are:

(A) Elevation: Less than 3,300 ft (1,000 m). (B) Annual precipitation: 50 to 75 in (130 to 190 cm). (C) Substrate: Shallow soils, little to no herbaceous layer. (D) Canopy: Acacia, Diospyros, Metrosideros, Myrsine, Pouteria, Santalum. (E) Subcanopy: Dodonaea, Freycinetia, Leptecophylla, Melanthera, Osteomeles, Pleomele, Psydrax. (F) Understory: Carex, Dicranopteris, Diplazium, Elaphoglossum, Peperomia.

(ii) In units 2, 3, 4, 5, 6, 7, 8, 9, 38, and 39, the primary constituent elements of critical habitat for the Akohekohe are:

(A) Elevation: Less than 3,300 ft (1,000 m). (B) Annual precipitation: Greater than 75 in (190 cm). (C) Substrate: Clays; ashbeds; deep, well-drained soils; lowland bogs. (D) Canopy: Antidesma, Metrosideros, Myrsine, Pisonia, Psychotria. (E) Subcanopy: Cibotium, Claoxylon, Kadua, Melicope. (F) Understory: Alyxia, Cyrtandra, Dicranopteris, Diplazium, Machaerina, Microlepia.

(iii) In units 10, 11, 12, 13, 14, 15, 16, 40, and 41, the primary constituent elements of critical habitat for the Akohekohe are:

(A) Elevation: Between 3,300 and 6,500 ft (1,000 and 2,000 m) (B) Annual precipitation: Greater than 75 in (190 cm). (C) Substrate: Well-developed soils, montane bogs. (D) Canopy: Acacia, Charpentiera, Cheirodendron, Metrosideros. (E) Subcanopy: Broussaisia, Cibotium, Eurya, Ilex, Myrsine. (F) Understory: Ferns, Carex, Coprosma, Leptecophylla, Oreobolus, Rhynchospora, Vaccinium.

(iv) In units 18, 19, 20, 21, 22, and 42, the primary constituent elements of critical habitat for the Akohekohe are:

(A) Elevation: Between 3,300 and 6,500 ft (1,000 and 2,000 m). (B) Annual precipitation: Between 50 and 75 in (130 and 190 cm). (C) Substrate: Deep ash deposits, thin silty loams. (D) Canopy: Acacia, Ilex, Metrosideros, Myrsine, Nestegis, Nothocestrum, Pisonia, Pittosporum, Psychotria, Sophora, Zanthoxylum. (E) Subcanopy: Alyxia, Charpentiera, Coprosma, Dodonaea, Kadua, Labordia, Leptecophylla, Phyllostegia, Vaccinium. (F) Understory: Ferns, Carex, Peperomia.

(v) In units 24 and 25, the primary constituent elements of critical habitat for the Akohekohe are:

A) Elevation: Between 6,500 and 9,800 ft (2,000 and 3,000 m). (B) Annual precipitation: Between 15 and 40 in (38 and 100 cm). (C) Substrate: Dry ash; sandy loam; rocky, undeveloped soils; weathered lava. (D) Canopy: Chamaesyce, Chenopodium, Metrosideros, Myoporum, Santalum, Sophora. (E) Subcanopy: Coprosma, Dodonaea, Dubautia, Geranium, Leptecophylla, Vaccinium, Wikstroemia. (F) Understory: Ferns, Bidens, Carex, Deschampsia, Eragrostis, Gahnia, Luzula, Panicum, Pseudognaphalium, Sicyos, Tetramolopium.

(vi) In units 26, 27, 28, and 29, the primary constituent elements of critical habitat for the Akohekohe are:

(A) Elevation: Unrestricted. (B) Annual precipitation: Less than 75 in (190 cm). (C) Substrate: Greater than 65 degree slope, rocky talus. (D) Canopy: None. (E) Subcanopy: Antidesma, Chamaesyce, Diospyros, Dodonaea. (F) Understory: Bidens, Eragrostis, Melanthera, Schiedea.

(vii) In units 30, 31, 32, 33, 35, 36, 43, and 44, the primary constituent elements of critical habitat for the Akohekohe are:

(A) Elevation: Unrestricted. (B) Annual precipitation: Greater than 75 in (190 cm). (C) Substrate: Greater than 65 degree slope, shallow soils, weathered lava. (D) Canopy: None. (E) Subcanopy: Broussaisia, Cheirodendron, Leptecophylla, Metrosideros. (F) Understory: Bryophytes, ferns, Coprosma, Dubautia, Kadua, Peperomia.

Special Management Considerations or Protections

Existing manmade features and structures, such as buildings, roads, railroads, airports, runways, other paved areas, lawns, and other urban landscaped areas, do not contain one or more of the physical or biological features. Federal actions limited to those areas, therefore, would not trigger a consultation under section 7 of the Act unless they may affect the species or physical or biological features in adjacent critical habitat.

The primary threats to the physical or biological features essential to the conservation of all of these species include habitat destruction and modification by nonnative ungulates, competition with nonnative species, hurricanes, landslides, rockfalls, flooding, fire, drought, and climate change. Additionally, the rosy wolf snail poses a threat to the Newcomb’s tree snail and mosquito-borne diseases pose threats to the two forest birds. The reduction of these threats will require the implementation of special management actions within each of the critical habitat areas identified in this final rule.

Life History

Feeding Narrative

Juvenile: Adults and juveniles are nectarivores; crested honeycreepers feed on nectar in the tops of tall flowering trees, especially ohia-lehua (Pratt et al. 1987), also Vaccinium calycinum and Rubus hawaiiensis when ohia flowers are unavailable. They will also eat caterpillars and other insects obtained from foliage and from dead branches of trees; and they consume fruit when nectar supplies are low (USFWS, 2016).

Adult: Adults and juveniles are nectarivores; crested honeycreepers feed on nectar in the tops of tall flowering trees, especially ohia-lehua (Pratt et al. 1987), also Vaccinium calycinum and Rubus hawaiiensis when ohia flowers are unavailable. They will also eat caterpillars and other insects obtained from foliage and from dead branches of trees; and they consume fruit when nectar supplies are low (USFWS, 2016).

Reproduction Narrative

Adult: Breeding probably begins in February; immature birds are observed from June-August (Shallenberger 1984). Adults with juveniles have been seen in May (Matthews and Moseley 1990) (USFWS, 2016).

Habitat Narrative

Adult: The crested honeycreeper inhabits wet and mesic montane forest dominated by ohia on the northeastern slope of the Haleakala Volcano in eastern Maui. Most birds occur from 5,000 to 6,600 feet elevation, though some non-breeding birds have been found further down slope (Scott et al. 1986, p. 170) (USFWS, 2016).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS< 2016)

Dispersal/Migration Narrative

Adult: Crested honeycreepers are non-migrants (USFWS, 2016).

Population Information and Trends

Population Trends:

Stable (USFWS, 2016)

Number of Populations:

1 - 5 (NatureServe, 2015)

Population Size:

~ 3,800 (USFWS, 2016). Decline from ~ 3,800 to less than 2,411 individuals (USFWS, 2018).

Population Narrative:

The total population of crested honeycreepers in 2009 was approximately 3,800 birds and subsequent surveys have indicated the species' population is stable (Gorresen et al. 2009, p. 124) (USFWS, 2016). Past population estimates were steady at about 3,800 from 1980 to 2011 (Scott et al. 1986 and USFWS 1984, 2006, 2011, and 2014) with Gorresen et al. (2009) postulating that the current population may be larger than previously estimated. However, current population estimates from Maui forest bird surveys conducted in 2016 show a decline from about 3,800 to less than 2,411 individuals (MFBRP 2017). o Variable circular plots have been used to survey forest birds but according to Camp et al (2009) it is not an appropriate method for all species and provides poor estimates for extremely rare birds. Data from the surveys are currently being analyzed and more work needs to be completed before accurate population estimates and densities can be determined (MFBRP 2017) (USFWS, 2018).

Threats and Stressors

Stressor: Feral pigs (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Damage by feral pigs to understory vegetation providing mosquito breeding sites and depleting nectar resources needed during times of year when ohia blooms are less available (Berlin et al. 2001, p. 212) is listed as a threat to this species (USFWS, 2016).

Stressor: Deforestation (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Threats to the species and its critical habitat include loss of suitable habitat due to clearing of forest by logging and ranching (LaPointe 2008, p. 606).

Stressor: Climate change (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Global climate change increasing the elevation of regular transmission of avian malaria and avian pox virus (Benning et al. 2002, p. 14428) is listed as a threat to this species (USFWS, 2016).

Stressor: Predation (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Introduced predators (e.g. black and Polynesian rats (Rattus exulans), barn owls (Tyto alba), and cats (Felis catus)) (Scott et al. 1986, p. 363) are listed as threats to this species (USFWS, 2016).

Stressor: Ungulates (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Foraging and trampling of native plants by ungulates leading to severe erosion of watersheds and changes in plant composition and structure (Cuddihy and Stone 1990, p. 63) is listed as a threat to this species (USFWS, 2016).

Stressor: Rodents (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Rodent damage to plant propagules and seedlings of native trees changing forest composition and structure (Cuddihy and Stone 1990, p. 67) is listed as a threat to this species (USFWS, 2016).

Stressor: Non-native insects (USFWS, 2016)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Feeding or defoliation of native plants from alien insects (Cuddihy and Stone 1990, p. 71); alien insect predation of native insects decreasing pollination of native plant species (Cuddihy and Stone 1990, p. 71) and changes in nutrient cycling processes because alien invertebrates change the composition and structure of plant communities (Cuddihy and Stone 1990, p. 73) (USFWS, 2016).

Stressor: Range contracting since 1990's, possibly the 1980's (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: The `ākohekohe's range has been contracting since the 1990's, possibly the 1980's. The new range size is 23 square kilometers compared to the previous range size of 58 square kilometers (USFWS 2014) making it the smallest range of all Maui honeycreepers (MFBRP 2017) (USFWS, 2018).

Recovery

Conservation Measures and Best Management Practices:

- Ungulate monitoring and control – Crested honeycreepers are currently restricted to the windward forests of East Maui from Waikamoi to Manawainui Valley. Extensive work is still needed to fence and protect the lower elevation areas from Hanawi Natural Area Reserve to Waikamoi Preserve, which provide habitat within the current range of the crested honeycreeper. Habitat restoration and reestablishment of a population on the leeward or western exposures of East Maui is needed to promote natural demographic and evolutionary processes (USFWS, 2016).
- Predator monitoring and control – Control of small mammalian predators is needed throughout the species' range. Currently, intensive control of rats (Rattus spp.) is underway in a portion of Hanawi Natural Area Reserve (USFWS, 2016).
- Threats – predator control research – An important component of crested honeycreeper recovery is evaluation of the effect of rodent control on the species' reproduction and survival, and an expansion of the scale of rodent control if warranted. Broad scale aerial application of rodenticides is likely needed to protect the crested honeycreeper from rodent predation and reduce habitat damage caused by rats (USFWS, 2016).
- Disease monitoring and control – Identification of resistance or tolerance to avian diseases within the population is an important recovery strategy. Control of mosquitoes and their breeding sites is also needed. Much of the potential crested honeycreeper habitat on West Maui and East Molokai is managed as native ecosystems mostly free of ungulates. However, much of this lies at elevations below 1,350 meters (4,500 feet), where mosquitoes may be common. Ongoing habitat management and removal of ungulates may reduce mosquito densities, but surveys of mosquitoes and disease prevalence are needed prior to the reintroduction of crested honeycreeper in these areas. Hawaiian honeycreepers are likely vulnerable to avian diseases such as West Nile virus, that have not been introduced to Hawaii but which have the potential to become established in the Hawaiian Islands (LaPointe et al. 2004). The U.S. Geological Survey, National Wildlife Health Center, Honolulu Field Station collaborates with the USFWS and State of Hawaii in surveillance and interdiction efforts to detect and prevent the establishment of new avian diseases into the state, including surveillance for West Nile virus (USGS 2014). Continued support for this program is critical to prevent West Nile virus and other avian diseases from entering the State of Hawaii (USFWS, 2016).
- Captive propagation protocol development a – Research on captive breeding for the crested honeycreeper was initiated in 1997, when eggs were removed to the Maui Forest Bird Conservation Center and the Keauhou Bird Conservation Center on Hawaii. Translocation of wild-caught adult birds, however, may be the preferred method of establishing a second crested honeycreeper population, because the aggressive nature of this species makes it difficult to propagate in captivity (USFWS, 2016).

- Ungulate monitoring and control – `Ākohekohe are currently restricted to the windward forests of east Maui from Waikamoi to Manawainui Valley. Waikamoi Preserve, owned by The Nature Conservancy of Hawai`i, is completely enclosed and fenced. As of 2016, there are no ungulates within the entirety of the preserve including the East Maui Irrigation Company Ltd. addition that occurred in 2015. The total acreage of ungulate free habitat in Waikamoi is 3622 hectares (8,951 acres) (C. Wittenmyer pers. comm. 2018). Hanawī Natural Area Reserve is completely fenced with ongoing ungulate control. More habitat restoration and reestablishment of a population on the leeward or western exposures of east Maui is needed to promote natural demographic and evolutionary processes (USFWS, 2018).
- Predator monitoring and control – Control of small mammalian predators is needed throughout the species' range. Currently, intensive control of rats (Rattus 3 spp.) is underway in a portion of Hanawī Natural Area Reserve and Waikamoi Preserve (USFWS, 2018).
- Threats – predator control research – An important component of `ākohekohe recovery is evaluation of the effect of rodent control on the species' reproduction and survival, and an expansion of the scale of rodent control if warranted. Broad scale aerial application of rodenticides is likely needed to protect the `ākohekohe from rodent predation and reduce habitat damage caused by rats (USFWS, 2018).
- Disease monitoring and control – Identification of resistance or tolerance to avian diseases within the population is an important recovery strategy. Control of mosquitoes and their breeding sites is also needed. Much of the potential `ākohekohe habitat on west Maui and east Moloka`i is managed as native ecosystems mostly free of ungulates. However, much of this lies at elevations below 1,350 meters (4,500 feet), where mosquitoes may be common. Ongoing habitat management and removal of ungulates may reduce mosquito densities, but surveys of mosquitoes and disease prevalence are needed prior to the reintroduction of `ākohekohe in these areas. Hawaiian honeycreepers are likely vulnerable to avian diseases such as West Nile virus, that have not been introduced to Hawai`i but which have the potential to become established in the Hawaiian Islands (LaPointe et al. 2009). The U.S. Geological Survey, National Wildlife Health Center, Honolulu Field Station collaborates with the USFWS and State of Hawai`i in surveillance and interdiction efforts to detect and prevent the establishment of new avian diseases into the state, including surveillance for West Nile virus (USGS 2018). Continued support for this program is critical to prevent West Nile virus and other avian diseases from entering the State of Hawai`i (USFWS, 2018).
- Captive propagation protocol development – Research on captive breeding for the `ākohekohe was initiated in 1997, when eggs were removed to the Maui Bird Conservation Center and the Keauhou Bird Conservation Center on Hawai`i. Translocation of wild-caught adult birds, however, may be the preferred method of establishing a second `ākohekohe population, because the aggressive nature of this species makes it difficult to propagate in captivity (USFWS 2006) (USFWS, 2018).

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SPECIES ACCOUNT: *Paroreomyza flammea* (Molokai creeper)

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed delisting

Physical Description

A forest songbird; a honeycreeper native to Molokai. Length is 13.0 - 14.2 cm. Adult male plumage is entirely flame scarlet. Adult female plumage is olive brown upper parts, and gray under parts. The bill is short and straight, and legs are light pinkish brown (Baker and Baker 2000) (NatureServe, 2015).

Taxonomy

Its closest relatives are the Maui creeper (P. montana) and the O`ahu creeper (P. maculata). The kakawahie is in the Hawaiian honeycreeper family (family Fringillidae, subfamily Drepanidinae) (USFWS, 2006).

Historical Range

Occurred on Molokai in the Hawaiian Islands; formerly (1890s) abundant on both the windward and leeward sides of Molokai at elevations above 1,200 m. Last seen in the early 1960s on Ohialele Plateau above Pelekunu Valley, between Pepeopae Bog, Papaala Pali, and Waikolu (Baker and Baker 2000); any remaining individuals are likely to be in this area (NatureServe, 2015).

Current Range

The large area on East Molokai with suitable habitat (approximately 2,300 hectares [5,700 acres]) (USFWS 2012), and the many remote areas within this that are only rarely visited by qualified observers, increase the potential that a small population of kakawahie could still exist on Molokai (USFWS, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

<u>Adult:</u> Adults and immatures are invertivores. Obtains insects and other invertebrates from bark of trunks and larger branches of trees (NatureServe, 2015). This species is an insectivore that gleans vegetation and bark in wet `ohi`a (Metrosideros polymorpha) forests (USFWS, 2006).

Reproduction Narrative

<u>Adult:</u> Not available

Habitat Narrative

Adult: Inhabits wet montane ohia forest with dense understory of mosses, vines, and tree ferns (Matthews and Moseley 1990) (NatureServe, 2015).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Unknown, last detected in 1963 (USFWS, 2015); possibly extinct (NatureServe, 2015)

Resiliency:

Very low (inferred from USFWS, 2006; see current range/distribution)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

0 - 1 (inferred from NatureServe, 2015)

Population Size:

Zero to 50 individuals (NatureServe, 2015)

Resistance to Disease:

Low (USFWS, 2015)

Adaptability:

Low (inferred from NatureServe, 2015)

Population Narrative:

This species has experienced a long term decline of > 90%. "Probably extinct" (Baker and Baker 2000) (NatureServe, 2015). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). The last confirmed detections of kakawahie were in 1961-1963 (Pekelo 1963). The status of the species is unknown (USFWS, 2015). Surveys for Hawaiian forest birds using the variable circular-plot method as previously conducted by Scott et al. (1986) were conducted in forest areas on Molokai in 2010 in areas with historical occurrence of kakawahie (R. Camp, U.S. Geological Survey, pers. comm. 2015). Kakawahie were not detected during these surveys (USFWS, 2015). Elphick et al. (2010) estimated the extinction of the kakawahie to have occurred in1969 using a method by which the predicted probability of extinction increases as a function of the time since a species was last observed. Using 1963 as the last reliable observation record for kakawahie, the authors determined the year 1985 as the upper 95% confidence bound for species extinction. This approach for establishing extinction probability however is problematic when applied to extremely rare species such as kakawahie that are potentially distributed over a large area because the absence of observation records may be the result of inadequate survey effort and the few if any visits by qualified observers to remote areas where rare and potentially extinct species may still exist (USFWS, 2015). Scott et al. (2008), a reference not included in the previous 5-year review, estimated the number of 8-minute variable circular-plot surveys needed to be 215,427 to determine with 95% confidence the absence of kakawahi on Molokai. In 2008, only 131 variable circular-plot surveys had been conducted on Molokai in areas where kakawahie might still exist. A 1,644-fold increase in survey effort using the variable circular-plot survey methodology therefore would be required to determine with 95% confidence the absence of kakawahie in areas of suitable habitat for the species (USFWS, 2015). Surveys and searches have been unsuccessful in finding kākāwahie since the last sighting in 1963 (Pekelo 1963, p. 64), including surveys on the Olokui Plateau in 1980 and 1988 and the Rare Bird Search of the Kamakou-Pelekunu Plateau in 1995 (Reynolds and Snetsinger 2001, p. 141). In response to the reported sighting in 2005 of an omaʻo or Molokaʻi thrush (Myadestes lanaiensis rutha), biologists John Vetter and Kristy Swinnerton spent 2 to 3 days in Puʻu Aliʻi NAR, the last place the kākāwahie was sighted in the 1960s (Pekelo 1963, p. 64; USFWS 2006, p. 2-29). Using playback recordings for olomao they covered the Puʻu Aliʻi NAR well, but no olomao or kākāwahie were sighted (John Vetter, USFWS, pers. comm. 2018). Forest bird surveys conducted on Molokaʻi in 2010 (R. Camp pers. comm. 2015, p. 2) found no evidence of kākāwahie. In January 2015, a four-day survey of the Olokui Plateau had no detections of kākāwahie (Oppenheimer et al. 2015, p. 8) (USFWS, 2018). The Variable Circular Plot (VCP) survey method is the primary method used to survey birds on a large geographic scale in Hawaiʻi (Camp et al. 2009, p. 92). VCP surveys are conducted using 8-minute point counts at survey stations spaced 100 to 250 meters (m) (328 to 820 feet (ft)) apart. Survey stations are along transect lines spaced 1.6 to 3.2 kilometers (1 to 2 miles) apart (Scott et al. 1986, pp. 34-40). No kākāwahie were detected during the most recent Hawaiian forest bird survey on Molokaʻi in 2010 using the VCP method (R. Camp, U.S. Geological Survey, pers. comm. 2015, p. 2). Using VCP data, Scott et al. (2008, p. 7) estimated that 215,427 8-minute point counts would be needed to determine with 95% confidence the absence of kākāwahie on Molokaʻi. However, in 2008, only 131 VCP counts were conducted. A more than 1,500-fold increase in survey effort would be needed to determine the species extinction with 95% confidence using the VCP method (USFWS, 2018). Although VCP has been the primary method used to survey birds in Hawaiʻi it is not appropriate for all species and provides poor estimates for extremely rare birds (Camp et al. 2009, p. 92). In recognition of this problem, the Rare Bird Search (RBS) was undertaken in 1994 through 1996 to update the status and distribution of 13 “missing” Hawaiian forest birds (Reynolds and Snetsinger 2001, pp. 134-137). The RBS was designed to improve efficiency in search for extremely rare species using the method of continuous observation during 20- to 30-minute timed searches in areas where target species were known to have occurred historically, in conjunction with audio playback of species vocalizations (when available). Based on species detection probability the RBS determined the likelihood of the kākāwahie being extirpated from the Kamkou-Pelekunu Plateau was greater than 95%. Although the kākāwahie was believed to be extinct over the entirety of its range, the RBS did not determine extinction probability because not all potential suitable habitat was searched (Reynolds and Snetsinger 2001, p. 141) (USFWS, 2018). Elphick et al. (2010, p. 620) developed a method by which the predicted probability of a species extinction is determined based on the length of time since the species was last observed. Using 1963 as the last reliable observation record for kākāwahie, the 3 authors estimated that the kākāwahie became extinct in 1969, with 95% confidence of the species having become extinct by 1985. However, when applied to extremely rare species this approach for establishing extinction probability has the drawback that species extinction may be assigned incorrectly due to inadequate survey effort and/or insufficient time spent by qualified observers in the area where the species could still potentially exist (USFWS, 2018).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. Lia et al. (2015) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and expect even high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for kakawahie as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Lower-elevation forested habitats on East Moloka`i have largely disappeared the last century as result of agriculture, urbanization, and ungulate grazing. One of the primary threats to this species and to other Hawaiian forest birds is habitat loss and degradation by agriculture, urbanization, cattle (Bos taurus) grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities (USFWS 2006; USFWS, 2009).

Stressor: Nonnative species (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Feral pigs (Sus scrofa), and goats (Capra hircus) to a lesser degree, have had a long-term damaging effect upon native forests in the remaining kakawahie range by consuming and damaging understory vegetation, creating openings on the forest floor for nonnative weeds, transporting nonnative weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants. Impacts of nonnative birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2009).

Stressor: Disease and predation (USFWS, 2009)

Exposure:
Response:
Consequence:
Narrative: Predation by nonnative mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by nonnative mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2009).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2009).

Stressor: Climate change destruction or degradation of habitat (USFWS, 2015).
Exposure:
Response:
Consequence:
Narrative: Climate change destruction or degradation of habitat – Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. In Hawaii, the threshold temperature for transmission of avian malaria has been estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak P. relictum prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Benning et al. 2002). Benning et al. (2002) used GIS simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by some climate models (e.g., IPCC 2013; ICAP 2010), would result in 100 years in the virtual complete disappearance from Kauai of habitat where malaria transmission currently is only periodic. Kauai is a taller island than Molokai and it is expected effects of climate change will be similar on Molokai. Lia et al. (2015) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and expect even high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable 3 habitat for kakawahie as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Avian Disease (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: A recent analytic tool proposes using information on threats to infer species extinction based on an evaluation of whether identified threats are sufficiently severe and prolonged to

cause local extinction and sufficiently extensive in geographic scope to eliminate all individuals(Keith et al. 2017, p. 320). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum). At elevations below 1,500 m (4,921 ft) in Hawaiʻi, the key factor driving disease epizootics of pox virus (Avipoxvirus) and avian malaria is the seasonal and altitudinal distribution and density of the primary vector of these diseases, the mosquito Culex quinquefasciatus (Atkinson and Lapointe 2009a, pp. 237-238, 245-246). The disappearance of all but a few Hawaiian honeycreeper species over the last century from areas below 1,500 m (4,921 ft) points to effects of avian disease having been sufficiently severe and prolonged, and extensive in geographic scope to cause wide-spread species range contraction and possible extinction. It is highly likely avian disease is the primary causal factor for the disappearance of several species of Hawaiian honeycreepers from forested areas below 1,500 m (4,921 ft) elevation on the islands of Kauaʻi, Oʻahu, Molokaʻi, and Lānaʻi (Scott et al. 1986, p. 148; Banko and Banko 2009, pp. 52-53; Atkinson and Lapointe 2009a, pp. 237-238) (USFWS, 2018).

Stressor: Climate change and temperature increase (USFWS, 2018).
Exposure:
Response:
Consequence:
Narrative: Climate change and temperature increase presents an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs. In Hawaiʻi, the threshold temperature for transmission of avian malaria is estimated to be 13 degrees Celsius (55 degrees Fahrenheit), whereas peak Plasmodium relictum prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 17 degrees Celsius (64 degrees Fahrenheit) (Atkinson and Lapointe 2009b, p. 58-59). Benning et al. (2002, p. 14248) used Geographic Iinformation System simulation to show that an increase in temperature of 2 degrees Celsius (3.6 degrees Fahrenheit), which is within the range predicted by different climate models, in 100 years will result in the virtual complete disappearance from Kauaʻi of all habitat where malaria transmission currently is only periodic. Prevalence of malaria infection in forest birds increased significantly on Kauaʻi between the periods of 1994 to 1997 and 2007 to 2013 at elevations between 1,100 and 1,350 m (3,609 and 4,429 ft) in conjunction with increased air temperatures, declining precipitation, and changes in stream flow that improved conditions for mosquito breeding (Atkinson et al. 2014, p. 2427). The highest elevations on Kauaʻi and Molokaʻi are only slightly greater than 1,500 m (4,921 ft) and it is expected the effects of climate change for both islands are largely the same. Liao et al. (2015, p. 3486) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations predicting even high 4 elevation forest bird habitat (above 1,500 m) will remain relatively mosquito free only to the mid-21st Century (USFWS, 2018).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2009).

2. Either (a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or

(b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2009).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2009).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2009).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2009).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories – One of the most important recovery actions for the kakawahie is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006). Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 1986) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, the Service recommends that an intensive search for kakawahie be conducted on Molokai using similar methodologies as those employed during the Hawaii Rare Bird Search 1994-1996 (Reynolds and Snetsinger 2001). In addition, the Service recommends that autonomous recording units, or ARUs (Fitzpatrick 2002; Wallace 2010), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2015).
- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal

distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. The Service encourages continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).

- Habitat and natural process management and restoration – Kakawahie would benefit in the long-term from habitat restoration to assist other native Hawaiian forest birds on Molokai (USFWS, 2015).
- Captive propagation for reintroduction and genetic storage – Should kakakawhie be rediscovered the Service recommends the Rare Bird Discovery Protocol in the revised recovery plan for Hawaiian forest birds (USFWS 2006) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2015).
- Surveys / inventories – Forest bird surveys were conducted on Molokai in 2010, but no birds were detected (USFWS, 2015).
- Surveys / inventories o One of the most important recovery actions for the kakawahie is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006). Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 1986) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, we recommend that an intensive search for kakawahie be conducted on Molokai using similar methodologies as those employed during the Hawaii Rare Bird Search 1994-1996 (Reynolds and Snetsinger 2001). o In addition, we recommend that autonomous recording units, or ARUs (Fitzpatrick 2002; Wallace 2010), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The 4 tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2015).
- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. We encourage continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).

- Habitat and natural process management and restoration – Kakawahie would benefit in the long-term from habitat restoration to assist other native Hawaiian forest birds on Molokai (USFWS, 2015).
- Captive propagation for reintroduction and genetic storage – Should kakakawhie be rediscovered we recommend the Rare Bird Discovery Protocol in the revised recovery plan for Hawaiian forest birds (USFWS 2006) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2015).
- Captive propagation for reintroduction and genetic storage – There are instances where rare Hawaiian birds have been rediscovered after they were presumed extinct or have been found in larger populations than expected (Reynolds and Snetsinger 2001, p. 142). Should kākāwahie be rediscovered we recommend the Rare Bird Discovery Protocol in the Revised Recovery Plan for Hawaiian Forest Birds (USFWS 2006, pp. 3-17 – 3-21) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2018).

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SPECIES ACCOUNT: *Paroreomyza maculata* (Oahu creeper)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/13/1970; Pacific Region (R1) (USFWS, 2016)

Physical Description

A honeycreeper 11.3-12.9 cm in length. It is dark (usually brown) above and pale (dull yellow) below; adult males are olive-green above, golden yellow below, with a yellow forehead and eyebrow line and a dark streak through the eye; females and immatures are greenish-gray above with some whitish below; females have two prominent white wing bars; overall length is about 4.5 inches (Berger 1981, Pratt et al. 1987). Adult female and immature plumages are dull olive green, with broad, pale-buff, double wing-bars and a distinct pale greenish supercilium. Adult male plumage is a brighter shade of olive; yellow face divided by dark lores and dark postocular stripe, no wing bars. Bill straight, dark brown above, pale below (Baker and Baker 2000) (NatureServe, 2015).

Taxonomy

Belongs to the family Fringillidae, subfamily Drepanidinae. It is currently placed in the genus Paroreomyza (Olson and James 1982b, Pratt 1992b, American Ornithologists' Union 1998), but its generic designation has changed repeatedly and it has at various times been placed in the genera Oreomyza (Perkins 1903), Oreomystis (Stejneger 1903), and Loxops (Amadon 1950, Shallenberger and Pratt 1978). The closest relatives and only congeners of the O`ahu creeper are the Maui (P. montana) and Moloka`i (P. flammea) creepers, and all three taxa have been considered conspecific by some authors (e.g., Munro 1960) (USFWS, 2006).

Historical Range

Perkins (1903) also described the O`ahu creeper as "a common enough species" and "found on both mountain ranges," but said, "it seems to have entirely disappeared from the mountains in the immediate neighborhood of Honolulu, where it formerly occurred." Palmer (in Rothschild 1893 to 1900) reported that he found O`ahu creepers "only in the upland region of Wailua" above 350 meters (1,500 feet) elevation (USFWS, 2006).

Current Range

Resident on Oahu in the Hawaiian Islands. Extremely rare or possibly extinct; last reported in Koolau Mountains north of Honolulu (Pratt et al. 1987, Baker and Baker 2000). Sightings since 1977 have been restricted to the Koolau and Waianae Ranges, between 330 and 830 m (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Gleans insects from leaves and branches; sometimes forages by moving along bark of tree branches, including dead branches of koa; sometimes feeds on koa sap (Ehrlich et al. 1992, Pratt 1992). This species exhibits a diurnal phenology (NatureServe, 2015). The O`ahu creeper is insectivorous and forages by creeping methodically up and down the trunks and branches of large trees, probing the bark for insects. Perkins (1903) reported that it fed largely on caterpillars and spiders, and that the stomach contents of specimens included large numbers of Carabid beetles (USFWS, 2006).

Reproduction Narrative

Adult: Nesting has been recorded in late January; nest contained 2 eggs (see Berger 1981) (NatureServe, 2015).

Geographic or Habitat Restraints or Barriers

Adult: 300 - 650 m elevation (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: Flocks (USFWS, 2006)

Habitat Narrative

Adult: Recent sightings have all been within mid to upper reaches of Koolau Mountains between 300 and 650 meters where habitat is remnant native lowland mesic to wet forest. Predominant habitat is mixed koa/ohia forest grading into ohia shrubland at higher elevation. Mixed forest (koa lowland mesic forest) is diverse with may native shrubs, ferns, and epiphytes, with uluhe fern dominant ground cover (Baker and Baker 2000) (NatureServe, 2015). O`ahu creepers apparently formed foraging flocks during parts of the year. Perkins (1903) reported that as many as a dozen creepers often were seen together, and Swedberg (in Shallenberger and Pratt 1978) reported a flock of 30 to 50 birds at Poamoho Trail in September 1968, some of which were collected and proved to be O`ahu creepers (USFWS, 2006).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Unknown, last well-documented observation in 1985 (USFWS, 2010); possibly extinct (NatureServe, 2015)

Resiliency:

Very low (inferred from NatureServe, 2015; see current range/distribution)

Redundancy:
Very low (inferred from NatureServe, 2015)

Number of Populations:
0 - 2 (NatureServe, 2015)

Population Size:
Zero to 50 individuals (NatureServe, 2015)

Adaptability:
Low (inferred from NatureServe, 2015)

Population Narrative:
This species has experienced a long term decline of > 90%. It has declined to the point of extinction (Baker and Baker 2000). Scott et al. (1988) estimated that the total population probably is fewer than 100. In 1992, Ellis et al. (1993) estimated the population to be fewer than 10 individuals. The State of Hawaii Division of Forestry and Wildlife conducted surveys in 1991 and failed to detect any (Baker and Baker 2000). No extensive surveys were made between 1992 and 1997 (Baker and Baker 2000). Historically reported from 13 general areas on Oahu, of which only 8 have recent sightings. However, no confirmed records since 1985; the last probable sighting was in 1990 (Baker and Baker 2000). Sightings since 1976 have been restricted to two general areas of Oahu (NatureServe, 2015). The species status is unknown. The last well-documented observation of the O`ahu creeper was of two birds on December 12, 1985, during the Waipi`o Christmas Bird Count (Bremer 1986) (USFWS, 2010).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Native forested habitats on O`ahu as result of agriculture, urbanization, and ungulate grazing are now removed almost completely below 2,000 feet elevation. Habitat loss and degradation by agriculture, urbanization, cattle grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities have been some of the primary threats to this species (USFWS 2006) (USFWS, 2010).

Stressor: Nonnative species (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Feral pigs, and goats to a lesser degree, have had a long-term damaging effect upon native forests in the remaining O`ahu creeper range by consuming and damaging understory vegetation, creating openings on the forest floor for weeds, transporting weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants. Impacts of alien birds are not well understood, but include aggressive behavior towards native bird

species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2010).

Stressor: Disease and predation (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Predation by alien mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by alien mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2010).

Stressor: Stochastic events (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2010).

Stressor: Climate change (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Climate change may also pose a threat to the O`ahu creeper. However, current climate change models do not allow specific predictions as to what those effects, and their extent, would be for this species (USFWS, 2010).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2010).

2. Either a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2010).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2010).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2010).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2010).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories - One of the most important recovery actions for the O'ahu creeper is to intensively and systematically search areas of forest habitat where the species occurred historically. Since the O'ahu creeper has not been seen in 10 years, it was determined to be a Hawaii Rare Bird. Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects that do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare and/or likely extinct Hawaiian forest birds will be detected or rediscovered. Therefore, the Service recommends that an intensive search for O'ahu creeper be conducted on Oahu using similar methodologies as those employed during the 1994-1996 Hawaii Rare Bird Search. In addition, the Service recommends that autonomous recording units be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2013).

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SPECIES ACCOUNT: *Phoebastria (=Diomedea) albatrus* (Short-tailed albatross)

Species Taxonomic and Listing Information

Listing Status: Endangered; July 31, 2000 (65 FR 46643).

Physical Description

The short-tailed albatross is a large, pelagic bird with long, narrow wings adapted for soaring just above the water surface. The bill, which is disproportionately large compared to the bills of other northern hemisphere albatross, is pink with a bluish hooked tip and a thin black line around the base. Like all birds in the Order Procellariiformes (tube-nosed marine birds), the short-tailed albatross' beak has conspicuous external nostrils. Of the three species of North Pacific albatross, the short-tailed albatross is the largest, with a body length of 84 to 94 centimeters (cm) (33 to 37 inches [in.]). The wingspan of the short-tailed albatross is also the largest of the three species, at 213 to 229 cm (84 to 90 in.). Short-tailed albatross are also the only North Pacific albatross that develops an entirely white back at full maturity. The white heads of both sexes develop a yellow-gold crown and nape over several years. Fledged juveniles are dark brown-black, but soon develop pale bills and legs that distinguish them from black-footed (Phoebastria nigripes) and Laysan albatross (Phoebastria immutabilis) (USFWS 2008).

Taxonomy

The short-tailed albatross was first described as Diomedea albatrus in Spicilegia Zoologica in 1769. The short-tailed albatross was classified within the family Diomedeidae, in the order Procellariiformes. Following the results of genetic studies, the family Diomedeidae was arranged into four genera. The genus Phoebastria now includes the short-tailed albatross, the Laysan albatross (Phoebastria immutabilis), the black-footed albatross (Phoebastria nigripes), and the waved albatross (Phoebastria irrorata). Recent analyses, based on complete nucleotide sequencing of the mitochondrial cytochrome b gene, confirm this as a valid taxon (USFWS 2008).

Historical Range

Historically, short-tailed albatross were found from California to Alaska as well as throughout the entire North Pacific to the coast of China, including the Japan Sea, the Okhotsk Sea, and the Bering Sea. Records include siting of the short-tailed albatross from the Komandorskie Islands, Diomede Islands, and Norton. The short-tailed albatross were common in areas of high biological productivity such as along the west coast of North America, the Bering Sea, and offshore from the Aleutians. Nine historical breeding locations in the western North Pacific have been identified, including Torishima Island in the Izu Islands; Mukojima and Nishinoshima in the Bonin Islands; Kita-daitojim, Minami-daitojima, and Okino-daitojima of the Daito group; Senakaku Retto, Agincourt Island, north of Taiwan; and Byosho. There also may have been breeding on Kobisho of the Senkaku group in the southern Ryukyu Islands; Yomeshima and Kitanoshima in the Bonin Islands; Pescadores between Taiwan and mainland China; and Iwo Jima in the western volcanic Islands (NatureServe 2015; USFWS 2008).

Current Range

Nesting is currently restricted to two small island groups, roughly 1,500 kilometers (km) (932 miles [mi.]) apart: Torishima Island (Izu Islands) is approximately 580 km (360 mi.) south of Japan; and Minami-kojima (Senkaku Islands of the southwestern Ryukyu Islands) is about 270 km (167 mi.) northeast of Taiwan. When not on the nesting islands (Torishima and Senkaku Islands), short-tailed albatrosses are distributed widely throughout their historic range in the North Pacific. Data from satellite-tracked individuals indicate that albatrosses range across much of the North Pacific, from Torishima to the west and south to the Bering Sea, Gulf of Alaska, and California. Short-tailed albatross are found closer to islands and mainland coasts than to mid-ocean areas (NatureServe 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Short-tailed albatross forage diurnally and possibly nocturnally, either alone or in groups and predominantly hunt for prey by surface-seizing. The short-tailed albatross feeds on squid, crustaceans, and various fishes; chicks are fed a mixture of stomach oil and partially digested, regurgitated food. The short-tailed albatross visits and follows commercial fishing vessels in Alaska, and although commercial longlining bait is not historically a part of the short-tailed albatross' normal diet, it now constitutes a notable portion of the calorie intake for these bird. In addition, Albatross chicks and adults eat trash and plastics found in the Pacific Ocean. Albatross chicks often choke and die from eating the plastics. At-sea competition from other albatross species, especially from Laysan albatross, may be hindering the rate of recovery of short-tailed albatross (65 FR 46643; USFWS 2008).

Reproduction Narrative

Adult: For the short-tailed albatross, breeding begins in late October; egg-laying occurs from late October through early November; and hatching occurs from late December through early January. The incubation period lasts for 64 to 65 days, and both sexes incubate the eggs. Only one egg is laid, and parents alternate incubating the egg and taking foraging trips that may last up to 2 to 3 weeks. While one parent is foraging, the other stays on the nest without eating or drinking. Parents forage primarily off the eastern coast of Honshu Island. Chicks remain near the nest for about 5 months and fledge in June. Short-tailed albatross reach sexual maturity at 5 years, but typically begin breeding at 8 to 9 years. Immature birds annually visit the breeding colony for several years before reaching sexual maturity. The vast majority (80 to 85 percent) of the known breeding short-tailed albatross use a single colony, Tsubamezaki, on Torishima Island. A new colony, Hatsunezaki, has recently formed on the northwest side of Torishima Island, on a safer, less actively eroding site.The short-tailed albatross does not breed on the continental United States, but recent observations of infertile short-tailed albatross eggs, together with reports from the 1930s, suggest that the short-tailed albatross may have once nested on Midway Atoll at the northwestern end of the Hawaiian Archipelago. Although nesting attempts have been observed, there have never been more than two short-tailed albatross individuals reported on the Atoll during the same year, and no successful nesting has been confirmed. Eggs have been produced, but were likely infertile; none have hatched. No historical breeding accounts have been confirmed for Midway Atoll. Midway Atoll, the only area within the jurisdiction of the United States where short-tailed albatross have attempted to breed, is a National Wildlife Refuge, managed by the U.S. Fish and Wildlife Service (USFWS) for the conservation of seabirds and other fish and wildlife, and their habitats.Short-tailed albatross nest on isolated, windswept, offshore islands, with restricted human access. Nest sites may be flat or sloped, and consist of a divot on the ground that is lined with sand and vegetation. Grass at the colony sites stabilizes soils and provides cover for the breeding short-tailed albatross. It is possible that there may be some minimum population size that is needed to trigger successful breeding in this species; there is evidence that 50 pairs at a given breeding site satisfies social breeding requirements (NatureServe 2015; USFWS 2008).

Geographic or Habitat Restraints or Barriers

Adult: Habitat can be restricted for the short-tailed albatross during nesting season by volcanic eruptions and mass erosion, both of which can cause nest failures.

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Community with all requirements.

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High

Habitat Narrative

Adult: Short-tailed albatross nest on isolated, windswept, offshore islands, with restricted human access. Nest sites may be flat or sloped, or sparse or full vegetation. Grass at the colony sites stabilizes soils and provides cover for the breeding short-tailed albatross. On Torishima, human access is limited from breeding areas. The island is subject to volcanic eruptions, erosion, and landslides. The North Pacific marine environment most heavily used by short-tailed albatross is characterized by regions of upwelling and high productivity. The shelf break in these areas has been described as a “greenbelt” of high chlorophyll concentration and primary productivity (NatureServe 2015; USFWS 2008).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Long distance migrant.

Dispersal

Adult: During the nonbreeding season, short-tailed albatross range along the Pacific Rim from southern Japan to the west coast of Canada and the United States, primarily along continental shelf margin. Immature birds exhibit two patterns of post-breeding dispersal: some move rapidly north to the western Aleutian Islands; others stay within the coastal waters of northern Japan and the Kuril Islands throughout the summer. In early September, the individuals that remained near northern Japan in the summer move into the western Aleutian Islands. Once in the Aleutians, most birds travel east toward the Gulf of Alaska (USFWS 2008).

Dispersal/Migration Narrative

Adult: Short-tailed albatross are highly mobile and can migrate long distances around the North Pacific. Arrival at Torishima begins in early October and increases until breeding begins in late October. Failed breeders and nonbreeders depart in winter and spring, and successful breeders and fledglings depart from late May to June (NatureServe 2015). During the nonbreeding season, short-tailed albatross range along the Pacific Rim from southern Japan to the west coast of Canada and the United States, primarily along continental shelf margins. Immature birds exhibit two patterns of post-breeding dispersal: some move relatively rapidly north to the western Aleutian Islands; others stay within the coastal waters of northern Japan and the Kuril Islands throughout the summer. In early September, the individuals that remained near northern Japan in the summer move into the western Aleutian Islands. Once in the Aleutians, most birds travel east toward the Gulf of Alaska (USFWS 2008).

Additional Life History Information

Adult: Arrival at Torishima begins in early October and increases until breeding begins in late October. Failed breeders and nonbreeders depart in winter and spring, and successful breeders and fledglings depart from late May to June (NatureServe 2015).

Population Information and Trends

Population Trends:

Decreasing; in the short term, the population has increased more than 10 percent. The long-term population trend has had a decrease of more than 90 percent (NatureServe 2015).

Species Trends:

Decreasing

Resiliency:

Low

Representation:

Moderate

Redundancy:

Low

Population Growth Rate:

Slow

Number of Populations:

1 to 5 (NatureServe 2015).

Population Size:

250 to 2,500 individuals (NatureServe 2015); as of 2000, the total population was estimated at approximately 1,200 birds (600 breeding age birds, 600 immature birds) (65 FR 46643).

Resistance to Disease:

Moderate

Additional Population-level Information:

Small populations will have difficulty surviving the combined effects of demographic and environmental stochasticity. The small population size of short-tailed albatross puts them at some risk to the deleterious effects of demographic and environmental stochasticity (USFWS 2008).

Population Narrative:

At the beginning of the 20th century, short-tailed albatross declined in population to near extinction, primarily as a result of hunting at the breeding colonies in Japan. Short-tailed albatross were killed for their feathers and various other body parts. The down feathers were used for quilts and pillows, and wing and tail feathers were used for writing quills; their bodies were processed into fertilizer, their fat was rendered. In addition, the breeding areas of short-tailed albatross have shrunk from nine historically identified breeding locations in the western North Pacific to two current breeding locations on Torishima and Senkaku Islands. As a result of habitat management projects, stringent protection, and the absence of any significant volcanic eruption events, the population has increased. When not nesting on the island, short-tailed albatrosses are distributed widely throughout their historic range in the North Pacific, from Torishima to the west and south to the Bering Sea, Gulf of Alaska, and California. The short-tailed albatross now has a population of 250 to 2,500 individuals. The short-term population trend is an increase of more than 10 percent. The long-term population trend was a decline of more than 90 percent of the population. However, even with the slow increase, small populations will have difficulty surviving the combined effects of demographic and environmental stochasticity. This small population size puts them at some risk to the deleterious effects of demographic and environmental stochasticity (NatureServe 2015; USFWS 2008).

Threats and Stressors

Stressor: Potential habitat destruction
Exposure: Volcanic eruptions, monsoons, and climate change.
Response: Mortality, reduction in habitat, and reduction in food.
Consequence: Reduction in population numbers and habitat.
Narrative: Habitat destruction is a large potential threat to short-tailed albatross. Habitat destruction from volcanic eruption poses a significant threat to short-tailed albatross at the primary breeding colony on Torishima. The threat is not predictable in time or magnitude; eruptions could be catastrophic or minor, and could occur at any time of year. A worst-case scenario is that about 63 percent of the Torishima population could be killed in a catastrophic eruption, or about 54 percent of the world population. A catastrophic eruption could also render the breeding habitat currently used on Torishima uninhabitable.In addition, monsoon rains affect Torishima. Monsoon rains that occur on the island result in frequent mud slides and severe

erosion at this site, which can result in habitat loss, nest destruction, and chick mortality. Breeding success at Torishima has been lower in years when there are significant typhoons. Perturbations of oceanic parameters may affect the availability of food for the short-tailed albatross and other marine birds. Climate changes may also affect vegetation and other characteristics of the short-tailed albatross breeding colony sites (65 FR 46643; NatureServe 2015; USFWS 2008).

Stressor: Environmental contaminants
Exposure: Plastics and oil released into ocean environments.
Response: Mortality, illness, and injury.
Consequence: Reduction in population numbers, reduction in habitat, and decreased reproductive success.
Narrative: Environmental contaminants are known to adversely affect birds. The effects of contaminants can include impaired reproduction, decreased immune function, inability to thermoregulate, disrupted endocrine balance, genetic mutations, and direct mortality. Short-tailed albatross and other birds may be exposed to organochlorine contaminants such as polychlorinated biphenyls and pesticides, and to toxic metals (e.g. mercury and lead) via atmospheric and oceanic transport. Uptake of these toxins through the food chain may affect these birds throughout their growth and development. Adverse effects of petroleum on marine birds and their prey are widely known, and petroleum products released into the marine environment can remain for years. Oil spills can occur in many parts of the marine range of the short-tailed albatross. Consumption of plastics may also be a factor affecting the species' survival. Albatross often consume plastics at sea, presumably mistaking them for food items. The ingestion of plastic pieces can result in internal injury or mortality to the birds, and large volumes of ingested plastic can result in a reduction of gut volume available for food and water absorption, leading to malnutrition and dehydration (USFWS 2008).

Stressor: Nonnative species
Exposure: New species brought onto the islands where short-tailed albatross nest.
Response: Mortality
Consequence: Reduction in population numbers.
Narrative: Black rats, or ship rats (Rattus rattus), were introduced to Torishima at some point during human occupation. Rats are known to feed on chicks and eggs of other seabird species. Cats (Felis cattus) were also historically present on Torishima, most likely from introductions during the feather-hunting period; they have caused damage to other seabirds populations on the island, but little research has been done to confirm the effect of their presence on the albatross.Nonnative plants, such as shrubs, can limit or destroy suitable nesting habitat on breeding islands. Presence and control of invasive plants may be a concern on proposed reintroduction sites, where the public are allowed to make day visits (65 FR 46643; NatureServe 2015; USFWS 2008).

Recovery

Reclassification Criteria:
The short-tailed albatross may be reclassified from endangered to threatened under the following conditions:

The total breeding population of short-tailed albatross reaches a minimum of 750 pairs (USFWS 2008).

At least three breeding colonies each exhibiting at 3-year running average growth rate of more than 6 percent for more than 7 years, at least two of which occupy island groups other than Torishima, with a minimum of more than 50 breeding pairs each (USFWS 2008).

Delisting Criteria:
The short-tailed albatross may be delisted under the following conditions:

The total breeding population of short-tailed albatross reaches a minimum of 1,000 pairs (population totaling 4,000 or more birds) (USFWS 2008).

The 3-year running average growth rate of the population as a whole is greater than 6 percent for more than 7 years (USFWS 2008).

At least 250 breeding pairs exist on two island groups other than Torishima, each exhibiting 6 percent growth for more than 7 years (USFWS 2008).

A minimum of 75 pairs occur on a site or sites other than Torishima and the Senkaku Islands (USFWS 2008).

Recovery Actions:

- USFWS remains committed to implementing recovery actions for this species until it no longer requires the protections afforded it by the Endangered Species Act. All recovery actions taking place outside of the United States will take place in close coordination with appropriate governmental entities. Initially, the highest priority short-tailed albatross recovery actions include:
- Continue to monitor population and manage habitat on Torishima (USFWS 2008);
- Monitor the size and productivity of the Senkaku Island population (USFWS 2008).
- Continue telemetry studies to determine at-sea habitat use, spatial and temporal distribution relative to environmental conditions, and potential for interactions with particular fisheries (USFWS 2008).
- Establish one or more breeding colonies on nonvolcanic islands as insurance against catastrophic events on Torishima (USFWS 2008).
- Continue research on fisheries operations and mitigation measures that will help managers reduce take of short-tailed albatross throughout their range (USFWS 2008).
- Conduct other research that will facilitate recovery (USFWS 2008).
- Conduct other management-related activities that will facilitate recovery (USFWS 2008).
- Conduct outreach and international negotiations that will raise awareness of this species situation among stakeholders and management agencies in albatross-range states (USFWS 2008).
- Compile protocols for all aspects of recovery work (USFWS 2008).

Conservation Measures and Best Management Practices:

-

Additional Threshold Information:

-
-

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SPECIES ACCOUNT: *Picoides borealis* (Red-cockaded woodpecker)

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed reclassification to threatened

Physical Description

From USFWS (2003): Red-cockaded woodpeckers are relatively small. Adults measure 20 to 23 cm (8 to 9 in) and weigh roughly 40 to 55 g (1.5 to 1.75 oz; Jackson 1994, Conner et al. 2001). Red-cockaded woodpeckers are black and white with a ladder back and large white cheek patches. These cheek patches distinguish red-cockaded woodpeckers from all others in their range. Red-cockaded woodpeckers are black above with black and white barring on their backs and wings. Their breasts and bellies are white to grayish white with distinctive black spots along the sides of breast changing to bars on the flanks. Central tail feathers are black and outer tail feathers are white with black barring. Adults have black crowns, a narrow white line above the black eye, a heavy black stripe separating the white cheek from a white throat, and white to grayish or buffy nasal tufts. Bills are black, and legs are gray to black. Sexes of adult red-cockaded woodpeckers are extremely similar in plumage and generally indistinguishable in the field. Juveniles may be distinguished from adults in the field by duller plumage, white flecks often present just above the bill on the forehead, and by diffuse black shading in the white cheek patch.

Taxonomy

From USFWS (2003): Red-cockaded woodpeckers are currently recognized as Picoides borealis. The species is endemic to the southeastern United States but other members of the genus are found throughout the Americas. Red-cockaded woodpeckers were first described for science as Picus borealis, “le pic boreal”, by the French businessman and amateur naturalist Vieillot (1807). In 1810, unaware of Vieillot’s description, Alexander Wilson described the species as Picus querulus because of its distinctive vocalizations (Wilson 1810).

Historical Range

P. borealis was once a common bird distributed continuously across the southeastern United States. The species has been extirpated from New Jersey, Missouri, Maryland, Tennessee, and Kentucky (USFWS 2006, 2003).

Current Range

Currently, the species occurs in Alabama, Arkansas, Louisiana, Mississippi, Texas, Florida, Georgia, North Carolina, Oklahoma, Virginia, and South Carolina (USFWS 2006).

Distinct Population Segments Defined

No (USFWS 2006)

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: From USFWS (2003): The diet of nestlings consists principally of arthropods, and fruits may be given on occasion (Baker 1971a, Harlow and Lennartz 1977, Hanula and Engstrom 2000, Hanula et al. 2000b). Large arthropod prey are commonly fed to nestlings in addition to or instead of ants (Hanula and Franzreb 1995, Hess and James 1998, Hanula and Engstrom 2000, Hanula et al. 2000b). For the first several days after fledging, the young birds are somewhat reluctant to fly, and spend considerable time perched high up in the pines, clinging to the trunk. Parents and helpers sometimes forage some distance away from the young at this time, but return frequently to feed them.

Adult: From USFWS (2003): Over 75 percent of the diet of red-cockaded woodpeckers consists of arthropods, especially ants and roaches, but also beetles, spiders, centipedes, true bugs, crickets, and moths (Beal et al. 1941, Baker 1971a, Harlow and Lennartz 1977, Hanula and Franzreb 1995, Hess and James 1998, Hanula and Engstrom 2000, Hanula et al. 2000b). Ants are particularly common in the diet of adults, comprising over half the stomach contents of adults and sub-adults in the Gulf coast region (Beal et al. 1941) and the Apalachicola National Forest in Florida (Hess and James 1998). Crematogaster ashmeadii was the most prominent of the ant species in the diet of red-cockaded woodpeckers in the Apalachicola, comprising 74 percent of the ant biomass taken (Hess and James 1998). Fruits and seeds make up the small remaining portion of the adult diet. From USFWS (2006): Red cockaded woodpeckers require abundant foraging habitat. Suitable foraging habitat consists of mature pines with an open canopy, low densities of small pines, little or no hardwood or pine midstory, few or no overstory hardwoods, and abundant native bunchgrass and forb groundcovers. Red-cockaded woodpeckers generally capture arthropods on and under the outer bark of live pines and in dead branches of live pines.

Reproduction Narrative

Adult: From USFWS (2003): Red-cockaded woodpeckers are a cooperatively breeding species and highly monogamous. Cavities are a critical resource that red-cockaded woodpeckers excavate in live pines, a task that commonly takes several years to complete. Longleaf pine is a preferred tree species for cavity excavation. Most clutches contain 2 to 4 eggs, although the full range is 1 to 5 eggs. Nest failure rates average about 20 percent. The average number of young fledged from successful nests is about two in northern populations. It is not unusual to see young being fed two months after fledging, and young are occasionally seen begging as late as the subsequent winter (Ligon 1970). The sex ratio among fledglings has been reported as biased toward males in a South Carolina population (Gowaty and Lennartz 1985), biased toward females in a Florida population (Epting and DeLotelle, unpublished) and unbiased (i.e., 1:1) in three North Carolina populations (Walters 1990, unpublished, LaBranche 1992) and another Florida population (Hardesty et al. 1997). A dispersing individual, if it survives, may become a breeder at age one. Individuals may remain helpers for up to eight years, but most become breeders within a few years (Walters et al. 1988a, 1992a). The group produces a single brood (Haig et al. 1993, 1994b), and not all groups attempt nesting in a given year. If the nest fails, the group may renest. Ages 4 to 8 are the peak reproductive years, as productivity is reduced somewhat at ages 9 and beyond in both sexes. Adult survival rates are 70 - 80%. Survival is fairly constant at ages 1 to 10 in males, and 1 to 8 in females.

Geographic or Habitat Restraints or Barriers

Adult: Restricted to mature pine forests (inferred from USFWS 2006, 2003)

Spatial Arrangements of the Population

Adult: Clumped (USFWS 2003)

Environmental Specificity

Adult: Narrow (inferred from USFWS 2006, 2003)

Tolerance Ranges/Thresholds

Adult: Moderate (inferred from USFWS 2003)

Site Fidelity

Adult: High (inferred from USFWS 2003)

Dependency on Other Individuals or Species for Habitat

Adult: Longleaf pine trees (USFWS 2006, 2003)

Habitat Narrative

Adult: From USFWS (2006): This species endemic to open, mature and old growth pine ecosystems. Red-cockaded woodpeckers require open pine woodlands and savannahs with large old pines for nesting and roosting habitat (clusters). Large old pines are required as cavity trees because the cavities are excavated completely within inactive heartwood, so that the cavity interior remains free from resin that can entrap the birds. From USFWS (2003): Because of the cooperative breeding system, red-cockaded woodpecker populations are unusually resistant to environmental and demographic variation, but highly sensitive to the spatial arrangement of habitat. Colonization of unoccupied habitat is an exceedingly slow process under natural conditions, because cavities take long periods of time to excavate and birds do not occupy habitat without cavities. Birds cannot tolerate the hardwood encroachment that results from lack of fire. The species is distributed largely as distinct populations, with large gaps of unoccupied land between them.

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS 2003)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from USFWS 2003)

Dispersal

Adult: Low to high (USFWS 2003)

Immigration/Emigration

Adult: May emigrate (USFWS 2003)

Dispersal/Migration Narrative

Adult: From USFWS (2003): P. borealis exhibits limited dispersal characteristic of cooperative breeders (Walters et al. 1988a, Daniels and Walters 2000a; see 2B). Young birds may either disperse in their first year to search for a breeding vacancy, or they may remain on the natal territory and become a helper. When helpers move, it is usually to an adjacent territory, and they rarely disperse across more than two territories. In contrast, individuals of both sexes dispersing in their first year sometimes move long distances, more than 100 km in a few cases (Walters et al. 1988b, Conner et al. 1997c, Ferral et al. 1997). Bradshaw (1995) reported that average year-round home range size for 6 groups in coastal Virginia was 120.2 ha (297 ac); Nesbitt et al. (1983) estimated that summer range for 5 groups in south Florida was 144.5 ha (357 ac); and Engstrom and Sanders (1997) reported that home range size for 7 groups in old growth forest in southwest Georgia was 46.9 ha (116 ac).

Population Information and Trends

Population Trends:
Increasing (USFWS 2006)

Resiliency:
High (inferred from USFWS 2003)

Representation:
Moderate (USFWS 2003)

Redundancy:
High (USFWS 2003)

Population Growth Rate:
Slow (USFWS 2003)

Population Size:
14, 068 (USFWS 2003)

Minimum Viable Population Size:
250 - 350 breeding groups (USFWS 2003)

Population Narrative:
The status of this species is improving (USFWS 2006). From USFWS (2003): Currently, there are an estimated 14,068 red-cockaded woodpeckers living in 5,627 known active clusters across eleven states. The cooperative breeding system does not allow rapid natural growth of populations. Combining budding and pioneering, growth rates are 0.7 percent, 2.4 percent, and 2.2 percent per year for the North Carolina Sandhills, Croatan National Forest, and Marine Corps Base Camp Lejeune, respectively. Genetic differences between populations are greater than is typical of birds, but equivalent to those in other endangered birds. However, populations do not exhibit unique alleles and some small populations exhibit reduced heterozygosity. Currently, the USFWS estimates the population size necessary to withstand effects of environmental stochasticity is 250 potential breeding groups, although some researchers consider 350 breeding groups the minimum size necessary to produce enough novel variation to offset loss from drift.

Threats and Stressors

Stressor: Habitat loss and modification (USFWS 2003)
Exposure:
Response:

Consequence:
Narrative: From USFWS (2003): Today, longleaf forests have declined to less than 1.2 million ha (3 million ac; Landers et al. 1995), of which roughly 3 percent remains in relatively natural condition (Frost 1993). Little old growth remains, and virtually no longleaf forest has escaped changes in the natural fire regime (Simberloff 1993, Walker 1999). Southern pine forests today are very different from precolonial communities not only in extent, but also in species composition, age, and structure (Ware et al. 1993, Noel et al. 1998). Much of today's forest is young, dense, and dominated by loblolly pine, with a substantial hardwood component and little or no herbaceous groundcover (Ware et al. 1993, Noel et al. 1998). Loss of residual trees in the twentieth century has been a major factor in the decline of woodpecker populations (Costa and Escano 1989, Conner et al. 2001; see 2D). A second major impact of habitat loss on the viability of red-cockaded woodpeckers is the resultant fragmented distribution. Fragmentation and isolation have occurred both among groups within a population and among populations, with serious consequences for red-cockaded woodpeckers.

Stressor: Fire suppression (USFWS 2003)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2003): Natural fire frequency declined as fires were reduced in area because of roads, plowed fields, and other human-made firebreaks (Frost 1993, Ware et al. 1993). Active fire suppression began to be institutionalized in the southeastern United States between 1910 and 1930 (Frost 1993, Ware et al. 1993). Fire suppression has severe and numerous impacts on southern pine ecosystems, including changes in tree species composition and forest structure. Longleaf pine cannot reproduce without access to the mineral soil, and will be replaced under fire suppression by other species of pines and hardwoods. The structure of the forest changes from two layers, a canopy and a diverse groundcover, to a multi-layered midstory and canopy with little or no groundcover. With increasing hardwood midstory, arthropod communities change in species abundance, species composition, and distribution on the substrate (Collins 1998, Provencher et al. 2001a). Red-cockaded woodpeckers are directly and adversely affected by each of these changes.

Stressor: Silviculture (USFWS 2003)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2003): Several silvicultural practices have been detrimental to red-cockaded woodpeckers, including short rotations, clearcutting, and conversion to sub-optimal pine species. Cutting of second-growth longleaf pines began during World War II and continues today. Removal of second-growth longleaf has exceeded growth by over 40 percent, and much of the remaining longleaf is aging without replacement (Landers et al. 1995).

Stressor: Logging (USFWS 2003)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2003): Logging is a potential threat to woodpecker populations on private lands (Cely and Ferral 1995), as harvests of mature pines continues at a high rate. One

recent study estimated the current rate of pine cutting on private lands in parts of South Carolina and Georgia at 4.0 percent per year, a rate much higher than those estimated by similar methods for temperate or tropical rainforest (Pinder et al. 1999). One of the most common ways longleaf pine cover is lost is by replacement of other pine species after logging (Outcalt and Sheffield 1996). Widespread conversion of longleaf to plantations of other pine species began in the 1940's and this process still continues today.

Stressor: Small population size (USFWS 2003)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2003): One identified threat to species viability that stems from habitat loss is the set of risks inherent to critically small populations. Small populations may be extirpated because of random environmental, demographic, genetic, and catastrophic events (Shaffer 1981, 1987). Random environmental events affect an entire population; for example, an exceptionally severe winter that causes high adult mortality. Random demographic events act on individuals within populations; for example, a death due to predation, or a brood consisting of all males. Random genetic events are losses or gains in frequency of any given gene, simply due to chance inheritance. Lastly, catastrophic events, which can affect large as well as small populations, are similar to environmental events but larger in scale. Any of these processes alone or in concert can cause the extirpation of a small population. Such processes will continue to remain threats until population sizes are sufficient to withstand them (Shaffer 1981, 1987, Crowder et al. 1998, Letcher et al. 1998, Walters et al. 2002b).

Recovery

Reclassification Criteria:
1. The Central Florida Panhandle Primary Core Population in the East Gulf Coastal Plain Recovery Unit is stable or increasing and contains at least 350 potential breeding groups (400 to 500 active clusters) (USFWS 2003).

2. There is at least one stable or increasing population containing at least 250 potential breeding groups (275 to 350 active clusters) in each of the following recovery units: Sandhills, Mid-Atlantic Coastal Plain, South Atlantic Coastal Plain, West Gulf Coastal Plain, Upper West Gulf Coastal Plain, and Upper East Gulf Coastal Plain (USFWS 2003).

3. There is at least one stable or increasing population containing at least 100 potential breeding groups (110 to 140 active clusters) in each of the following recovery units: Mid-Atlantic Coastal Plain, Sandhills, South Atlantic Coastal Plain, and East Gulf Coastal Plain (USFWS 2003).

4. There is at least one stable or increasing population containing at least 70 potential breeding groups (75 to 100 active clusters) in each of four recovery units, Cumberlands/Ridge and Valley, Ouachita Mountains, Piedmont, and Sandhills. In addition, the Northeast North Carolina/Southeast Virginia Essential Support Population is stable or increasing and contains at least 70 potential breeding groups (75 to 100 active clusters) (USFWS 2003).

5. There are at least four populations each containing at least 40 potential breeding groups (45 to 60 active clusters) on state and/or federal lands in the South/Central Florida Recovery Unit (USFWS 2003).

6. There are habitat management plans in place in each of the above populations identifying management actions sufficient to increase the populations to recovery levels, with special emphasis on frequent prescribed burning during the growing season (USFWS 2003).

Delisting Criteria:
1. There are 10 populations of red-cockaded woodpeckers that each contain at least 350 PBGs (potential breeding groups) (400 to 500 active clusters), and one population that contains at least 1000 PBGs (1100 to 1400 active clusters), from among 13 designated primary core populations, and each of these 11 populations is not dependent on continuing installation of artificial cavities to remain at or above this population size (USFWS 2003).

2. There are 9 populations of red cockaded woodpeckers that each contain at least 250 potential breeding groups (275 to 350 active clusters), from among 10 designated secondary core populations, and each of these 9 populations is not dependent on continuing installation of artificial nest cavities to remain at or above this population size (USFWS 2003).

3. There are at least 250 potential breeding groups (275 to 350 active clusters) distributed among designated essential support populations in the South/Central Florida Recovery Unit, and six of these populations (including at least two of the following: Avon Park, Big Cypress, and Ocala) exhibit a minimum population size of 40 potential breeding groups that is independent of continuing artificial nest cavity installation (USFWS 2003).

4. The following populations are stable or increasing and each contain at least 100 potential breeding groups (110 to 140 active clusters): (1) Northeast North Carolina/Southeast Virginia Essential Support Population of the Mid-Atlantic Coastal Plain Recovery Unit, (2) Talladega/Shoal Creek Essential Support Population of the Cumberlands/Ridge and Valley Recovery Unit, and (3) North Carolina Sandhills West Essential Support Population of the Sandhills Recovery Unit; and these populations are not dependent on continuing artificial cavity installation to remain at or above this population size (USFWS 2003).

5. For each of the populations meeting the above size criteria, responsible management agencies shall provide (1) a habitat management plan that is adequate to sustain the population and emphasizes frequent prescribed burning, and (2) a plan for continued population monitoring (USFWS 2003).

Recovery Actions:
- 1. Application of frequent fire to both clusters and foraging habitat (USFWS 2003).
- 2. Protection and development of large, mature pines throughout the landscape (USFWS 2003).
- 3. Protection of existing cavities and judicious provisioning of artificial cavities (USFWS 2003).
- 4. Provision of sufficient recruitment clusters in locations chosen to enhance the spatial arrangement of groups (USFWS 2003).

- 5. Restoration of sufficient habitat quality and quantity to support the large populations necessary for recovery (USFWS 2003).

Conservation Measures and Best Management Practices:

- Population monitoring (USFWS 2003)
- Cavity management (USFWS 2003)
- Predator and cavity kleptoparasite control (USFWS 2003)
- Translocation (USFWS 2003)
- Silviculture (USFWS 2003)
- Prescribed burning (USFWS 2003)
- Habitat restoration (USFWS 2003)
- Ecosystem management (USFWS 2003)

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SPECIES ACCOUNT: *Pipilo crissalis eremophilus* (Inyo California towhee)

Species Taxonomic and Listing Information

Listing Status: Threatened; proposed for delisting due to recovery ; 08/03/1987; California/ Nevada Region (R8) (USFWS, 2016)

Physical Description

The Inyo California towhee is a grey-brown, sparrow-like songbird. It is medium sized, approximately 17 to 19 centimeters (7 to 7.5 inches) in length. The sexes are similar in size and color: uniform gray-brown above and below, with buff or rust-colored undertail coverts. The species has a characteristic long tail with a short, thick, and pointed bill. Inyo California towhees are slightly smaller than the Sacramento California towhee (Pipilo crissalis carolae), its nearest geographic relative; there are significant differences in bill, middle toe, wing, and tail lengths. Plumage coloration of the Inyo California towhee is a slightly paler ash gray than other members of this species, a difference not readily discernable to the naked eye (USFWS 1998).

Taxonomy

The Inyo California towhee was first described in 1935. The Inyo California towhee is considered to be a subspecies of the California towhee (Pipilo crissalis). The California towhee has been variously considered a separate species from the canyon towhee (Pipilo fuscus) or combined with it. When considered together, the California and canyon towhees are referred to as the brown towhee. As a result of a number of studies, the American Ornithologists Union's Committee on Classification and Nomenclature currently considers the Inyo California towhee and canyon towhee as separate species. The Inyo California towhee was originally listed as the Inyo brown towhee (Pipilo fuscus eremophilus). To conform to the accepted nomenclature, the U.S. Fish and Wildlife Service changed the name of this listed subspecies to Inyo California towhee (Pipilo crissalis eremophilus) on the list of endangered and threatened wildlife (USFWS 2008; 52 FR 28780). More recently, the American Ornithologist Union changed the scientific name of the California towhee to Melozone crissalis, changing the Inyo California towhee's scientific name to Melozone crissalis eremophilus. These changes did not alter where or to what individuals protections of the Endangered Species Act apply (78 FR 65938).

Historical Range

The Inyo California towhee is a relict population of a species that was prehistorically widespread in the southwestern United States and northern Mexico. This subspecies became restricted to mountain areas in the northern Mojave Desert as a result of prehistoric climatic changes beginning in the Pliocene. The primary range of the Inyo California towhee is limited to riparian habitats in the southern Argus Range, Inyo County, California (USFWS 1998).

Current Range

The Inyo California towhee occurs on the western and eastern slopes of the southern Argus Mountains of the Mojave Desert. The Argus Mountains are a north-south oriented range between the Sierra Nevada to the west and the Panamint and Slate mountains to the east. Elevations range from approximately 817 to 1,890 meters (m) (2,680 to 6,200 feet [ft.]) above sea level (USFWS 2008).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 8/3/1987.

Legal Description

On August 3, 1987, the Service determined the Inyo brown towhee (Pipilo fuscus eremophilus) to be a threatened species and designated critical habitat.

Critical Habitat Designation

Critical habitat lies in the vicinity of the following: Margaret Ann Springs, Snooky Spring, Ruby Spring, Quail Spring. Benko Spring. Bainter Spring, Indian Joe Spring, Great Falls Basin, Mountain Springs Canyon, and a number of unnamed springs and canyons in this area.

California, Inyo County: lands within and adjacent to the China Lake Naval Weapons Center identified as follows:

(1) Approximately 2.0 miles of streambed and 1/8 mile on either side of the wash from Margaret Ann Spring and proceeding downstream to the eastern boundary of Section 3 near Snooky Spring. The above includes portions of Sections 3.4.9. and 10. T23S R42E.

(2) A circle 1/8 mile in radius with the spring in T23S R42E W1/2 NE1/4 Section 8 as the center.

(3) Approximately 2 miles of streambed and 1/8 mile on either side of the wish from Ruhy Spring (T23S R42E. Section 22) and proceeding downstream to the boundary between Sections 25 and 26. The above includes portions of Sections 22, 23, 25, and 26. T23S R42E.

(4) A circle 1/8 mile in radius with Quail Spring as the center in T23S R42E, NE 1/4 Section 28.

(5) A circle1/8 mile in radius with Benko Spring as the center in T23S R42E, Sections 34 and 35.

(6) A circle 1/8 mile in radius with Bench Mark 5465 (some USGS maps report this as 5484) near the common boundary of Sections 31 and 32, T23S R42E as the center and Iying within Sections 31 and 32.

(7) T24S R42E. NW 1/4 NW 1/4 Section 2 and NE 1/4 NE 1/4 Section 3.

(8) T24S R42E, E 1/2 SE 1/4 Section 6.

(9) Approximately 1.8 miles of streambed and 1/8 mile on either side of Great Falls Basin Wash commencing from the western boundary of E 1/2 Section 11, T24S R42F and proceeding downstream along the streambed to the eastern boundery of Section 13. The above includes portions of Sections 11, 12, 13, and 14, T24S R42E.

(10) Circles with1/8 mile radii around Mumford and Austin Springs in T24S R43E. Section 7 and Bainter Spring in Section 18 and around Indian Joe Spring in T24S R42E Section 24.

(11) Approximately 5 miles of streamhed and 1/8 mile on either aide of Mountain Springs Canyon commencing fromm the southern border of Section 8 and continuing along the streambed to the point at which Mountain Springs Canyon Wash intersects the eastern boundarv of SW 1/4 Section 12. The above includes portions of Sections 8, 9, 10, 11, 12, 13, 14 and 17. T23S R41E.

Primary Constituent Elements/Physical or Biological Features

The desert riparian scrub habitat, which is encompassed by the rule and the proposal following, provides sufficient cover for nesting, roosting, and escaping from predators, and also provides a source of food and water.

Major constituent element: desert riparian scrub vegetation.

Special Management Considerations or Protections

Actions that could adversely affect critical habitat for this species are removal, thinning, or destruction of riparian vegetation: a lowering of the present water tables would also directly affect the vegetation, which would then affect the towhee. Specific activities that could cause the above are: (1) Water diversion or substantially increased water use for mining or other purposes; (2) grazing by domestic livestock, wild horses, or wild burros; (3) mechanical brush clearing for any purpose; or (4) damage to vegetation from recreational vehicles. Any of these actions occu

Any of these actions occurring on land under Federal jurisdiction will require section 7 consultation if there is a potential impact on the Inyo brown towhee or its critical habitat. In addition, any actions on non-federal lands that are subject to Federal approval, funding, or other action will also require Section 7 consultations between the Federal agency and the Service, if the proposed activities may affect a listed species or its critical habitat. Section 4

Life History

Feeding Narrative

Adult: Inyo California towhees are insectivore and granivore opportunistic feeders, foraging primarily in open rocky and sandy desert hillsides on just about any seed or invertebrate they encounter. To eat, towhees primarily peck and glean when foraging, but will also engage in scratching, flycatching, chasing, and harvesting to find or capture food. The diet of the Inyo California towhee consists mostly pf seeds, but they also eat insects. The Inyo California towhee migrate to lower elevations to find food when there is not enough available (most likely due to snow cover). Little is known about competition between Inyo California towhees and other species. Ground-foraging birds such as mountain quail (Oreorty pictus), California quail (Callipepla californica), and chukar (Alectoris chukar) may forage on the same desert hillsides and also feed on seeds. Spotted towhees (Pipilo maculatus) and Inyo California towhees do not tolerate each other during the breeding season (USFWS 1998).

Reproduction Narrative

Adult: Sexual maturity in Inyo California towhees is generally attained in the first breeding season after hatching. Initiation of nesting coincides with local plant growth and flowering periods, which are influenced by rainfall and temperature that also affect insect abundance. Inyo California towhees are monogamous. The breeding season generally starts early in spring, with courtship and nest building commencing in March. The first clutches are laid in April, but can be laid as early as late March; replacement clutches may be laid as late as May or early June. If the first clutch fails, the pair will use the same nest and try again, but breeding behavior usually ceases for the pair when the first clutch is successful. Two to four eggs are laid, with four being laid more commonly. Only the female incubates the eggs, but both parents share in the brooding and feeding of the young. Parents continue to feed young for at least 4 weeks after fledging. The young are fully independent of the parents at 6 weeks, but remain in their natal nest area through the following fall and winter. Inyo California towhees need tree-dense canopies high off the ground for protection from predators (NatureServe 2015; USFWS 1998; USFWS 2008)

Geographic or Habitat Restraints or Barriers

Adult: Habitat degradation has limited the habitat for the Inyo California towhee.

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Community with key requirements common.

Tolerance Ranges/Thresholds

Adult: Moderate; the climate is severe, with temperatures in summer regularly exceeding 38 degrees Celsius (100 degrees Fahrenheit), accompanied by strong winds and infrequent rainfall. Winter conditions are equally extreme; temperatures often fall below freezing, with occasional snowfall (USFWS 1998).

Site Fidelity

Adult: High

Habitat Narrative

Adult: Inyo California towhees are scattered over a relatively small area (approximately 43,700 ha [108,000 ac.]), within approximately 51.5 kilometers (32 miles) of canyons of the Argus Mountains. The mountains range from approximately 893 to 1,877 m (2,680 to 5,630 ft.) above sea level. These habitat areas consist of desert riparian habitats with dense thickets (often of willows) around desert springs and streams in rocky canyons. In the breeding area, arroyo willow (Salix lasiolepis), Fremont cottonwood (Populus fremontii), and desert olive (Forestiera neoinexicana) with associated rubber rabbit brush (Chrysothamnus nauseosus) and squaw waterweed (Baccharis sergiloides) are extensive. The Inyo California towhee requires areas of dense riparian habitat to provide nesting substrate, protection from predators, and shade from the desert sun. Adjacent upland habitats are their principal foraging grounds, which also provides nesting habitat. Inyo California towhees have a moderate tolerance, tolerating a wide variety of temperatures. In the summer, temperatures regularly exceed 38 degrees Celsius (100 degrees Fahrenheit), and are accompanied by strong winds and infrequent rainfall. Winter conditions are equally extreme; temperatures often fall below freezing, with occasional snowfall (NatureServe 2015; USFWS 1998; USFWS 2008)

Dispersal/Migration

Motility/Mobility

Adult: Mobile

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Moderate

Immigration/Emigration

Adult: Unlikely

Dispersal/Migration Narrative

Adult: Inyo California towhees are mobile, and hold their territories year-round (nonmigratory). However, if snow cover does not allow towhees to forage for seeds, they may disperse to lower elevations within their range to find food. Territories are defended from intruders by both the male and female year-round, but more vigorously during the breeding season. Territories include nest sites, foraging areas, roosts, and perches. Territories range from 10 to 25 ha (25 to 62 ac.), and decrease in size during the breeding season. Inyo California towhees will move outside their territories during the nonbreeding season to forage in the open desert (USFWS 1998).

Additional Life History Information

Adult: Inyo California towhees are nonmigratory, holding their territories year-round. However, if snow cover does not allow towhees to forage for seeds, they may disperse to lower elevations within their range to find food (USFWS 1998).

Population Information and Trends

Population Trends:

Stable population for the short-term trend, increasing for the long-term trend (NatureServe 2015).

Species Trends:

Increasing (NatureServe 2015)

Resiliency:

Low

Representation:

Moderate

Redundancy:

Low

Population Growth Rate:

Stable

Number of Populations:

One

Population Size:

250 to 1,000 individuals (NatureServe 2015). Based on the results of four systematic surveys conducted over the 13-year period from 1998 to 2011, the estimated total range-wide population has been between 640 and 741 individuals (78 FR 65928).

Resistance to Disease:

Disease is not a threat to Inyo California towhees (USFWS 2008).

Adaptability:

Moderate

Population Narrative:

California Inyo towhees have a stable population for the short-term trend, and the population has been increasing in the long-term trend. Currently, the population is estimated to be between 250 and 1,000 individuals (NatureServe 2015). However, based on the results of 2007 surveys, the current Inyo California towhee population is estimated to be between 706 and 741 adults (USFWS 2008).

Threats and Stressors

Stressor: Habitat destruction
Exposure: Grazing, recreation, water diversion.
Response: Reduction in habitat.
Consequence: Reduction in population numbers.
Narrative: Inyo California towhees are scattered over a relatively small area in the Argus Mountains. Although it has not been quantified, the actual amount of towhee habitat in this area is much smaller because towhees are restricted to areas in near dense riparian vegetation. Habitat destruction, including grazing, recreational use (hiking, camping, hunting, and OHV use), and water diversion can severely threaten Inyo California towhees. Grazing of grasses, shrubs, and forbs, and trampling of riparian and adjacent upland scrub habitats by feral burros, and to a lesser extent by feral horses and cattle, have significantly reduced the ability of these habitats to support Inyo California towhees. Feral burros are particularly destructive due to their practice of creating “burro baths,” which can be up to 3 m (10 ft.) in diameter, destroy all vegetation, and create miniature dust bowls. Altering riparian habitat in this manner also encourages the disproportionate growth of native species that are not preferred by the California Inyo towhee, and the invasion of exotics like salt cedar (Tamarix spp.) and carrizo (Phragmies australis). Recreation may result in loss and degradation of habitat through crushing by vehicles; trampling by hikers, hunters, and campers; cutting for firewood; and soil compaction. Water diversion can reduce the amount of water available to maintain riparian vegetation, resulting in negative impacts to the habitat of the towhee (USFWS 2008).

Stressor: Invasive species
Exposure: Nonnative plants and animals in Inyo California towhee habitat.
Response: Reduction in habitat.
Consequence: Reduction in population numbers.

Narrative: A potential threat which may possibly affect the California Inyo towhee is the encroachment of invasive and nonnative plant species. Disturbed areas, such as those caused by grazers, allow for the establishment of invasive and nonnative plant species. Although the impact of invasive and nonnative plants on towhees is unknown, the occurrence of these plants is increasing, and thought to limit the number of native trees and shrubs that California Inyo towhee use for breeding (USFWS 2008).

Recovery

Reclassification Criteria:
Reclassification criteria are not identified in the Recovery Plan.

Delisting Criteria:
Delisting could be considered for the Inyo California towhee when the population has been sustained at a minimum of 400 individuals for a 5-year period. This numerical goal for recovery is based on the estimated carrying capacity, the maximum number of towhees the habitat can support without detrimental effects. At this goal, the population should be reproductively self-sustaining and distributed throughout its range; the threats to its habitat managed, reduced, or eliminated; and all degraded habitat restored, where possible (USFWS 1998).

Recovery Actions:
- Identify and monitor all suitable habitat and threats, assess level of habitat degradation, and prescribe recovery actions to restore and protect habitat as necessary (USFWS 1998).
- Determine and monitor the presence and breeding status of Inyo California towhees throughout their range (USFWS 1998).
- Enhance suitable habitat by increasing the amount and quality of riparian vegetation (USFWS 1998).
- Develop and implement an outreach program for the Inyo California towhee (USFWS 1998).

Conservation Measures and Best Management Practices:
-

Additional Threshold Information:
-
-

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SPECIES ACCOUNT: *Polioptila californica californica* (Coastal California gnatcatcher)

Species Taxonomic and Listing Information

Listing Status: Threatened; March 30, 1993 (58 FR 16742).

Physical Description

The coastal California gnatcatcher (Polioptila californica californica) is a small blue-gray songbird which measures only 11 centimeters (4.5 inches) and weighs 6 grams (0.2 ounce). It has dark blue-gray feathers on its back and grayish-white feathers on its underside. The wings have a brownish wash to them. Its long tail is mostly black, with white outer tail feathers. They have a thin, small bill. The males have a black cap during the summer which is absent during the winter. Both males and females have a white ring around their eyes (USFWS 2016).

Taxonomy

The coastal California gnatcatcher, along with other gnatcatcher species, is a songbird (class Aves, order Passeriformes). At the time of listing, gnatcatchers as a group (tribe Polioptilini) were part of the Muscicapidae, a family encompassing many taxonomic groupings below the family level. Since listing, the family Muscicapidae has been reorganized and split into several families. The gnatcatcher group is now a subfamily (Polioptilinae) in the family Sylviidae. However, recent evidence suggests that further reorganization of this family is needed (USFWS 2010). The coastal California gnatcatcher differs from the other subspecies in darker body plumage, less extensive white on the tail feathers (rectrices 5 and 6), and a longer tail (NatureServe 2015). Prior to listing, the black-tailed gnatcatcher (P. melanura) was split into two species, with coastal and Baja California peninsular forms becoming the California gnatcatcher and the interior forms remaining the black-tailed gnatcatcher. The coastal California gnatcatcher was then recognized as one of several subspecies of California gnatcatchers (USFWS 2010). A new subspecies has been proposed, P. californica atwoodi, for the California gnatcatchers that occur in coastal northwestern Baja California from just south of the United States–Mexico border region to about El Rosario, Baja California. This analysis was based primarily on a qualitative assessment of the plumage characteristics of female gnatcatchers. The U.S. Fish and Wildlife Service (USFWS) is not aware of any nuclear DNA data from this species; however, mitochondrial DNA data indicate a lack of geographic structure of California gnatcatcher populations throughout the entire species' range. This finding suggested that phenotypic characteristics that make the coastal California gnatcatcher distinguishable are being maintained by natural selection for plumage suitable to their local habitat rather than by restricted gene flow (USFWS 2010).

Historical Range

At the time of listing, the information available suggested that the northernmost populations in southern Ventura and southwestern San Bernardino counties were extirpated, but observations since listing have shown that populations in those counties are extant. The gnatcatcher was historically thought to occur from southern California and northwestern Baja California, Mexico, south to approximately El Rosario, Mexico (USFWS 2010).

Current Range

The range of the gnatcatcher is coastal southern California and northwestern Baja California, Mexico, from southern Ventura and San Bernardino counties, California, south to approximately El Rosario, Mexico, at about 30 degrees north latitude. Historically, the range of the gnatcatcher extended farther east than it does today, in the vicinity the San Gorgonio Pass (USFWS 2010). The range of the gnatcatcher closely follows that of coastal scrub. The northern and eastern limits of the coastal scrub vegetation communities used by the gnatcatcher are largely bound by mountainous areas, while the southern limit is defined by the transition to the Vizcaíno desert (USFWS 2010).

Distinct Population Segments Defined

No: April 23, 2003 (68 FR 20228; USFWS 2010).

Critical Habitat Designated

Yes; 10/24/2000.

Legal Description

On December 19, 2007, the U.S. Fish and Wildlife Service (Service) designated revised final critical habitat for the coastal California gnatcatcher (Polioptila californica californica) under the Endangered Species Act of 1973, as amended (72 FR 72010 - 72213). In total, approximately 197,303 acres (ac) (79,846 hectares (ha)) of habitat in San Diego, Orange, Riverside, San Bernardino, Los Angeles, and Ventura Counties, California, are designated as critical habitat for the coastal California gnatcatcher. This revised final designation constitutes a reduction of 298,492 ac (120,795 ha) from the 2003 revised proposed rule.

Critical Habitat Designation

Critical habitat includes coastal California gnatcatcher habitat throughout the species' range in the U.S. (i.e., Ventura, Los Angeles, Orange, San Bernardino, and San Diego Counties, California) in a variety of climatic zones and vegetation types to preserve the genetic and behavioral diversity that currently exists within the species. The designated lands are under Federal, State, local, and private ownership.

Unit 1: South San Diego County. Unit 1 encompasses approximately 14,898 ac (6,029 ha) within the MSCP planning area of which about half is under Federal ownership (San Diego National Wildlife Refuge and Bureau of Land Management (BLM)) and the other half is under private ownership (see Table 3 above). Lands essential to the conservation of the coastal California gnatcatcher within the cities of El Cajon, and Santee; major amendment areas within the San Diego County MSCP Subarea Plan; and water district lands owned by Sweetwater Authority, Helix Water District, Otay Water District, the San Diego National Wildlife Refuge, and BLM lands on Otay Mountain are included in this unit. Lands designated as critical habitat contain core populations of the species, sage scrub, and non-sage scrub habitats (PCEs 1 and 2), and areas providing connectivity between core populations and sage scrub. Populations in this unit occur in high-quality coastal sage scrub and persist in high densities. Lands in the eastern section of this unit are also some of the least fragmented within this portion of the range in the U.S. and, therefore, are less subject to edge effects which negatively influence habitat quality. Lands in this unit are also located adjacent to the U.S./Mexico border, and populations located there serve to promote demographic and genetic interchange with populations in Mexico. Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher

(PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 2: Upper San Diego River and El Capitan Linkage. Unit 2 encompasses approximately 14,508 ac (5,871 ha) in the upper San Diego River drainage area of which the majority are under Federal (USFS) and private ownership (see Table 3 above). This unit includes an essential population of coastal California gnatcatchers on the Cleveland National Forest south of State Route 78 near the upper reaches of the San Diego River, as well as canyons and corridors that provide linkages to MSCP Multiple Habitat Preserve Area (MHPA) lands adjacent to this unit. This population is the easternmost within the species' range and occurs at one of the highest elevations known. Individuals within this population likely contain unique genetic or behavioral adaptations that allow them to persist, which is essential to the species survival and recovery as environmental conditions change through time. Therefore, habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion especially in light of the October 2003 wildfires and degradation occurring in conjunction with urban and agricultural development.

Unit 3: North San Diego County Multiple Habitat Conservation Plan (MHCP). Unit 3 encompasses approximately 17,325 ac (7,011 ha) of which the majority are under private ownership (see Table 3 above) within the MHCP planning area in northwestern San Diego County. Included are lands within the cities of Encinitas, Escondido, Oceanside, San Marcos, Solana Beach, and Vista. Lands designated as critical habitat contain the last significant coastal California gnatcatcher populations remaining south of MCB Camp Pendleton abutting the coast. Coastal populations of the coastal California gnatcatcher have been found to be denser than inland locales (Preston et al. 1998), and are essential to support more inland populations through emigration (e.g., Unit 4). This unit also provides connectivity between significant populations at MCB Camp Pendleton (adjacent to Unit 5), MSCP reserve areas in Unit 1, and populations in northern San Diego County (Unit 4). Lands within this unit are being designated as critical habitat because they were occupied at the time of listing, are currently occupied, and contain all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 5: North County Subarea of the MSCP for Unincorporated San Diego County. Unit 5 encompasses approximately 29,639 ac (11,995 ha) within the planning area for the North County Subarea of the MSCP for San Diego County. The majority of the lands is under private ownership (see Table 3 above). Lands designated within this unit contain several core coastal California gnatcatcher populations and intervening linkage areas of sage scrub. This unit constitutes the primary inland linkage along the I–15 corridor between San Diego populations and those in southwestern Riverside County. Habitat quality in this area was also classified as high to very high by the habitat model. This population is located adjacent to a north-south corridor connecting Riverside and San Diego Counties, and likely provides a significant number of dispersing juveniles into this corridor. Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 6: Southern NCCP Subregion of Orange County. Unit 6 encompasses approximately 6,515 ac (2,637 ha) the majority of which is under private ownership (see Table 3 above). While these lands are within the approximately 131,000 ac (53,014 ha) study area for the Orange County Southern Subregion HCP, they are not included in the approximately 86,076 ac (34,834 ha) permit area covered under the HCP (Service 2007a, p. 24). Areas not covered by the HCP include land in the cities of Lake Forest and Dana Point, portions of San Juan Capistrano, an ‘‘Existing Use’’ Girl Scout Camp, Ladera Ranch, Las Flores, Tesoro High School, the Foothill Transportation Corridor-North, the Nichols Institute bounded by Caspers Wilderness Park, the sewage treatment facility in Chiquita Canyon and other areas that are in the Southern Subregion but are defined as ‘‘Not a Part’’ of the HCP (Service 2007a, p. 24). As stated in the 2003 revised proposed rule, lands within the study area for the Orange County Southern Subregion HCP contain some of the largest, most robust populations known (e.g., Chiquita ridge), as well as essential regional populations (e.g., Prima Deshecha Canada, Talega Canyon) and linkages in Cristianitos Canyon, Arroyo Trabuco, and Saddle Creek/Live Oak Canyon, and provide for connectivity and genetic interchange among core populations and contain large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. This area also provides the primary linkage for significant populations in North San Diego MHCP (Unit 3), and the Fallbrook Naval Weapons Station, to those further north in Orange County (Unit 7). Of the 44,340 ac (17,940 ha) included in the 2003 revised proposed critical habitat designation, approximately 17,022 ac (6,888 ha) within the Orange County Southern Subregional HCP area are being excluded from this revised final designation under section 4(b)(2) of the Act (see ‘‘Exclusions Under Section 4(b)(2) of the Act’’ section below for a detailed discussion of this exclusion). The remaining approximately 7,576 ac (3,066 ha) included in this revised final designation were occupied at the time of listing, are currently occupied, and contain all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). These 7,576 ac (3,066 ha) are within modeled habitat for the coastal California gnatcatcher identified as containing core populations or providing important linkage areas within the Orange County Southern Subregion HCP study area. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 7: Central-Coastal NCCP Subregions of Orange County (CentralCoastal NCCP). Unit 7 encompasses approximately 4,309 ac (1,744 ha) under private ownership (see Table 3 above).

The areas included in this revised final designation include core coastal California gnatcatcher populations and sage scrub within select areas defined in the NCCP/HCP as Existing Use Areas (areas not included in the CentralCoastal NCCP/HCP), the designated reserve (panhandle portion) of the El Toro Reuse Area, approximately 210 ac (85 ha) owned by the Boy Scouts of America within the area formerly referred to as the North Ranch Policy Planning Area, and the most southern portion of Chino Hills State Park (CDPR) in Orange County. While these lands are within the approximately 208,000 ac (84,175 ha) planning area for the Orange County Central-Coastal NCCP/HCP, they are not included in the permit area covered under the NCCP/HCP (Service 1996b, pp. 15–16) and, therefore, there is no requirement to manage for coastal California gnatcatcher or its habitat in these areas. As discussed in the 2003 revised proposed critical habitat rule, lands identified for preservation under the Orange County Central-Coastal NCCP/HCP were considered but not included in the proposed designation (see ‘‘Exclusions under Section 4(b)(2) of the Act’’ section below for a reaffirmation of our exclusion of these areas). Additionally in this revised final rule, we have excluded lands covered by the O’Hill HCP and lands within the area formerly referred to as the North Ranch Policy Planning Area on The Irvine Ranch under section 4(b)(2) of the Act (see the ‘‘Exclusions under Section 4(b)(2) of the Act’’ and ‘‘Other Conservation Partnerships—Exclusions Under Section 4(b)(2) of the Act’’ sections below for detailed discussions of these exclusions). Habitat within this unit was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). These areas contain highquality habitat and dense populations of coastal California gnatcatchers and also serve to link populations located in southern Orange County (Unit 6) with those in northern Orange and Riverside Counties. These lands are within modeled habitat for the coastal California gnatcatcher identified as containing core populations and/or providing important linkage areas within the NCCP/HCP study area. Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 8: Palos Verdes Peninsula Subregion, Los Angeles County. Unit 8 encompasses approximately 4,462 ac (1,806 ha) under private ownership (see Table 3 above) on the Palos Verdes Peninsula, the majority of which is within the City of Rancho Palos Verdes’ draft NCCP/MSHCP subregional planning area. This unit includes a core population of coastal California gnatcatchers and high-quality sage scrub habitat in Portuguese Bend, Agua Amarga Canyon, San Pedro, and adjacent canyons, as well as connecting linkages. The former landfill adjacent to the South Coast Botanic Garden does not currently contain habitat and is not designated as critical habitat, yet it will continue to be evaluated as it represents a significant potential restoration area for the recovery of this population of the species. Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 9: East Los Angeles County-Matrix NCCP Subregion of Orange County. Unit 9 encompasses approximately 17,552 ac (7,103 ha) the majority of which is under private ownership (see Table 3 above) within the Montebello Hills, Puente-Chino Hills, and West Coyote Hills areas. Core populations are known from the Montebello Hills, south slopes of the Puente-Chino Hills from Whittier east to Yorba Linda, and the East and West Coyote Hills. The Brea Canyon Landfill is not designated as critical habitat, but represents a significant potential restoration area to support these remaining populations and aid in recovery of the species. The unit also provides the primary connectivity between significant coastal California gnatcatcher populations and sage scrub habitat within the Orange County Central-Coastal NCCP (Unit 6), the Western Riverside County MSHCP (Unit 10) and the Bonelli Regional Park population within East Los Angeles (Unit 12). Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 10: Western Riverside County Multiple Species Habitat Conservation Plan (MSHCP). Unit 10 encompasses a total of approximately 27,529 ac (11,140 ha) the majority of which is under private and Federal (USFS, BLM) ownership (see Table 3 above). Of this total, 21,776 ac (8,812 ha) are in the Western Riverside County MSHCP plan area and approximately 5,757 ac (2,330 ha) are within southern San Bernardino County adjacent to the planning area for the Western Riverside County MSHCP. Of the 21,776 ac (8,812 ha) in the Western Riverside County MSHCP plan area being designated as critical habitat, 10,176 ac (4,118 ha) are owned by the Metropolitan Water District who is not a permittee to the MSHCP and therefore not being excluded from this final designation. An additional 199 ac (81 ha) of private land in the Western Riverside County MSHCP plan area are also not being excluded from this final designation. These 199 ac (81 ha) are covered under a settlement agreement and Memorandum of Understanding (MOU) signed on February 24, 2004, by the County of Riverside and several property owners, including Murdock Alberhill, the owner of these 199 ac (81 ha), which specifically exempts and excludes these landowners' properties from the Western Riverside County MSHCP (Riverside County 2004, p. 5). Therefore, the 199 ac (81 ha) owned by Murdock Alberhill are not required to be managed for coastal California gnatcatcher consistent with the Western Riverside County MSHCP. The remaining 11,401 ac (xx ha) being designated in the Western Riverside County MSHCP plan area are under Federal ownership (BLM and USFS). Since these lands contain the features essential to the conservation of the species and may require special management considerations and protection, they are being included in this revised final designation. This unit also encompasses contiguous habitats in southern San Bernardino County, including essential coastal California gnatcatcher populations in the Jurupa Hills, and the Blue Mountain/Reche Canyon region. Though not included, the Santa Ana River may be an important movement corridor in this area, connecting the Jurupa and La Loma Hills to populations in the Box Springs Mountains, as well as to the few pairs known from the Pedley Hills and Norco Hills. Though a few coastal California gnatcatchers have been observed from the upper Santa Ana River wash in the vicinity of Highland, we do not yet have evidence that this area constitutes a core population. Further survey work in this area may help clarify its use by coastal California gnatcatchers. Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 12: East Los Angeles County. Unit 12 encompasses approximately 2,829 ac (1,145 ha) all of which is under private and local ownership (see Table 3 above) in eastern Los Angeles County in Bonelli Regional Park and along the San Jose Hills to the west. This unit functions as an archipelago of persistent populations toward the northern end of the range of the species, and is a likely source population for the nesting pairs that are reported from the foothills of the San Gabriel Mountains north of the Los Angeles basin. Disturbed and vacant areas within Bonelli Regional Park and the BKK landfill at the western end of the San Jose Hills represent the last available vacant land for restoration of habitat to recover the species in this unit. Isolated habitat patches between this unit and the East Los Angeles County-Matrix NCCP Subregion of Orange County (Unit 9), are not included, but serve to maintain connectivity. This unit does not include a potential movement corridor along the foothills of the San Gabriel Mountains towards the Etiwanda Fan (former Unit 11) as we do not currently have evidence of coastal California gnatcatcher movement through this area. Habitat within this unit is being designated because it was occupied at the time of listing, is currently occupied, and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). Additionally, this unit provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion and degradation occurring in conjunction with urban and agricultural development.

Unit 13: Western Los Angeles and Ventura Counties. Unit 13 encompasses approximately 57,737 ac (23,365 ha) of which the majority is under private ownership (see Table 3 above) in eastern Ventura and western Los Angeles Counties along the southern and eastern slopes of the Santa Susana Mountains and a portion of the interior foothills of the San Gabriel Mountains. It includes the only known breeding population of coastal California gnatcatchers in Ventura County and includes high-quality coastal sage scrub. Habitat between the San Gabriel and Santa Susana Mountains contains the PCEs required by this species and serves as an essential linkage between the two isolated populations: the core population in the Moorpark area in Ventura County and the pairs documented in the foothills of the San Gabriel Mountains in Los Angeles County. Without this linkage, the population located in Ventura County has no other natural area connecting them with populations located east and south of Ventura County. Also, without the natural areas and habitat located on the south-facing slopes of the Santa Susana and San Gabriel Mountains, these two populations of coastal California gnatcatchers would be completely isolated and prone to extirpation. This unit encompasses the northern and western distributional extreme of the coastal California gnatcatcher’s current range, and as such acts as a source population for future recovery of coastal California gnatcatcher populations to the north and west. Peripheral populations also likely contain essential genetic or behavioral adaptations that are important to the species as environmental conditions change through time (Lesica and Allendorf 1995). Habitat within this unit is being designated because it is currently occupied and contains all of the features essential to the conservation of the coastal California gnatcatcher (PCEs 1 and 2). As discussed in the ‘‘Criteria Used To Identify Critical Habitat’’ section above, while we do not currently have pre-listing occupancy data for Ventura County, we do have records of the species occurrence in that County as early as 1998 (Leverett 1998, p. 1). Based on the species’ nonmigratory nature and the fact that dispersal distances are usually limited (see ‘‘Primary Constituent Elements’’ section above), we believe that Ventura County was occupied by coastal California gnatcatcher at the time of listing. Habitat within this unit is also essential to the conservation of the species because it provides for connectivity and genetic interchange among core populations and contains large blocks of high-quality habitat capable of supporting persistent populations of coastal California gnatcatchers. The PCEs contained within this unit may require special management considerations or protection to minimize impacts associated with habitat type conversion especially in light of the 2003 wildfires and degradation occurring in conjunction with urban and agricultural development.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Los Angeles, Orange, Riverside, San Bernardino, San Diego, and Ventura Counties, California. The primary constituent elements (PCEs) of critical habitat for coastal California gnatcatcher are:

(i) Dynamic and successional sage scrub habitats: Venturan coastal sage scrub, Diegan coastal sage scrub, Riversidean sage scrub, maritime succulent scrub, Riversidean alluvial fan scrub, southern coastal bluff scrub, and coastal sage-chaparral scrub in Ventura, Los Angeles, Orange, Riverside, San Bernardino, and San Diego Counties that provide space for individual and population growth, normal behavior, breeding, reproduction, nesting, dispersal and foraging; and

(ii) Non-sage scrub habitats such as chaparral, grassland, riparian areas, in proximity to sage scrub habitats as described for PCE 1 above that provide space for dispersal, foraging, and nesting.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, airports, roads, and other paved areas) and the land on which they are located existing on the effective date of this rule and not containing one or more of the PCEs.

Once coastal California gnatcatcher habitat has been protected from direct loss, such habitat may still be rendered unsuitable for the species because of type conversion (conversion of one habitat type to another), habitat degradation, altered fire regime, or other factors. Many of the factors that limit the population size and growth rate of coastal California gnatcatcher populations can be controlled through special management actions. Examples of special management actions that may be necessary to protect essential habitat features and thus prevent further declines and loss of populations of coastal California gnatcatchers are the following:

(1) Actions to prevent the type conversion of sage scrub (PCE 1) into other unsuitable habitats. Many factors either individually or in tandem appear to result in the type-conversion of sage scrub into other vegetation types, especially nonnative grasslands. Factors such as exotic weed invasion, increased fire frequency, human disturbance, and possibly air pollution have combined to reduce sage scrub cover in southern California (Minnich and Dezzani 1998). Special management actions, such as exotic weed control and fire management and prescription, can

help to retard the conversion of shrublands to grasslands. (2) Actions to reduce human degradation of sage scrub (PCE 1). Many otherwise productive coastal California gnatcatcher habitats have been compromised by human actions including unauthorized trail use, offroad vehicle use, and illegal dumping. Special management actions such as fencing, trail building, posting signs, and increased law enforcement attention can help to reduce these destructive activities. (3) Actions to restore degraded habitat areas. Coastal sage scrub and related plant communities (PCEs 1 and 2) have been successfully restored to support breeding coastal California gnatcatchers. Restoration of degraded habitats can increase local population sizes and facilitate movement between populations (e.g., Miner et al. 1998).

Life History

Feeding Narrative

Adult: Coastal California gnatcatchers are insectivores and invertivores. They are opportunistic feeders and eat grasshoppers, crickets, spiders, beetles, bees, and caterpillars found widely distributed throughout their environment. They also prey upon arthropods, including insects such as leafhoppers and planthoppers (Homoptera), and spiders commonly found in sage scrub plant communities. They can face feeding competition from birds with similar feeding habits also found in the same environments (72 FR 72010; Mock 2004; USFWS 2010).

Reproduction Narrative

Adult: Coastal California gnatcatchers breed from late February through July (sometimes later), with the peak of nest initiations (start-ups) occurring from mid-March through mid-May. Nests are composed of grasses, bark strips, small leaves, spider webs, down, and other materials, and are often located in California sagebrush (Artemisia californica) plants about 1 m (3 ft.) above the ground. Nests are constructed over a 4- to 10-day period. Clutch size averages four to six eggs. The incubation and nestling periods encompass about 14 and 16 days, respectively. Both sexes participate in all phases of the nesting cycle (USFWS 2010). Females typically incubate the egg 61 percent of time during day and at night. Females also control the duration of incubation. Males incubate the nest at night. Males typically bring in more food than females (Mock 2004). Although the gnatcatcher may occasionally produce two broods in one nesting season, the frequency of this behavior is not known; however, the species is known to rapidly and repeatedly renest following the loss of eggs or juveniles to predators. Juveniles are dependent on or remain closely associated with their parents for up to several months following departure from the nest and dispersal from their natal territory (USFWS 2010).

Geographic or Habitat Restraints or Barriers

Adult: Fragmentation of habitat.

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Moderate

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High

Habitat Narrative

Adult: The range and distribution of the gnatcatcher is closely aligned with coastal scrub vegetation found on dry coastal slopes, washes, and mesas. This vegetation is typified by low (less than 1 m [3 ft.]) shrub and sub-shrub species that are often drought deciduous (NatureServe 2015; USFWS 2010). Characteristic plants of this community include coastal sagebrush (Artemisia californica), various species of sage (Salvia spp.), California buckwheat (Eriogonum fasciculatun), lemonadeberry (Rhus integrifolia), California encelia (Encelia californica), pricklypear and cholla cactus (Opuntia spp.), and various species of Haplopoppus. The coastal California gnatcatcher commonly occurs in coastal sage scrub vegetation dominated by coastal sagebrush, although in some portions of its range (e.g., western Riverside County) other plant species may be more abundant (58 FR 16742).Starting at the United States–Mexico border and continuing southward, the gnatcatcher-associated plant communities increasingly include succulent species. The coastal scrub plant communities that overlap the range of the gnatcatcher include Venturan, Diegan, and Riversidean coastal sage scrub communities, and Martirian and Vizcainan coastal succulent scrub communities. These different plant communities generally reflect the transition from a wetter, Mediterranean-type climate in the north to a dryer, tropical-desert climate in the south. Gnatcatchers may also occur in other nearby plant communities, especially during the nonbreeding season, but gnatcatchers are closely tied to coastal scrub for reproduction. Moreover, all coastal scrub is not equal with respect to gnatcatchers. Gnatcatchers are patchily distributed, and the density of gnatcatchers is highest in high-quality habitat and decreases as habitat quality decreases (NatureServe 2015; USFWS 2010).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory (NatureServe 2015)

Dispersal

Adult: Moderate; higher with juveniles.

Immigration/Emigration

Adult: Immigration/emigration.

Dispersal/Migration Narrative

Adult: The gnatcatcher is nonmigratory and defends breeding territories ranging in size from 1 to 6 hectares (ha) (2 to 14 acres [ac.]). The home range size of the gnatcatcher varies seasonally and geographically, with winter season home ranges being larger than breeding season ranges, and inland populations having larger home ranges than coastal populations. Dispersal of juveniles generally requires a corridor of native vegetation that provides certain foraging and sheltering requisites, and that connects to larger patches of appropriate sage scrub vegetation. These dispersal corridors facilitate the exchange of genetic material and provide a path for recolonization of extirpated areas. The gnatcatcher generally disperses short distances through contiguous, undisturbed habitat, but juvenile gnatcatchers are capable of dispersing long distances (up to 22 km [14 mi.]) across fragmented and highly disturbed sage scrub habitat, such as that found along highway and utility corridors or remnant mosaics of habitat adjacent to developed lands (USFWS 2010).

Additional Life History Information

Adult: The gnatcatcher generally disperses short distances through contiguous, undisturbed habitat, but juvenile gnatcatchers are capable of dispersing long distances (up to 22 kilometers [km] [14 miles (mi.)]) across fragmented and highly disturbed sage scrub habitat, such as that found along highway and utility corridors or remnant mosaics of habitat adjacent to developed lands (USFWS 2010).

Population Information and Trends

Population Trends:

Long-term; decline of less than 50 to relatively stable. Short-term: decline of less than 30 percent to relative stable (NatureServe 2015).

Species Trends:

Long-term; decline of less than 50 to relatively stable. Short-term: decline of less than 30 percent to relative stable (NatureServe 2015).

Resiliency:

Moderate

Representation:

Moderate

Redundancy:

Moderate

Number of Populations:

24 core populations; core population areas supporting 30 or more pairs of California Gnatcatcher include: 1. Palos Verdes Peninsula; 2. Montebello; 3. Coyote Hills near Fullerton; 4. Puente/Chino Hills; 5. El Toro Air Station; 6. Coastal (Upper Newport Bay to Dana Point Headlands east to Interstate-5); 7. North-central and southern Orange County (Interstate-5 to base of Santa Ana Mountains, from El Toro to southern county Border); 8. Camp Pendleton/Fallbrook; 9. Oceanside; 10. North Carlsbad; 11. Southeast Carlsbad; 12. Southwest San Marcos; 13. Rainbow/Pala; 14. Olivenhain/Lake Hodges/San Pasqual; 15. Poway; 16. Upper San Diego River/El Capitan Reservoir; 17. Mission Trails/Miramar; 18. Lakeside/Dehesa; 19. Sweetwater River Reservoir; 20. Jamul Mountains; 21. Otay Lakes/Mesa; 22. Tijuana River mouth; 23. Lake Elsinore Lake Skinner; and 24. Temecula (Mock 2004).

Population Size:

Population estimates on public and quasi-public lands of Orange and San Diego counties: 1,324 (95 percent confidence interval: 976 to 1,673) gnatcatcher pairs over a 44,923-ha (111,006-ac.)

area (USFWS 2010). United States population likely exceeds 3,000 pairs, and is maybe as high as 5,000 pairs during years with favorable weather conditions (Mock 2004).

Resistance to Disease:

Unknown (USFWS 2010)

Adaptability:

Moderate

Additional Population-level Information:

The highest densities occur in coastal areas of Orange and San Diego counties. Lower densities occur in western Riverside and southwestern San Bernardino counties and inland San Diego County. Small, now disjunct, populations were documented for Ventura and Los Angeles counties (Mock 2004).

Population Narrative:

Historically, gnatcatchers were “common locally” in the United States. However, the amount of coastal scrub had already been reduced as of 1944. Numbers of gnatcatchers continued to decline so that coastal California gnatcatchers were considered it to be “very rare” (USFWS 2010). A recent study estimated 1,324 (95 percent confidence interval: 976 to 1,673) gnatcatcher pairs over a 44,923-ha (111,006-ac.) area on public and quasi-public lands of Orange and San Diego counties. Their sampling frame covered only a portion of the United States range, focusing on the coast, and was limited to one year (USFWS 2010). The United States population likely exceeds 3,000 pairs, and is maybe as high as 5,000 pairs during years with favorable weather conditions (Mock 2004). Core population areas supporting 30 or more pairs of California Gnatcatcher include Palos Verdes Peninsula, Montebello, Coyote Hills near Fullerton, Puente/Chino Hills, El Toro Air Station, coastal (Upper Newport Bay to Dana Point Headlands east to Interstate-5), north-central and southern Orange County (Interstate-5 to base of Santa Ana Mountains, from El Toro to southern county Border), Camp Pendleton/Fallbrook, Oceanside, North Carlsbad, southeast Carlsbad, Southwest San Marcos, Rainbow/Pala, Olivenhain/Lake Hodges/San Pasqual, Poway, Upper San Diego River/El Capitan Reservoir, Mission Trails/Miramar, Lakeside/Dehesa, Sweetwater River Reservoir, Jamul Mountains, Otay Lakes/Mesa, Tijuana River mouth, Lake Elsinore Lake Skinner, and Temecula (Mock 2004).The highest densities occur in coastal areas of Orange and San Diego counties. Lower densities occur in western Riverside and southwestern San Bernardino counties and inland San Diego County. Small, now disjunct, populations were documented for Ventura and Los Angeles counties (Mock 2004).At the time of listing in 1993, it was estimated that about 2,562 pairs of gnatcatchers remained in the United States, and about 2,800 pairs were reported to occur in Baja California. However, these estimates were not statistically valid because they were conducted using methods not supported by probability theory. Additionally, gnatcatcher population sizes are known to fluctuate from year to year, which further complicates any trend assessment. It is likely there are more gnatcatchers in the United States portion of the range than was suggested by earlier estimates; a 2008 study estimated nearly as many gnatcatchers in the portion of the United States range sampled in their study as was originally estimated for the entire United States range. USFWS is not aware of any recent estimates of gnatcatcher populations in Baja California (USFWS 2010).

Threats and Stressors

Stressor: Habitat destruction
Exposure: Urban and agriculture development, population growth, and lack of protection in Mexico.
Response: Removal or degradation of habitat, and fragmentation.
Consequence: See narrative.
Narrative: Habitat and range of the gnatcatcher has been significantly reduced, and coastal sage scrub is "one of the most depleted habitat types in the United States." 58 to 61 percent of coastal sage scrub habitat had been lost in the three counties that supported about 99 percent of the U.S. gnatcatcher population (USFWS 2010). Development for urban use involves clearing of existing vegetation. Larger urban developments also often involve earth-moving activities that result in topographical recontouring. Urban development not only results in permanent buildings, roads, and other infrastructure, but also includes "temporary" impacts, such as pipeline installation or heavy equipment activity proximal to permanent urban development. Without active management in the form of habitat restoration, sites formerly supporting coastal sage scrub vegetation have undergone severe disturbance. Urban and agricultural development in areas of coastal scrub within the range of the gnatcatcher results in destruction, modification, and curtailment of its habitat (USFWS 2010). In Mexico, urban and agricultural development continues as a threat to gnatcatcher habitat in certain areas. For example, much of the coastline north of Ensenada has been developed, and agricultural and tourism development along the San Quintin coastal plain has affected a large portion of the coastal scrub habitat. A vegetation and land-use map of northwestern Baja California indicates much of the area of gnatcatcher habitat ("coastal sage scrub" and "maritime succulent scrub") has been converted to urban and agricultural areas, especially around the greater Tijuana area and the immediate coast. Land use is not as heavily regulated in Mexico as it is in the United States. Privately owned land in northwestern Baja California is often managed in ways that are not consistent with preservation of natural resources (USFWS 2010). In addition, the alteration of habitat causes fragmentation "when a large expanse of habitat is transformed into a number of smaller patches of smaller total area, isolated from each other by a matrix of habitats unlike the original." Moreover, isolated habitat patches are subject to "secondary fragmentation," resulting from altered disturbance regimes that allow increased incursion of invasive nonnative plant species, ultimately resulting in habitat loss through type conversion.

Stressor: Wildland fire
Exposure: Fire in coastal scrub.
Response: Temporal removal of habitat, conversion of habitat to grassland, and reduction in habitat.
Consequence: Reduction in habitat, or reduction of gnatcatchers in habitat due to frequency of fire; and mortality or injury.
Narrative: Fire in coastal scrub, regardless of ignition source, burns all or most of the aboveground portions of the plants, thereby reducing the habitat value of the area to the gnatcatcher. In broad terms, coastal scrub (i.e., gnatcatcher habitat) recovers from fire and, over time, returns as suitable habitat for the gnatcatcher. However, frequent fire can exacerbate habitat type conversion, generally consisting of the conversion of coastal scrub to grassland dominated by nonnative grasses and forbs. Areas denuded by fire do not support gnatcatchers. Wildland fire can result in the direct death or injury of individual gnatcatchers (USFWS 2010).The threat of wildland fire depends on how much gnatcatcher habitat has burned. Data indicate that more than one-third of the habitat within the U.S. portion of the range of the gnatcatcher has

burned since 2003, and the overall fire frequency has been increasing over time. Therefore, the magnitude of the threat from wildland fire is high, and we anticipate it to stay high for the foreseeable future. Moreover, high fire frequencies contribute to habitat type conversion (USFWS 2010).

Stressor: Grazing
Exposure: Animals such as cattle, sheep, and goats.
Response: Trampling and eating coastal scrub, and invasion by nonnative plants.
Consequence: Alteration of habitat and reduction in gnatcatcher numbers.
Narrative: Grazing animals such as cattle, sheep, and goats eat and trample coastal scrub plants, destroying and modifying gnatcatcher habitat. Areas of native sage scrub vegetation that have been disturbed by livestock appear to be more susceptible to invasion by nonnative plants, and thus habitat type conversion. In the United States, the amount of grazing in coastal sage scrub since listing has declined as urbanization has spread. Therefore, the magnitude of grazing as a threat in the United States is small (USFWS 2010).In Mexico, where seasonal movement of livestock still occurs, there are no restrictions on grazing activities. The magnitude of this threat in Mexico is not clear, but because livestock are seasonally moved, it does not severely impact gnatcatcher habitat. In sum, grazing and associated trampling by livestock continues, but since listing, the magnitude of this threat has decreased to minimal levels in the United States. The magnitude of this threat in Mexico, though larger than in the United States, is likely low. However, grazing is thought to contribute to habitat type conversion (USFWS 2010).

Stressor: Habitat type conversion
Exposure: Stressors such as pollutants and invasive species.
Response: Conversion or degradation of habitat.
Consequence: See narrative.
Narrative: Stressors can contribute to the degradation of coastal scrub even without obvious external perturbations. Anthropogenic atmospheric pollutants can directly harm coastal scrub plants or place them at a competitive disadvantage compared to nonnative plants. For example, the input of nitrogen-based compounds (nitrification) increases the mortality rate of coastal scrub plants and causes shifts in mycorrhizal communities that favor nonnative plant species (USFWS 2010).Invasive, nonnative plants—especially annual grasses—have far-reaching impacts on native species. Within the range of the gnatcatcher, the introduction of many nonnative plant species is linked to historical grazing activities. Now, nonnative plant species are widely established in coastal scrub in southern California and northwestern Baja California. However, the presence of invasive, nonnative plant species does not necessarily, by itself, cause coastal scrub to type covert. Often, other stressors give the invading species a competitive advantage over the established natives. For example, severe physical disturbance (e.g., clearing by heavy machinery) has allowed areas formerly covered with coastal scrub species to become dominated by nonnative species (USFWS 2010).

Stressor: Predators and brood parasitism
Exposure: Predators and brown-headed cowbirds, proximity to agriculture and livestock.
Response: Failure of young to fledge, nest abandonment, brood parasitism and renesting.
Consequence: Reduced fitness; mortality; reduced population.
Narrative: Nest predation occurs when eggs or nestlings are consumed or otherwise killed (e.g., knocked from the nest) by a predator or potential predator. A number of species of reptiles, birds, and mammals are considered potential gnatcatcher nest predators. In particular, snakes

and western scrub-jays (Aphelocoma californica) have been singled out as known or likely nest predators of gnatcatchers and other shrub-nesting birds in coastal sage scrub vegetation communities. Additionally, Argentine ants (Linepithema humilis) are known to have infested gnatcatcher nests, resulting in death of nestlings (USFWS 2010).Brown-headed cowbirds (Molothrus ater) are obligate brood parasites; that is, they do not raise their own young and instead lay their eggs in the nests of other birds to be raised by them, the hosts. Brown-headed cowbirds are host generalists, laying their eggs in the nests of a wide range of host species. Brood parasitism of gnatcatchers by cowbirds has been recognized for many years. Parasitized gnatcatcher nests typically do not fledge gnatcatcher young, and only rarely fledge cowbird young. Moreover, parasitized nests are abandoned significantly more often than nonparasitized nests. However, a successful parasitism event is prolonged and may occupy hosts for much of the breeding season, as opposed to nest predation events or other nest failures that are sudden and often allow time for the hosts to renest. Given that cowbirds are not native to the region and likely spread due to anthropogenic changes, any rate of parasitism exceeds natural (historical) rate (USFWS 2010).The nest predation rate for gnatcatchers appears higher than expected for most open-nesting passerines; therefore, this threat has a high immediacy. However, the gnatcatcher is known for its ability to repeatedly renest, suggesting the species' life-history trait may have evolved to counteract higher nest predation rates. Therefore, the evidence suggests the magnitude of nest predation as a threat to the gnatcatcher is low (USFWS 2010).

Stressor: Climate change
Exposure: See narrative.
Response: See narrative.
Consequence: Unknown
Narrative: Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate warmer air temperatures, more intense precipitation events, and increased summer continental drying. Changes in rainfall quantity, timing, and frequency may affect coastal scrub vegetation. Assessments for California include predicted increases in the size and frequency of wildland fires, and possibly severity. This may include promoting habitat type conversion. Nonetheless, predictions of climatic conditions and other physical forces are uncertain. Although USFWS recognizes that climate change is an important issue with potential effects to listed species and their habitats, they lack adequate information to make accurate predictions regarding its effects to the gnatcatcher at this time. Therefore, the magnitude of this threat is unknown at this time (USFWS 2010).

Stressor: Inadequacy of regulatory mechanism
Exposure: Little protection under state, Mexican, and some federal laws.
Response: See narrative.
Consequence: See narrative.
Narrative: The coastal California gnatcatcher is not protected under any state legislation or under the California Endangered Species Act (CESA). The California Environmental Quality Act (CEQA) requires state and local government agencies to consider and disclose environmental impacts of projects, and to avoid or mitigate them where possible. Under CEQA, public agencies must prepare environmental documents to disclose environmental impacts of a project, and to identify conservation measures and project alternatives. However, CEQA itself does not guarantee that conservation measures will be implemented; the lead agency may either require mitigation through changes to a project, or determine that overriding considerations make mitigation infeasible. Therefore, protection of specific species depends on the determination of the lead

agency involved. Prior to listing of the gnatcatcher under the Endangered Species Act, USFWS reported that CEQA did not adequately address potential impacts to the coastal California gnatcatcher and its habitat, if such impacts were considered at all. Therefore, CEQA is not an adequate regulatory mechanism to conserve the species (USFWS 2010).Sikes Act: The Sikes Act is an Improvement Act to authorize the Secretary of Defense to implement a program to provide for the conservation and rehabilitation of natural resources on military installations. To do so, the Department of Defense was required to work with federal and state fish and wildlife agencies to prepare an Integrated Natural Resource Management Plan (INRMP) for each facility with significant natural resources. The INRMPs provide a planning tool for future improvements, provide for sustainable multipurpose use of the resources (including activities such as hunting, fishing, trapping, and nonconsumptive uses), and allow some public access to military installations to facilitate their use. The implementation of these plans is subject to funding availability. On Department of Defense lands, including Camp Pendleton, Detachment Fallbrook, and Miramar, gnatcatcher habitat is generally not subjected to threats associated with large-scale development. However, the primary purpose for military 2010 Coastal California Gnatcatcher 5-year Review lands, including most gnatcatcher habitat areas, is to provide for military support and training. At these installations, INRMPs provide direction for project development and for the management, conservation, and rehabilitation of natural resources, including gnatcatchers and gnatcatcher habitat. Despite these benefits, in total, the Sikes Act, as amended, is an inadequate regulatory mechanism to conserve the gnatcatcher (USFWS 2010).Mexico Laws: Mexico's federal government listed the P. c. atwoodi subspecies of the California gnatcatcher in the Official Mexican Norm NOM–059–ECOL–2001, Mexico's threatened species law. The coastal California gnatcatcher, as listed under the Endangered Species Act in the United States, includes the P. c atwoodi subspecies. The Mexican law may be implemented to modify development projects or support creation of Natural Protected Areas, but successful implementation often falls upon individuals or groups outside of the Mexican government. Although this law may contribute to the conservation of the gnatcatcher in northwestern Baja California, it is an inadequate regulatory mechanism to recover the gnatcatcher in Mexico (USFWS 2010).State, U.S. federal, and Mexican federal laws make contributions toward the conservation of the gnatcatcher, but are inadequate regulatory mechanisms by themselves (USFWS 2010).

Stressor: Cumulative effects (USFWS, 2016).
Exposure:
Response:
Consequence:
Narrative: Threats can work in concert with one another to cumulatively create conditions that may impact the coastal California gnatcatcher or its habitat beyond the scope of each individual threat. The best available data indicate that cumulative impacts are currently occurring from the combined effects of a number of stressors, including vegetation type conversion, wildland fire, and the effects of climate change. The climate change-wildland fire connection will likely result in a reduction in the amount of suitable habitat for the coastal California gnatcatcher and will likely lead to a greater chance of vegetation type conversion that degrades and eventually eliminates coastal California gnatcatcher habitat. Moreover, these stressors, working singly or in combination, are operating at a landscape scale. These stressors may affect large areas and may not be addressed by current management plans. Thus, in the absence of management to counteract the identified effects, these stressors are contributing to the habitat-degradation and type-conversion continuum that is occurring throughout the range of the subspecies. Therefore,

as summarized above and as described in our 2010 5- year review, the best available data indicate that the cumulative effects of vegetation type conversion, wildland fire, and climate change will continue to act as a high-level stressor on the coastal California gnatcatcher and its habitat now and into the future. (USFWS, 2016).

Recovery

Reclassification Criteria:
Reclassification or uplisting criteria have not been identified for this species. A recovery plan has not been prepared for this species (USFWS 2010).

Delisting Criteria:
Neither a recovery plan nor a recovery outline containing delisting criteria has been prepared for this species (USFWS 2010).

Recovery Actions:
- Habitat Restoration. Wildland fires burned approximately one-third of the habitat of the gnatcatcher in southern California between 2003 and 2007. These areas are at risk of habitat type conversion. The U.S. Fish and Wildlife Service should work with partners, including those associated with the State of California's Natural Community Conservation Planning Act (NCCP) and regional Habitat Conservation Plans (HCP) plans to restore burned habitat areas most at risk from habitat type conversion (USFWS 2010).
- Validate NCCP/HCP Reserve Design. The core-and-linkage reserve design spanning multiple NCCP/HCP areas should be validated with a study that examines the amount of gene flow across gnatcatcher populations within the system of preserves (USFWS 2010).

Conservation Measures and Best Management Practices:
-

Additional Threshold Information:
-
-

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SPECIES ACCOUNT: *Polyborus plancus audubonii* (Audubon's crested caracara)

Species Taxonomic and Listing Information

Commonly-used Acronym: CRCA (USFWS 2009)

Listing Status: Threatened; July 6, 1987; Southeast Region (R4) (USFWS 2009)

Physical Description

From USFWS (1999): Audubon?s crested caracara is a large raptor with a crest, naked face, heavy bill, elongate neck, and unusually long legs. It is about 50 to 64 cm long and has a wingspan of 120 cm. The adult is dark brownish black on the crown, wings, back, and lower abdomen. The lower part of the head, throat, upper abdomen, and under tail coverts are white, sometimes tinged with yellow; the breast and upper back are whitish, heavily barred with black. The tail is white with narrow, dark crossbars and a broad, dark terminal band. Prominent white patches are visible near the tips of the wings in flight. The large, white patches in the primaries and the white tail, broadly tipped with black, are both very conspicuous in flight and can be recognized at a long distance (Bent 1961). Juveniles have a similar color pattern but are brownish and buffy with the breast and upper back streaked instead of barred. Subadults resemble adults but are more brownish in color. Adults have yellow orange facial skin and yellow legs. Facial skin of juveniles is pinkish in color, and the legs are gray (Layne 1978). Full adult plumage is obtained sometime after 2 years of age (J. Morrison, University of Florida, personal communication 1997).

Taxonomy

From USFWS (2009): While listed as Audubon’s crested caracara (Polyborus plancus audubonii), taxonomic research has revealed that the Florida population should be recognized as the northern crested caracara (Caracara cheriway) (Dove and Banks 1999; Integrated Taxonomic Information System 2008). Minor variations between populations do not warrant recognition of subspecies within C. cheriway (Dove and Banks 1999). This taxonomic change has been accepted by the scientific community.

Historical Range

From USFWS (2009): Its historic range in Florida generally consisted of St. Johns River marshes in Brevard County and the major prairie ecosystem originally present within Highland, Glades, Polk, Osceola, Okeechobee, Hardee, Desoto, Indian River, St. Lucie, and Martin Counties (Davis 1967; Morrison 2006).

Current Range

From USFWS (2009): Caracara cheriway ranges from northern Brazil, through Central America and Mexico, north to the United States (except Guadalupe Island) (Dove and Banks 1999). The overall current range of CRCA in Florida remains relatively similar to the historical range, with sightings of individuals in other neighboring counties, but the fragmentation and degradation of habitat from land use changes has resulted in patchy suitable areas where CRCA occur in a clustered distribution (Morrison 2006; Root and Barnes 2007). Core CRCA habitat (i.e., a 95 percent kernel of high density area) lies within the Kissimmee Prairie, located northwest of Lake Okeechobee, and includes less than 1000 km2 of suitable habitat (Root and Barnes 2007).

Distinct Population Segments Defined

USFWS (2009): Yes. While the CRCA was listed prior to the 1996 DPS policy, the entity listed was restricted to the Florida population.

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: From USFWS (1999): Caracaras are highly opportunistic in their feeding habits, eating carrion and capturing live prey. Their diets include insects and other invertebrates, fish, snakes, turtles, birds, and mammals (Layne 1978). Live prey also include rabbits, skunks, prairie dogs, opossums (Didelphis marsupialis), rats (Rattus spp.), mice, squirrels, frogs, lizards, young alligators (Alligator mississippiensis), crabs, crayfish, fish, young birds, cattle egrets (Bubulcus ibis), beetles, grasshoppers, maggots, and worms (Bent 1961, Layne et al. 1977). Several authors have noted that caracaras may consume unusual items, including turtle and other eggs (Terres 1980, Grossman and Hamlet 1964) as well as coconut meat (Haverschmidt 1947). Caracars are diurnal. These raptors hunt on the wing, from perches, and on the ground (FWS 1989). They will also regularly patrol sections of highway in search of carrion (Palmer 1988).

Reproduction Narrative

Egg: Incubation lasts for about 28 days (USFWS 1999).

Juvenile: Young fledge after 8 weeks (Layne 1978) (USFWS 2009).

Adult: From USFWS (2009): Clutch size averages two eggs (Dickinson and Arnold 1996; Layne 1996; Morrison 1999 [2.23 eggs]). Double-brooding has been documented, but second clutches are generally not as successful as first attempts (Morrison 1996; 1998). Annual survival estimates suggest a lifespan of 8 to 10 years (Morrison 2003), and banding records indicate wild individuals living over 20 years (Morrison 2009). The age at first breeding is approximately 3 years (Morrison 2009). CRCA most frequently nest in cabbage palms within pasture or grassland habitat, but a few nests have been observed in cypress, live oak, pine, and other trees (Bent 1938; Sprunt 1954; Service 1989; Morrison et al. 1997; Morrison 2007). From USFWS (1999): The pair bond is relatively strong, lasting until one mate dies (FWS 1989). Egg laying has been estimated to begin as early as late September based upon evidence of chicks fledging in December (Humphrey and Morrison 1997). The height of the nesting season is in January and February. Nests with eggs have also been found as late as April (Nicholson 1929). In their study, Humphrey and Morrison (1997) suggest that most reproductive activity occurs during the winter dry season, although nesting attempts may occur throughout the year. Caracaras construct new nests each nesting season, often in the same tree as the previous year. Incubation is shared by both sexes.

Spatial Arrangements of the Population

Adult: Clustered (see current range/distribution)

Site Fidelity

Adult: High (see reproduction narrative)

Habitat Narrative

Adult: From USFWS (2009): Primary CRCA habitat in Florida consists of prairies interspersed with marshes and cabbage palm hammocks (Morrison and Humphrey 2001). Current habitat use of CRCA, based on habitat evaluations conducted proximal to nest sites, includes (ranked highest to lowest proportion): improved pasture, dry prairie, freshwater marsh, mixed upland hardwoods, shrub swamp, shrub and brushland, grassland, pinelands, bare soil, urban, other agriculture, citrus, and scrub (Morrison 2006).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS 1999)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS 1999)

Dispersal/Migration Narrative

Adult: From USFWS (1999): Caracaras are resident and nonmigratory. Adult caracaras may be found in their home range year-round. Home ranges may encompass an area of up to 2,389 ha with an average of 1,552 ha.

Population Information and Trends

Population Trends:

Unknown (USFWS 2009)

Representation:

Unknown (USFWS 2009)

Population Size:

500 (USFWS 2009)

Population Narrative:

From USFWS (2009): Results from continuing research initiated in 2006 suggest all territories identified in the 1990s remain occupied, but breeding success has not been evaluated. Based on current knowledge of over 150 nest sites within a limited portion of the bird’s range in Florida, over 500 individuals inhabit Florida (Morrison 2009). Information concerning present levels of genetic diversity and variation in CRCA is not available.

Threats and Stressors

Stressor: Habitat loss, fragmentation, and degradation (USFWS (2009)
Exposure:
Response:

Consequence:
Narrative: From USFWS (2009): Conversion of improved pasture to citrus, sugarcane, or residential development would clearly be unsuitable (Humphrey and Morrison 1997; Service 1999; Morrison 2006). Many changes in land use that occur are not associated with any regulatory review, but are detrimental to CRCA. The scope and severity of this threat are high. This threat also increases the severity of all other threats addressed subsequently. Analyses by Zwick and Carr (2006) indicate that the central Florida region is expected to experience “explosive” growth, with continuous urban development from Ocala to Sebring; virtually all of the natural systems and wildlife corridors in this region will be fragmented, if not replaced, by urban development.

Stressor: Disease (USFWS 2009)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2009): The blood parasite, Haemoproteus tinnunculi, has been found in CRCA (Foster et al. 1998). The effect of this parasite on survival is not known. West Nile virus, St. Louis encephalitis, and Eastern equine encephalitis are also documented in CRCA (Dwyer 2009).

Stressor: Predation (USFWS 2009)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2009): Detailed information regarding predators of CRCA is lacking, but fish crows (Corvus ossifragus) and raccoons (Procyon lotor) are known nest predators (Layne 1996), and fire ants (Solenopsis invicta) have killed young (Dickinson 1995).

Stressor: Road mortality (USFWS 2009)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2009): Road-killed animals are an important source of carrion to CRCA (Layne 1996), but vehicle strikes are a major cause of mortality for fledglings and immature CRCA (Morrison 1996). Fifty-five percent of mortalities of radio-tagged CRCA in 1994 to 1995 were from collisions with vehicles (Morrison 1996).

Recovery

Delisting Criteria:
1. Further loss, fragmentation, and degradation of habitat in south-central Florida has been prevented (USFWS 1999)

2. The number of territories in the historic range increases from 200 to 300 (USFWS 1999)

3. This number of territories has been maintained or exceeded for at least 10 years (USFWS 1999)

4. The territories are well-distributed throughout the core counties of Glades, DeSoto, Highlands, Okeechobee, and Osceola (USFWS 1999)

5. Additional breeding pairs have established territories on unoccupied or restored habitat (USFWS 1999)

6. Those lands have been protected through land acquisition, conservation easements, or cooperative agreements (USFWS 1999)

7. The Florida population exhibits an intrinsic rate of increase (r) equal to or greater than 0.0, sustained as a 3-year running average over at least 10 years (USFWS 1999)

Conservation Measures and Best Management Practices:

- Evaluate the effects of nest tree loss, quantify the effects of habitat conversion on adult and juvenile CRCA, and determine the threshold for a detrimental response (USFWS 2009).
- Develop and improve methods to assess population trends and breeding success rates (USFWS 2009).
- Continue work on juvenile and non-breeding individuals to better assess limitations to population growth and recruitment rates of young (USFWS 2009).
- Identify short-term and long-term priorities for management and recovery; establish quantitative objectives (USFWS 2009).
- Work with landowners to gain access so that monitoring on private lands can be improved.
- More clearly describe the range of the CRCA so that management actions can be most effectively targeted and range changes can be documented if they occur.
- Continue work on the CRCA tool and conservation strategy to better evaluate and offset impacts to the species.
- Actively work with owners of large ranches to enhance and maintain habitat for CRCA.
- Develop mechanism(s) to maintain CRCA habitat on private lands in cooperation with landowners.
- Minimize road-side mortalities of CRCA by posting signs and/or lowering speed limits in areas with high frequencies of mortality.
- Determine the availability of suitable breeding habitat; test habitat suitability models currently available.
- Develop a model to identify the most suitable parcels within the CRCA's range. Pursue conservation agreements and/or acquire land that includes these areas where CRCA are particularly successful.
- Revise the current listing to reflect the taxonomic change and evaluate formally listing the Florida population as a DPS.
- Revise the 1999 recovery plan, to reflect the current status and threats to the CRCA; develop or revise recovery criteria, objectives, and tasks.

References

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SPECIES ACCOUNT: *Polysticta stelleri* (Steller's Eider)

Species Taxonomic and Listing Information

Listing Status: Threatened; 06/11/1997; Alaska Region (R7) (USFWS, 2016)

Physical Description

An eider, an arctic duck. Length:43 Weight: 842 (NatureServe, 2015). The Steller's eider is a small sea duck with circumpolar distribution and the sole member of the genus Polysticta. Males are in breeding plumage (Figure 3.4) from early winter through mid-summer. Females are dark mottled brown with a white-bordered blue wing speculum (Figure 3.4). Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage. Refinements in 2019: The Steller's eider is a small, compact sea duck, with an average body mass of 852 g (female) to 877 g (male) (Frederickson 2001, p. 2). It has a thick-based, slightly drooping bill and steep forehead and nape. While more closely related to large eiders, it resembles dabbling ducks in size, appearance and the body-tipping foraging behaviors employed on the tundra breeding grounds. Compared to the large eiders, the body mass of Steller's eiders is 60% of spectacled eider (Somateria fischeri), 53% of king eider (Somateria spectabilis, and 34% of the common eider (Somateria mollissima) (Frederickson 2001, p. 2). Steller's eider plumage is sexually dimorphic. Males are in breeding (alternate) plumage from early winter through mid-summer. They have a large white shoulder patch contrasting with chestnut breast and belly that darkens centrally, and a black spot on each side in front of their wings. Their head is white to silver with pale green on the lores, a distinctive black spot surrounding eye, and a dark olive patch flanked by black on the nape. Their neck is black, extending in arrow shape down the back. The non-breeding (basic) male plumage resembles female but maintains white upper wing coverts. Females are dark mottled brown with a white-bordered blue wing speculum. Juveniles are dark mottled brown until fall of their second year, when they acquire breeding plumage. During flight, adult Steller's eiders are distinguished from other eiders by their faster wing beat, small size, black back, white belly, and white-bordered blue speculum. (USFWS, 2019b).

Taxonomy

Steller's eiders are the sole member of the genus Polysticta. Based on a recent mitochondrial DNA genomic analysis, the Steller's eider is most closely related to the extinct Labrador duck (Camptorhynchus labradorius) within the sea duck tribe Mergini and is basal to the three other extant eider species in the genus Somateria (Buckner et al. 2018, p. 105). (USFWS, 2019b).

Current Range

Steller's eiders are divided into Atlantic and Pacific populations; the Pacific population is further subdivided into the Russia-breeding and Alaska-breeding populations. The Alaska-breeding population of Steller's eiders was listed as threatened on July 11, 1997 based on: • Substantial contraction of the species' breeding range on the ACP and Y-K Delta; o Steller's eiders on the North Slope historically occurred east to the Canada border (Brooks 1915), but have not been observed on the eastern North Slope in recent decades (USFWS 2002). • Reduced numbers breeding in Alaska; and • Resulting vulnerability of the remaining Alaska-breeding population to extirpation (USFWS 1997). In Alaska, Steller's eiders breed almost exclusively on the ACP and winter, along with the majority of the Russia-breeding population, in southwest Alaska (Figure 3.5). Periodic non-breeding of Steller's eiders, coupled with low nesting and fledging success, has resulted in very low productivity (Quakenbush et al. 2004). In 2001, the Service designated 2,830 mi2 (7,330 km2) of critical habitat for the Alaska-breeding population of Steller's eiders, including historical breeding areas on the Y-K Delta, molting and staging areas in the Kuskokwim Shoals and Seal Islands, molting wintering, and staging areas at Nelson Lagoon, and Izembek Lagoon (USFWS 2001). No critical habitat for Steller's eiders has been designated on the ACP.

Distinct Population Segments Defined

Alaska breeding population (USFWS, 2019a)

Critical Habitat Designated

Yes; 2/2/2001.

Legal Description

On February 2, 2001, the U.S. Fish and Wildlife Service (Service) designated critical habitat for the Alaska-breeding population of the Steller's eider (Polysticta stelleri), a threatened species listed pursuant to the Endangered Species Act of 1973, as amended (66 FR 8850 - 8884). These areas total approximately 7,333 square kilometers (approximately 2,830 square miles (mi2); 733,300 hectares; 1,811,984 acres) and 1,363 km (852 miles (mi)) of shoreline. Section 7 of the Act prohibits destruction or adverse modification of critical habitat by any activity funded, authorized, or carried out by any Federal agency.

Critical Habitat Designation

Critical habitat for the Alaska-breeding population of the Steller's eider includes breeding habitat on the Yukon-Kuskokwim Delta (Y–K Delta) and 4 units in the marine waters of southwest Alaska, including the Kuskokwim Shoals in northern Kuskokwim Bay, and Seal Islands, Nelson Lagoon, and Izembek Lagoon on the north side of the Alaska Peninsula.

Unit 1: Yukon-Kuskokwim Delta. The Yukon-Kuskokwim Delta critical habitat unit includes the vegetated intertidal zone of the central delta from the Askinuk Mountains to northern Nelson Island. This unit is comprised of 15 entire townships and 564 sections within 27 additional townships and encompasses 2,561 km2 (256,100 ha) (980 mi2). This unit is one of only two known breeding sites for the Alaskabreeding populations. The boundaries have been modified from those proposed to eliminate upland habitat not likely to be used by Steller's eiders, resulting in an 18 percent reduction in area for this unit. Primary constituent elements of Steller's eider critical habitat in this unit include all land within the vegetated intertidal zone, along with all open-water inclusions within that zone. The vegetated intertidal zone includes all lands inundated by tidally influenced water often enough to affect plant growth, habit, or community composition. Waters within this zone are usually brackish. Vegetative communities within this zone include, but are not limited to, low wet sedge tundra, grass marsh, dwarf shrub/graminoid (consisting of grasses and sedges) meadow, high and intermediate graminoid meadow, mixed high graminoid meadow/dwarf shrub uplands, and areas adjacent to open water, low wet sedge and grass marsh habitats. Within the indicated border, existing human development and areas not within the vegetated intertidal zone (e.g., barren mudflats and lands above the highest high tide line) are not considered critical habitat. Approximately 75 percent of the Yukon-Kuskokwim Delta Nesting Unit is located within the Yukon Delta National Wildlife Refuge, although a portion (up to 10 percent) is subject to selection by Native Village or Regional Corporations, under the terms of the Alaska Native Claims Settlement Act of 1971. The remainder of the proposed unit (approximately 25 percent) has been conveyed to Native Village or Regional Corporations.

Unit 2: Kuskokwim Shoals. The Kuskokwim Shoals critical habitat unit is a subset of the proposed Kuskokwim Bay critical habitat unit. The final designated unit differs from the proposed unit in two ways: (1) the southern portion (one of two discontinuous portions of the proposed unit) has been eliminated; and (2) the boundaries of the northern portion of Kuskokwim Bay have been modified to reflect comments we received on the proposal and further analysis of eider distributional data (see Summary of Changes from Proposed Rule section, below). The Kuskokwim Shoals critical habitat unit includes a portion of northern Kuskokwim Bay from the mouth of the Kolavinarak River to near the village of Kwigillingok, extending 17–38 km (approximately 11–24 mi) offshore. This unit encompasses approximately 3,813 km2 (1,472 mi2) of marine waters and about 184 km (115 mi) of shoreline (including the shoreline of barrier islands). This area is used by more than 5,000 Steller's eiders during molt, including individuals known to be from the listed, Alaska-breeding population, and is thought to be extremely important during spring staging, when tens of thousands of Steller's eiders congregate there prior to moving northward as the sea ice breaks up and recedes. The primary constituent elements for the Kuskokwim Shoals Unit are marine waters up to 9 m (30 ft) deep and the underlying substrate, the associated invertebrate fauna in the water column, and the underlying marine benthic community.

Unit 3: Seal Islands. The Seal Islands lagoon was originally proposed as a subunit of the North Side of the Alaska Peninsula unit but is now identified separately. It includes all waters enclosed within the Seal Islands lagoon and marine waters 400 m (1/4 mile) offshore of the islands and adjacent mainland between 159° 12' W and 159° 36' W. It encompasses 63 km2 (24 mi2) and 104 km (65 mi) of shoreline. Thousands of Steller's eiders molt in the Seal Islands, including at least one individual known to be from the listed, Alaska-breeding population, and significant numbers congregate there again in spring prior to migration. The primary constituent elements in the Seal Islands include waters up to 9 m (30 ft) deep, the associated invertebrate fauna in the water column, the underlying marine benthic community, and where present, eelgrass beds and associated flora and fauna.

Unit 4: Nelson Lagoon. The Nelson Lagoon critical habitat unit includes all of Nelson Lagoon (and a 400 m (1/4 mile) buffer offshore of the Kudobin Islands and the mainland west to 161° 24' W) and portions of Port Moller and Herendeen Bay. This complex was originally proposed as a subunit of the North Side of the Alaska Peninsula unit but is now identified separately. The boundary has been changed where it crosses Port Moller and Herendeen Bay to reflect further data analysis and comments on the proposed units (see Rationale for the Final Designation section, below). This unit encompasses 533 km2 (205 mi2) and 238 km (149 mi) of shoreline. This lagoon system is used by tens of thousands of Steller's eiders during molt, including individuals known to be from the listed, Alaska-breeding population. Tens of thousands also winter in this area during many winters, and numbers build again during spring, as up to 36,000 stage in the area prior to or early in spring migration. The primary constituent elements in Nelson Lagoon include waters up to 9 m (30 ft) deep, the associated invertebrate fauna in the water column, the underlying marine benthic community, and where present, eelgrass beds and associated flora and fauna.

Unit 5: Izembek Lagoon. Izembek Lagoon was originally proposed as a subunit of the North Side of the Alaska Peninsula unit but is now identified separately. It includes all waters of Izembek Lagoon, Moffett Lagoon, Applegate Cove, and Norma Bay, and waters 400 m (1/4 mile) offshore of the Kudiakof Islands and adjacent mainland between 162° 30' W and 163° 15' W. It encompasses 363 km2 (140 mi2) of marine waters and 297 km (186 mi) of shoreline. Like the Nelson Lagoon complex, this lagoon system is extremely important to Steller's eiders, being occupied during molt, winter, and spring staging by tens of thousands of individuals, including some known to be from the listed, Alaska-breeding population. The primary constituent elements in Izembek Lagoon include waters up to 9 m (30 ft) deep, the associated invertebrate fauna in the water column, the underlying marine benthic community, and where present, eelgrass beds and associated flora and fauna.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for the Yukon—Kuskokwim Delta (Unit 1), Kuskokwim Shoals (Unit 2), Seal Islands (Unit 3), Nelson Lagoon (Unit 4), and Izembek Lagoon (Unit 5). Within these areas, the primary constituent elements are those habitat components that are essential for the primary biological needs of feeding, roosting, molting, and wintering.

The primary constituent elements for Unit 1 include the vegetated intertidal zone and all open water inclusions within this zone.

The primary constituent elements for Units 2, 3, 4, and 5 are marine waters up to 9 m (30 feet) deep and the underlying substrate, the associated invertebrate fauna in the water column, the underlying marine benthic community, and where present, eelgrass beds and associated flora and fauna.

Special Management Considerations or Protections

Critical habitat does not include those areas within the boundary of any unit that do not fit the description of primary constituent elements for that unit. Critical habitat does not include existing human structures, such as buildings, roads, pipelines, utility corridors, airports, other paved areas, docks, wharves, buoys, or other developed areas.

Within the geographic area occupied by the species, only areas currently known to be essential and that may require special management considerations or protection are designated. Essential areas should already have the features and habitat characteristics that are necessary to sustain the species. It should be noted; however, that not all areas within the occupied geographic range of the species that contain the features and habitats that supports the species are essential and they may or may not require special management or protection.

Life History

Feeding Narrative

Adult: Hens with ducklings feed on aquatic insect larvae and freshwater crustaceans.

Reproduction Narrative

Adult: Steller's eiders arrive in small flocks of breeding pairs on the ACP in early June. Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK (Figure 3.6) and occurs at lower densities elsewhere on the ACP from Wainwright east to the Sagavanirktok River (Quakenbush et al. 2002). Long-term studies of Steller's eider breeding ecology near Barrow indicate periodic non-breeding by the entire local population. From 1991-2010, Steller's eiders nests were detected in 12 of 20 years (Safine 2011). Periodic non-breeding by Steller's eiders near Barrow seems to correspond to fluctuations in lemming populations and risk of nest predation (Quakenbush et al. 2004). During years of peak abundance, lemmings are a primary food source for predators including jaegers, owls, and foxes (Pitelka et al. 1955a, Pitelka et al. 1955b, MacLean et al. 1974, Larter 1998, Quakenbush et al. 2004). It is hypothesized that Steller's eiders and other ground-nesting birds increase reproductive effort during lemming peaks because predators preferentially select (prey-switch) for hyper-abundant lemmings and nests are less likely to be depredated (Roselaar 1979, Summers 1986, Dhondt 1987, and Quakenbush et al. 2004). Furthermore, during high lemming abundance, Steller's eider nest survival (the probability of at least one duckling hatching) has been reported as a function of distance from nests of jaegers and snowy owls (Quakenbush et al. 2004). These avian predators aggressively defend their nests against other predators and this defense likely indirectly imparts protection to Steller's eiders nesting nearby. Steller's eiders initiate nesting in the first half of June and nests are commonly located on the rims of polygons and troughs (Quakenbush et al. 2000, 2004). Mean clutch size at Barrow was 5.4 ± 1.6 SD (range = 1–8) over 5 nesting years between 1992 and 1999 (Quakenbush et al. 2004). Breeding males depart following onset of incubation by the female. Nest survival is affected by predation levels, and averaged 0.23 (±0.09, standard error [SE]) from 1991–2004 before fox control was implemented near Barrow and 0.47 (±0.08 SE) from 2005–2012 during years with fox control (USFWS, unpublished data). Steller's eider nest failure has been attributed to depredation by jaegers (Stercorarius spp.), common ravens (Corvus corax), arctic fox (Alopex lagopus), glaucous gulls (Larus hyperboreus), and in at least one instance, polar bears (Quakenbush et al. 1995, Rojek 2008, Safine 2011, Safine 2012). Hatching occurs from mid-July through early August, after which hens move their broods to adjacent ponds with emergent vegetation dominated by Carex spp. and Arctophila fulva (Quakenbush et al. 2000, Rojek 2006, 2007, and 2008). In these brood-rearing ponds, hens with ducklings feed on aquatic insect larvae and freshwater crustaceans. In general, broods remain within 0.7 km of their nests (Quakenbush et al. 2004); although, movements of up to 3.5 km from nests have been documented (Rojek 2006 and 2007). Large distance movements from hatch sites may be a response to drying of wetlands that would normally have been used for brood-rearing (Rojek 2006). Fledging occurs 32–37 days post hatch (Obritschkewitsch et al. 2001, Quakenbush et al. 2004, Rojek 2006 and 2007). Information on breeding site fidelity of Steller's eiders is limited. However, ongoing research at Barrow has documented some cases of site fidelity in nesting Steller's eiders. Since the mid-1990s, eight banded birds that nested near Barrow were recaptured in subsequent years again nesting near Barrow. Time between capture events ranged from 1 to 12 years and distance between nests ranged from 0.1 to 6.3 km (USFWS, unpublished data).

Habitat Narrative

Adult: NONBREEDING: shallow marine waters around bays, reefs, lagoons, and inlets (Palmer 1976, Flint et al. 1984, Armstrong 1990) or far offshore (Alison 1994). Often rests on beaches and sandbars, and on somewhat flat, seaweed-covered rocks exposed by low tide (Soothill and Whitehead 1978). BREEDING: Nests on grassy edges of tundra lakes and ponds, or within drained lake basins; occasionally on barren rocky tundra; on dry mossy site or in depression between grassy hummocks (Soothill and Whitehead 1978). Preferred habitat on Lena Delta, Russia, and in Barrow, Alaska, region is moss-lichen polygonal tundra (Pihl 1999, Quakenbush et al. 1995). Usually nests some distance inland, away from salt water (Soothill and Whitehead 1978) (NatureServe, 2015). Nesting on the ACP is concentrated in tundra wetlands near Barrow, AK (Figure 3.6) and occurs at lower densities elsewhere on the ACP from Wainwright east to the Sagavanirktok River (Quakenbush et al. 2002). Females with fledged broods depart the breeding grounds in late August and mid-September to rest and forage in freshwater and marine habitat near the Barrow spit prior to fall migration along the Chukchi coast. New in 2019: During molt they primarily occupy shallow marine areas with extensive eelgrass beds and/or intertidal mud and sand flats. (USFWS, 2019b).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory

Dispersal/Migration Narrative

Adult: Localized movements – Timing of departure from the breeding grounds near Barrow differs between sexes and between breeding and non-breeding years. In breeding years, male Steller's eiders typically leave the breeding grounds in late June to early July after females begin incubating (Obritschkewitsch et al. 2001, Quakenbush et al. 1995, Rojek 2006 and 2007). Females with fledged broods depart the breeding grounds in late August and mid-September to rest and forage in freshwater and marine habitat near the Barrow spit prior to fall migration along the Chukchi coast. Females with broods are often observed near the channel that connects North Salt Lagoon and Elson Lagoon (J. Bacon, NSBDWM, pers. comm.). In 2008, 10–30 Steller's eider adult females and juveniles were observed staging daily in Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the Chukchi Sea from late August to mid-September (USFWS, unpublished data). Before fall migration in breeding and non-breeding years, some Steller's eiders rest and forage in in coastal waters near Barrow including Elson Lagoon, North Salt Lagoon, Imikpuk Lake, and the vicinity of Pigniq (Duck Camp; Figure 3.7). In breeding years, these flocks are primarily composed of males that remain in the area until the second week of July, while in non-breeding years, flocks are composed of both sexes and depart earlier than in nesting years (J. Bacon, North Slope Borough Department of Wildlife Management [NSBDWM], pers. comm.). Safine (2012) investigated post-hatch movements of 10 Steller's eider hens with VHF transmitters in 2011. Most (8 of 10) females successfully reared broods to fledging. From late August through early September, females and fledged juveniles were observed in nearshore waters of the Chukchi and Beaufort seas from Point Barrow south along the coast approximately 18 km. During this period, marked Steller's eiders and broods frequented areas traditionally used for subsistence waterfowl hunting (e.g., Duck Camp; Figure 3.7). Wing molt – Following departure from the breeding grounds, Steller's eiders migrate to southwest Alaska where they undergo complete flightless molt for about 3 weeks. Preferred molting areas are shallow with extensive eelgrass (Zostera marina) beds and intertidal mud and sand flats where Steller's eiders forage on bivalve mollusks and amphipods (Petersen 1980, 1981; Metzner 1993). The Russia- and Alaska-breeding populations both molt in southwest Alaska, and banding studies found at least some individuals had a high degree of molting site fidelity in subsequent years (Flint et al. 2000). Primary molting areas include the north side of the Alaska Peninsula (Izembek Lagoon, Nelson Lagoon, Port Heiden, and Seal Islands; Gill et al. 1981, Petersen 1981, Metzner 1993) as well as the Kuskoskwim Shoals in northern Kuskokwim Bay (Martin et al. submitted). Larned (2005) also reported > 2,000 eiders molting in lower Cook Inlet near the Douglas River Delta, and smaller numbers of molting Steller's have been reported around islands in the Bering Sea, along the coast of Bristol Bay, and in smaller lagoons along the Alaska Peninsula (e.g., Dick and Dick

1971, Petersen and Sigman 1977, Wilk et al. 1986, Dau 1987, Petersen et al. 1991). Winter distribution – After molt, many Pacific-wintering Steller's eiders disperse throughout the Aleutian Islands, Alaskan Peninsula, and western Gulf of Alaska including Kodiak Island and lower Cook Inlet (Figure 3.8; Larned 2000a, Martin et al. submitted), although thousands may remain in molting lagoons unless freezing conditions force departure (USFWS 2002). The Service estimates the Alaska-breeding population comprises only ~ 1% of the Pacific-wintering population of Steller's eiders. Wintering Steller's eiders usually occur in shallow waters (< 10 m deep), within 400 m of shore or in shallow waters further offshore (USFWS 2002). However, Martin et al. (submitted) reported substantial use of habitats > 10 m deep during mid-winter, although this use may reflect nocturnal rest periods or shifts in availability of food resources (Martin et al. submitted). Spring migration – During spring migration, thousands of Steller's eiders stage in estuaries along the north coast of the Alaska Peninsula and, in particular, at Kuskokwim Shoals in late May (Figure 3.8; Larned 2007, Martin et al. submitted). Larned (1998) concluded that Steller's eiders show strong site fidelity to specific areas during migration, where they congregate in large numbers to feed before continuing northward. Spring migration usually includes movements along the coast, although some Steller's eiders may make straight line crossings of water bodies such as Bristol Bay (W. Larned, USFWS, pers. comm. 2000). Despite numerous aerial surveys, Steller's eiders have not been observed during migratory flights (W. Larned, USFWS, pers. comm. 2000). Steller's eiders likely use spring leads for feeding and resting as they move northward, although there is little information on distribution or habitat use after departure from spring staging areas. Migration patterns relative to breeding origin – Information is limited on migratory movements of Steller's eiders in relation to breeding origin, and it remains unclear where the Russia- and Alaska-breeding populations converge and diverge during their molt and spring migrations. Martin et al. (unpublished data) attached satellite transmitters to 14 Steller's eiders near Barrow in 2000 and 2001. Despite the limited sample, there was disproportionately high use of Kuskokwim Shoals by Alaska-breeding Steller's eiders during wing molt compared to the Pacific population as a whole. However, Martin et al. (submitted) did not find Alaska-breeding Steller's eiders to preferentially use specific wintering areas. A later study marked Steller's eiders wintering near Kodiak Island, Alaska and followed birds through the subsequent spring (n = 24) and fall molt (n = 16) migrations from 2004–2006 (Rosenberg et al. 2011). Most birds marked near Kodiak Island migrated to eastern arctic Russia prior to the nesting period and none were relocated on land or in nearshore waters north of the Yukon River Delta in Alaska (Rosenberg et al. 2011). Alaska-breeding population abundance and trends – Stehn and Platte (2009) evaluated Steller's eider population and trends from three aerial surveys on the ACP: • USFWS ACP survey ? 1989–2006 (Mallek et al. 2007) ? 2007–2008 (new ACP survey design; Larned et al. 2008, 2009) • USFWS North Slope eider (NSE) survey ? 1992–2006 (Larned et al. 2009) ? 2007–2008 (NSE strata of new ACP survey; Larned et al. 2008, 2009) ? Barrow triangle (ABR) survey, 1999–2014 (ABR, Inc.; Obritschkewitsch and Ritchie 2015) In 2007, the ACP and NSE surveys were combined under a single ACP survey design. Previously, surveys differed in spatial extent, timing, sampling intensity, and duration, and consequently, produced different estimates of population size and trend for Steller's eiders. These estimates, including results from previous analyses of the ACP and NSE survey data (Mallek et al. 2007, Larned et al. 2009), are summarized in Table 3.2. Most observations of Steller's eider from both surveys occurred within the boundaries of the NSE survey (Figure 3.9). Following assessment of potential biases inherent in both surveys, Stehn and Platte (2009) identified a subset of the NSE survey data (1993–2008) that were determined to be "least confounded by changes in survey timing and observers." Based on this subset, the average population index for Steller's eiders on the ACP was 173 (90% CI 88–258) with an estimated growth rate of 1.011 (90% CI 0.857–

1.193). Average population size of Steller's eiders breeding on the ACP was estimated at 576 (292–859, 90% CI; Stehn and Platte 2009) assuming a detection probability of 30% . Currently, this analysis provides the best available estimate of the Alaska-breeding Steller's eider population size and growth rate for the ACP. Note that these estimates are based on relatively few actual observations of Steller's eiders with none detected in some years. The annual "Barrow triangle" (ABR) survey provides more intensive coverage (50%, 1999–2004; 25–50%, 2005–2014) of the northern portion of the ACP. This survey has been conducted south of Barrow since 1999 over a 2,757 km2 area north of 70 degrees 50 minutes North and between the shorelines of the Chukchi Sea and Admiralty Bay (Figure 3.10) to compliment ground surveys closer to Barrow. Estimated Steller's eider density for the ABR survey area ranges from <0.01–0.03 birds/km2 in non-nesting years to 0.03–0.08 birds/km2 in nesting years. The estimated average population index for Steller's eiders within the Barrow triangle was 99.6 (90% CI 55.5–143.7; Stehn and Platte 2009) with an estimated growth rate of 0.934 (90% CI 0.686–1.272). If we assume the same 30% detection probability applied to NSE estimates, average population size of Steller's eiders breeding in the Barrow triangle area would be 332 (185–479, 90% CI).

Population Information and Trends

Resiliency:

"Overall, the available information, much of which comes from the Utqiaġvik study area, suggests that the northern subpopulation of Steller's eiders has low resiliency for the following reasons. The subpopulation has a low and variable numbers of Steller's eiders are present on the ACP annually, suggesting a small population size. Stressors affecting adult survival (shooting, ingestion of lead shot, collisions) continue to occur in the area with the highest nesting densities of Steller's eiders in Alaska. Stressors affecting breeding propensity and/or nest and brood survival (habitat loss, changes in the lemming – avian predator system, disturbance) may also affect demographic rates of the northern Alaska subpopulation. This is of particular concern if females have high breeding site fidelity, as suggested by genetic mark-recapture data (Safine et al., in prep.), and if productivity is already low on average. Our impression of the resiliency of the northern Alaska subpopulation is primarily based on measures of abundance and the existence of stressors, rather than the condition of habitat, because of the considerable uncertainty about the specific resource requirements of Steller's eiders, how stressors affect these requirements, and the resulting population-level effects on resiliency. However, given that habitat conditions, both in the tundra and marine environments, are influenced by highly variable environmental factors and ecological processes that seem to have changed in recent decades, our assessment of habitat conditions does not improve our impression of subpopulation resiliency. (USFWS, 2019b). We have very little information on the habitat requirements of Steller's eiders on the Y-K Delta. Changes to habitat caused by global climate change (see Section 7.1) and increases in goose populations (USFWS 2017e, p. 3-4) have occurred since Steller's eiders were listed, but the effect of these changes to habitat suitability for Steller's eiders is unknown. Given the small number of observations of Steller's eiders in this area, the lack of significant re-colonization since listing, and no plans for reintroduction in the foreseeable future, the population is considered functionally extirpated from that region of Alaska. Therefore, the current resiliency of the western Alaska subpopulation is very low. (USFWS, 2019b)."

Representation:

Alaska-breeding Steller’s eiders have moderate representation for the following reasons. Alaska-breeding Steller’s eiders historically occupied two ecological settings during the breeding season: Arctic tundra of the ACP and the sub-arctic, tidally-influenced coastal zone of the Y-K Delta. Currently, the breeding distribution of Steller’s eiders in Alaska is restricted to the ACP. It is possible that the western Alaska subpopulation exhibited different genetic, behavioral, and life history adaptations given their use of sub-arctic nesting area that encompasses a different ecological community than northern Alaska but differences were not documented prior to their disappearance. Within the northern subpopulation, the uneven distribution of Steller’s eiders on the ACP may indicate a preference for unidentified habitat characteristics that are specific to the Utqiaġvik Triangle, suggesting some specialization, but again, we have no data on such variation. The movement of Steller’s eiders to deeper water in response to high sea ice in shallow lagoons during the winter, and their ability to consume a variety of invertebrate prey (Section 5.1 and 5.5) allows Steller’s eiders to adapt to changing environmental conditions in marine areas. Steller’s eiders have no known morphological diversity throughout their range in Alaska. We have little data from which to infer the genetic adaptive potential in Steller’s eiders; however, analyses of nuclear microsatellite loci in DNA of Steller’s eiders captured near Utqiaġvik did not indicate signs of inbreeding or a lack of genetic diversity, and contained a similar number of alleles as other breeding populations (Pearce et al. 2005, p. 748). Also, the highly migratory nature of Steller’s eiders and the likelihood of male-mediated gene flow between the larger Russian-Pacific breeding population and the Alaska-breeding population (Pearce et al. 2005, p. 749-750) may introduce genetic diversity that allows the population to adapt to environmental changes over time. (USFWS, 2019b).

Redundancy:

Historically, the Alaska-breeding population consisted of two subpopulations: western and northern Alaska. The western Alaska subpopulation provided a level of redundancy that no longer exists within Alaska. The existence of the Russian-Pacific breeding population provides redundancy at the species-level, but does not necessarily ensure that the Alaska-breeding population will continue to persist over time, unless immigration is occurring at a level that allows persistence. The northern Alaska subpopulation has a wide distribution, but the density increases near the Utqiaġvik Triangle. The very low densities of nesting Steller’s eiders outside of the Utqiaġvik Triangle are so low as to provide little protection from catastrophic events occurring in the higher density area. Assuming that Alaska-breeding Steller’s eiders are evenly distributed among the Pacific-wintering population (which has not been tested), the population has a wide distribution throughout southwest Alaska during molt, winter and staging activities. This may provide some protection from a catastrophic event in part of the non-breeding range. Overall, the Alaska-breeding population has low redundancy. (USFWS, 2019b).

Population Size:

From data collected on the Arctic Coastal Plain (ACP) aerial survey, the estimated average number of Steller's eiders present on ACP annually from 2007 – 2017 ranged from 68 – 745 (mean = 308, 95% CI = 216 – 422). The number of Steller’s eiders estimated to be present annually in the Utqiaġvik Triangle ranged from 30 – 468 (mean = 204, 95% CI = 184 – 225). In some years, the point estimate of Steller’s eiders from the Utqiaġvik Triangle survey was higher than that of the ACP survey, despite the significantly smaller area surveyed in the Utqiaġvik Triangle (e.g., 2008, 2014). This suggests that the ACP survey may not be appropriate for estimating abundance of Steller’s eiders. (USFWS, 2019b)

Additional Population-level Information:

"In the 1997 final rule for listing, the Alaska-breeding population was determined lo have met the standards to qualify as a DPS, as outlined in the 1996 DPS policy. The population was considered discrete because it was physically separated from Russian-breeding populations by hundreds of kilometers across the Bering and Chukchi Seas. Second, the population was delimited by international boundaries, within which differences in conservation status existed. The population was considered significant because the loss of the Alaska-breeding population would represent a significant reduction in the species' breeding range worldwide. Additionally, the final rule identified another factor pertinent to the population segment's significance. Alaska is the only portion of the species' breeding range over which the United Stales government can exercise its authority to provide for the conservation of the species during nesting. Conservation of the Alaska-breeding population was predicted to increase in importance due to a concern about a possible range-wide decline of Steller's eiders. (USFWS, 2019a)"

Population Narrative:

Breeding population near Barrow, Alaska – The tundra surrounding Barrow supports the only significant concentration of Steller's eiders nesting in North America. Barrow is the northernmost community on the ACP and standardized ground surveys for eiders have been conducted near Barrow since 1999 (Figure 3.6; Rojek 2008). Counts of males are the most reliable indicator of Steller's eider presence because females are cryptic and often go undetected in counts. The greatest concentrations of Steller's eiders observed during Barrow ground surveys occurred in 1999 and 2008 with 135 and 114 males respectively (Table 3.2; Safine 2011). Total nests found (both viable and post-failure) ranged from 0–78 between 1991 and 2011, while the number of viable nests ranged from 0–27. Steller's eider nests were found in 14 of 22 years (64%) between 1991 and 2012 (Safine 2013).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: When the Alaska-breeding population was listed as threatened, factors causing the decline were unknown, although possible causes identified were increased predation, overhunting, ingestion of spent lead shot in wetlands, and habitat loss from development. Since listing, other potential threats have been identified, including exposure to other contaminants, disturbance caused during scientific research, and climate change, but causes of decline and obstacles to recovery remain poorly understood.

Stressor: Lead shot (USFWS, 2019b)
Exposure:
Response: Reduces female survival and mortality (USFWS, 2019b)
Consequence:
Narrative: Similarly, ingestion of lead shot causes mortality, particularly of breeding females, and there is evidence that lead shot is still available for purchase, and is used, within Steller's eider habitat. (USFWS, 2019b).

Stressor: Predation (USFWS, 2019b)

Exposure:
Response: Reduces reproductive success (USFWS, 2019b)
Consequence:
Narrative: Especially by pomarine jaegers and snowy owls. (USFW, 2019b).

Stressor: Disturbance (USFWS, 2019b)
Exposure:
Response: Reduces reproductive success (USFWS, 2019b)
Consequence:
Narrative: Human disturbance causing females to flush from the nest or be separated from a brood can lead to decreased nest survival rates (see Appendices A and B). Considering the overlap of the highest density of nesting Steller's eiders and a relatively high density of humans using the tundra for research, recreation, and subsistence harvest near Utqiaġvik, we consider the current condition of this requirement to be moderate. A significant portion of the northern Alaska subpopulation may be affected by human disturbance during the breeding season and disturbance events may occur relatively frequently near Utqiaġvik, where relatively high densities of Steller's eiders nest in some years. Effects on reproductive rates vary by individual tolerance and the number and frequency of disturbance events. (USFWS, 2019b).

Stressor: Major storms and harsh spring weather (USFWS, 2019b)
Exposure:
Response: May reduce reproductive success (USFWS, 2019b)
Consequence:
Narrative:

Stressor: Hunting (USFWS, 2019b)
Exposure:
Response: Immediate mortality (USFWS, 2019b)
Consequence:
Narrative:

Stressor: Oil and gas development, contaminants (USFWS, 2019b)
Exposure:
Response: May reduce reproductive success (USFWS, 2019b)
Consequence:
Narrative: "Contaminants such as heavy metals (e.g., Se, Hg, Cd, Cu), hydrocarbons, and persistent organic pollutants (POPs) could contaminate Steller's eider habitat or food (See Appendix D). While Steller's eiders could be exposed to local sources of trace elements during the breeding season, most exposure to trace elements probably occurs in marine areas used during the non-breeding season (Miller et al. 2016, p. 304; Lovvorn et al. 2013, p.250). Documentation on the effects of exposure to reproduction or survival of Steller's eiders is lacking; therefore, the effect of contaminants on population resiliency is unknown at this time. (USFWS, 2019b). Oil and gas development is expected to continue in Arctic Alaska. Onshore development is continuing around the existing oil field infrastructure and is spreading west into the National Petroleum Reserve- Alaska (e.g., GMT2 development, BLM 2018, p. 32). (USFWS, 2019b)"

Stressor: Collisions with fishing vessels and lighted structures (USFWS, 2019b)

Exposure:
Response: Immediate mortality (USFWS, 2019b)
Consequence:
Narrative: Collisions can also cause mortality in both tundra and marine environments. Based on limited data, collisions with large marine vessels do occasionally occur; however, given the tendency of Steller's eiders to frequent near-shore habitats, the risk is low. Alaska-breeding Steller's eiders are at risk from power line strikes near Utqiaġvik, where multiple wire strike mortalities have been documented since 1991 (See Appendix D). Similar to shooting, mortality of a few breeding adults in the population could be detrimental to the resiliency of a small population such as Alaska-breeding Steller's eiders; therefore, collisions pose a moderate effect on population resiliency. (USFWS, 2019b).

Stressor: Development of habitat (USFWS, 2019b)
Exposure:
Response: May reduce reproductive success (USFWS, 2019b)
Consequence:
Narrative:

Stressor: Changes to lemming population cycles (USFWS, 2019)
Exposure:
Response: Reduces reproductive success (USFWS, 2019b).
Consequence:
Narrative: Steller's eider breeding propensity and nest survival has been hypothesized to be influenced by lemming abundance and the presence of pomarine jaegers and snowy owls. (USFW, 2019b).

Stressor: Climate Change, changing marine conditions (USFWS, 2019b).
Exposure:
Response:
Consequence:
Narrative: "However, there is concern that changing marine conditions in the North Pacific and Bering Sea is affecting Steller's eiders through changes to the micro-habitat characteristics such as food availability. There is abundant published evidence that the Bering Sea and northern Gulf of Alaska have undergone massive regime shifts (Overland et al. 2008, p. 99), including a shift around 1989 that coincided with a low estimate of Steller's eider survival (Frost et al. 2013, p. 175). Similarly, a correlation was found between sea duck population trends and north pacific regime shifts (Flint 2012, p.3), and for populations of pelagic-foraging seabirds such as common murres (Uria aalge) and thick-billed murres (Uria lomvia; Irons et al. 2008, p. 1460). More recently, seabird die-offs in the Bering Sea and Gulf of Alaska have been attributed to the impact of changing oceanic conditions on food availability (USGS 2016). (USFWS, 2019b). Under all assessed emissions scenarios, the global mean surface temperature change is projected to increase, although the magnitude of projected climate change is substantially affected by choice of emissions scenario (IPCC 2014, p. 58 - 59). The Arctic region will continue to warm more rapidly than the global mean, and there will be more hot and fewer cold temperature extremes on daily and seasonal timescales (IPCC 2014, p. 60). Near-surface permafrost extent, and spring snow cover at northern latitudes are likely to decrease (IPCC 2014, p. 62). Global ocean temperatures will continue to warm, and year-round reductions in Arctic sea ice and global sea level rise are projected in all scenarios assessed (IPCC 2014, p. 60 - 62). Models also project a

global increase in ocean acidification for all emissions scenarios, particularly for polar marine ecosystems (IPCC 2014, p. 67). (USFWS, 2019b)."

Recovery

Reclassification Criteria:
In order to be reclassified from threatened to endangered under the current recovery plan, the population must have > 20% probability of extinction in the next 100 years for 3 consecutive years, or > 20% probability of extinction in the next 100 years and is decreasing in abundance. (USFWS, 2019a).

Recovery Actions:

- Criteria used to determine when species are recovered are often based on historical abundance and distribution, or on the population size required to ensure that extinction risk, based on population modeling, is tolerably low. For Steller's eiders, information on historical abundance is lacking, and demographic parameters needed for accurate population modeling are poorly understood. Therefore, the Recovery Plan for Steller's Eiders (USFWS 2002) establishes interim recovery criteria based on extinction risk, with the assumption that numeric population goals will be developed as demographic parameters become better understood. Under the Recovery Plan, the Alaska-breeding population would be considered for delisting from threatened status if it has less than or equal to 1% probability of extinction in the next 100 years, and each of the northern and western subpopulations are stable or increasing and have less than or equal to 10% probability of extinction in 100 years. (Corrections to previously listed < symbols were made based on USFWS, 2019a).

References

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USFWS. 2019b. Status Assessment Of The Alaska-breeding Population of Steller's Eiders. USFWS, Fairbanks Fish and Wildlife Field Office. 149 ppm.

SPECIES ACCOUNT: *Pseudonestor xanthophrys* (Maui parrotbill (Kiwikiu, honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Kiwikiu is a small (20–25 g) insectivorous Hawaiian honeycreeper with a short tail and a large, parrot-like bill (Simon et al. 1997). Adults are olive-green above with a yellow breast, belly, and cheeks, and a yellow supercilium (head stripe). Males are larger and brighter than females and have larger bills. The song is a series of “chewy, chewy, chewy,” notes descending in pitch and volume (Simon et al. 1997).

Current Range

The Kiwikiu persists in a single population occupying montane mesic and wet forest between 1,200 and 2,350 m elevation on Haleakala Volcano; they are most common from 1,700 to 2,100 m elevation.

Critical Habitat Designated

Yes; 3/30/2016.

Legal Description

On March 30, 2016, the U.S. Fish and Wildlife Service, designated or revised critical habitat for 125 listed species on the islands of Maui, Molokai, and Kahoolawe in the State of Hawaii (81 FR 17789 - 18110), including critical habitat for the Maui parrotbill (Pseudonestor xanthophrys). Critical habitat was designated for 50 plant and animal species, and critical habitat was revised for 85 plant species. In total, approximately 157,002 acres (ac) (63,537 hectares (ha)) on the islands of Molokai, Maui, and Kahoolawe fall within the boundaries of the critical habitat designation. Although critical habitat was proposed on 25,413 ac (10,284 ha) on the island of Lanai, this area is excluded from final designation under section 4(b)(2) of the Endangered Species Act. In addition, under section 4(b)(2), approximately 59,479 ac (24,070 ha) on the islands of Maui and Molokai are excluded from critical habitat designation.

Critical Habitat Designation

The following areas are designated critical habitat for this species: —Unit 1—Lowland Mesic-Maui, Maui County, Hawaii (477 ac; 193 ha); —Unit 2—Lowland Wet-Maui, Maui County, Hawaii (16,079 ac, 6,507 ha); —Unit 3—Lowland Wet-Maui, Maui County, Hawaii (65 ac, 26 ha); Unit 4—Lowland WetMaui, Maui County, Hawaii (1,247 ac, 505 ha); Unit 5—Lowland Wet-Maui, Maui County, Hawaii (864 ac, 350 ha); Unit 7— Lowland Wet-Maui, Maui County, Hawaii (136 ac, 55 ha); Unit 6—Lowland Wet-Maui, Maui County, Hawaii (30 ac, 12 ha); Unit 8—Lowland WetMaui, Maui County, Hawaii (898 ac, 364 ha); Unit 9—Lowland Wet-Maui, Maui County, Hawaii (230 ac, 93 ha); Unit 10—Montane Wet-Maui, Maui County, Hawaii (2,110 ac, 854 ha); Unit 11—Montane WetMaui, Maui County, Hawaii (14,583 ac, 5,901 ha); Unit 12—Montane Wet-Maui, Maui County, Hawaii (2,228 ac, 902 ha); Unit 13— Montane Wet-Maui, Maui County, Hawaii (1,833 ac, 742 ha); Unit 14— Montane Wet-Maui, Maui County, Hawaii (387 ac, 156 ha); Unit 15—Montane Wet-Maui, Maui County, Hawaii (1,399 ac, 566 ha); Unit 16— Montane Wet-Maui, Maui County, Hawaii (80 ac, 32 ha); Unit 18—Montane Mesic-Maui, Maui County, Hawaii (10,972 ac, 4,440 ha); Unit 19—Montane Mesic-Maui, Maui County, Hawaii (124 ac, 50 ha); —Unit 20— Montane Mesic-Maui, Maui County, Hawaii (174 ac, 70 ha); Unit 21—Montane MesicMaui, Maui County, Hawaii (72 ac, 29 ha); Unit 22—Montane Mesic-Maui, Maui County, Hawaii (170 ac, 69 ha); Unit 24—Subalpine-Maui, Maui County, Hawaii (15,975 ac, 6,465 ha); Unit 25— Subalpine-Maui, Maui County, Hawaii (9,886 ac, 4,001 ha); Unit 26—Dry Cliff-Maui, Maui County, Hawaii (755 ac, 305 ha); Unit 27—Dry Cliff-Maui, Maui County, Hawaii (200 ac, 81 ha); Unit 28—Dry Cliff-Maui, Maui County, Hawaii (315 ac, 127 ha); Unit 29—Dry Cliff-Maui, Maui County, Hawaii (1,298 ac, 525 ha); Unit 30—Wet Cliff-Maui, Maui County, Hawaii (290 ac, 117 ha); Unit 31—Wet Cliff-Maui, Maui County, Hawaii (1,407 ac, 569 ha); Unit 32—Wet Cliff-Maui, Maui County, Hawaii (438 ac, 177 ha); Unit 33—Wet Cliff-Maui, Maui County, Hawaii (184 ac, 75 ha); —Unit 35—Wet Cliff-Maui, Maui County, Hawaii (2,110 ac, 854 ha); Unit 36— Wet Cliff-Maui, Maui County, Hawaii (556 ac, 225 ha); Unit 37—Lowland Mesic-Molokai, Maui County, Hawaii (8,770 ac, 3,549 ha); Unit 38—Lowland Wet-Molokai, Maui County, Hawaii (2,949 ac, 1,193 ha); —Unit 39— Lowland Wet-Molokai, Maui County, Hawaii (1,950 ac, 790 ha); Unit 40—Montane Wet-Molokai, Maui County, Hawaii (3,397 ac, 1,375 ha); Unit 41— Montane Wet-Molokai, Maui County, Hawaii (910 ac, 368 ha); Unit 42—Montane Mesic-Molokai, Maui County, Hawaii (816 ac, 330 ha); Unit 43—Wet Cliff-Molokai, Maui County, Hawaii (1,607 ac, 651 ha); Unit 44— Wet Cliff-Molokai, Maui County, Hawaii (1,268 ac, 513 ha).

Unit 1— Lowland Mesic: This area consists of 477 ac (193 ha) of State land at Ukumehame on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland mesic ecosystem (see Table 5). Although Maui—Lowland Mesic—Unit 3 is not currently occupied by the plants Asplenium dielerectum, Bidens campylotheca ssp. pentamera, Colubrina oppositifolia, Ctenitis squamigera, Remya mauiensis, Santalum haleakalae var. lanaiense, or Zanthoxylum hawaiiense, or by the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland mesic species because it provides the PCEs for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 2 - Lowland Wet: This area consists of 6,616 ac (2,677 ha) of State land, 7,425 ac (3,005 ha) of privately owned land, and 2,038 ac (825 ha) of federally owned land (Haleakala National Park), from Haiku Uka to Kipahulu Valley on the northern and eastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plants Bidens campylotheca ssp. waihoiensis, Clermontia samuelii, Cyanea asplenifolia, C. copelandii ssp. haleakalaensis, C. duvalliorum, C. hamatiflora ssp. hamatiflora, C. kunthiana, C. maritae, C. mceldowneyi, Huperzia mannii, Melicope balloui, and M. ovalis. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 1 is not known to be occupied by the plants Clermontia oblongifolia ssp. mauiensis, C. peleana, Mucuna sloanei var. persericea, Phyllostegia haliakalae, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the

PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 3 - Lowland Wet: This area consists of 65 ac (26 ha) of State land at Moomoku, on the northwestern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plant Santalum haleakalae var. lanaiense. Although Maui—Lowland Wet—Unit 2 is not currently occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, or Wikstroemia villosa, by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), or by the Newcomb's tree snail (Newcombia cumingi), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 4— Lowland Wet: This area consists of 1,247 ac (505 ha) of State land at Honanana Gulch on the northeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). They are occupied by the plants Bidens conjuncta, Cyanea asplenifolia, and Pteris lidgatei. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 3 is not known to be occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 5— Lowland Wet: This area consists of 864 ac (350 ha) of State land at Kahakuloa Valley on the northeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). They are occupied by the plants Bidens conjuncta and Cyanea asplenifolia. These units also contain unoccupied habitat that is essential to the conservation of this these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 4 is not known to be occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 6— Lowland Wet: This area consists of 30 ac (12 ha) of State land at Iao Valley on the eastern side of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). Although Maui—Lowland Wet—Unit 5 is not known to be occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 7— Lowland Wet: This area consists of 136 ac (55 ha) of State land at Honokowai and Wahikuli valleys on the western slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plant Santalum haleakalae var. lanaiense. These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 6 is not currently occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, Bidens micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 8— Lowland Wet: This area consists of 898 ac (364 ha) of State land at Olowalu Valley, on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units are occupied by the plant Alectryon macrococcus. These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Lowland Wet—Unit 7 is not currently occupied by the plants Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 9— Lowland Wet: This area consists of 230 ac (93 ha) of State land at upper Ukumehame Gulch, on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). Although Maui—Lowland Wet—Unit 8 is not currently occupied by the plants Alectryon macrococcus, Asplenium dielerectum, Bidens conjuncta, B. micrantha ssp. kalealaha, Clermontia oblongifolia ssp. mauiensis, Ctenitis squamigera, Cyanea asplenifolia, C. glabra, C. kunthiana, C. lobata, C. magnicalyx, Cyrtandra filipes, C. munroi, Diplazium molokaiense, Hesperomannia arborescens, H. arbuscula, Huperzia mannii, Isodendrion pyrifolium, Kadua laxiflora, Peucedanum sandwicense, Phyllostegia bracteata, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 10— Montane Wet: This area consists of 1,313 ac (531 ha) of State land and 798 ac (323 ha) of privately owned land, at Haiku Uka on the northern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Cyanea duvalliorum, C. maritae, C. mceldowneyi, Huperzia mannii, Melicope balloui, and Phyllostegia pilosa, and by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—

Unit 1 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, C. samuelii, Cyanea copelandii ssp. haleakalaensis, C. glabra, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, Cyrtandra ferripilosa, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Melicope ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the mstockstill on DSK4VPTVN1PROD with RULES2 VerDate Sep<11>2014 20:48 Mar 29, 2016 Jkt 238001 PO 00000 Frm 00108 Fmt 4701 Sfmt 4700 E:\FR\FM\30MRR2.SGM 30MRR2Federal Register / Vol. 81, No. 61 / Wednesday, March 30, 2016 / Rules and Regulations 17897 reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 11— Montane Wet: This area consists of 4,075 ac (1,649 ha) of State land, 9,633 ac (3,898 ha) of privately owned land, and 875 ac (354 ha) of federally owned land (Haleakala National Park), from Haiku Uka to Puukaukanu and upper Waihoi Valley, on the northern and northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Bidens campylotheca ssp. pentamera, Clermontia samuelii, Cyanea copelandii ssp. haleakalaensis, C. duvalliorum, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, C. mceldowneyi, Geranium hanaense, G. multiflorum, and Wikstroemia villosa, and by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 2 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, Cyanea glabra, C. maritae, Cyrtandra ferripilosa, Diplazium molokaiense, Huperzia mannii, Melicope balloui, M. ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, and Schiedea jacobii, we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 12— Montane Wet: This area consists of 2,228 ac (902 ha) of federally owned land (Haleakala National Park) in Kipahulu Valley, on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, C. hamatiflora ssp. hamatiflora, C. maritae, and Melicope ovalis, and by the forest bird, kiwikiu (Pseudonestor xanthophrys). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 3 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Clermontia oblongifolia ssp. mauiensis, C. samuelii, Cyanea duvalliorum, C. glabra, C. horrida, C. kunthiana, C. mceldowneyi, Cyrtandra ferripilosa, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Huperzia mannii, Melicope balloui, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, or by the forest bird, the akohekohe (Palmeria dolei), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 13— Montane Wet: This area consists of 180 ac (73 ha) of State land and 1,653 ac (669 ha) of federally owned land (Haleakala National Park), in Kaapahu Valley on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units are occupied by the plants Clermontia samuelii, Cyanea copelandii ssp. haleakalaensis, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, C. maritae, Cyrtandra ferripilosa, and Huperzia mannii. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 4 is not known to be occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, Cyanea duvalliorum, C. glabra, C. mceldowneyi, Diplazium molokaiense, Geranium hanaense, G. multiflorum, Melicope balloui, M. ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 14— Montane Wet: This area consists of 222 ac (90 ha) of State land, and 165 ac (67 ha) of federally owned land (Haleakala National Park), near Kaumakani on the eastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units area occupied by the plant Bidens campylotheca ssp. pentamera. These units also contain unoccupied mstockstill on DSK4VPTVN1PROD with RULES2 VerDate Sep<11>2014 20:48 Mar 29, 2016 Jkt 238001 PO 00000 Frm 00109 Fmt 4701 Sfmt 4700 E:\FR\FM\30MRR2.SGM 30MRR217898 Federal Register / Vol. 81, No. 61 / Wednesday, March 30, 2016 / Rules and Regulations habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 5 is not currently occupied by the plants Adenophorus periens, Asplenium peruvianum var. insulare, Bidens campylotheca ssp. waihoiensis, Clermontia oblongifolia ssp. mauiensis, C. samuelii, Cyanea copelandii ssp. haleakalaensis, C. duvalliorum, C. glabra, C. hamatiflora ssp. hamatiflora, C. horrida, C. kunthiana, C. maritae, C. mceldowneyi, Cyrtandra ferripilosa, Diplazium molokaiense, Geranium hanaense,

G. multiflorum, Huperzia mannii, Melicope balloui, M. ovalis, Peperomia subpetiolata, Phyllostegia bracteata, P. haliakalae, P. mannii, P. pilosa, Platanthera holochila, Schiedea jacobii, or Wikstroemia villosa, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within the historical ranges of the species. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 15— Montane Wet: This area consists of 1,113 ac (451 ha) of State land, and 286 ac (116 ha) of privately owned land, at the summit and surrounding areas on west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). They are occupied by the plants Bidens conjuncta, Calamagrostis hillebrandii, Cyanea kunthiana, Geranium hillebrandii, Myrsine vaccinioides, and Sanicula purpurea. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 6 is not known to be occupied by the plants Acaena exigua, Cyrtandra oxybapha, Huperzia mannii, Phyllostegia bracteata, or Platanthera holochila, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 16— Montane Wet: This area consists of 80 ac (32 ha) of State land near Hanaula and Pohakea Gulch on the southeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). They are occupied by the plants Cyrtandra oxybapha and Platanthera holochila, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Wet—Unit 7 is not known to be occupied by the plants Acaena exigua, Bidens conjuncta, Calamagrostis hillebrandii, Cyanea kunthiana, Geranium hillebrandii, Huperzia mannii, Myrsine vaccinioides, Phyllostegia bracteata, or Sanicula purpurea, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 18— Montane Mesic: This area consists of 6,593 ac (2,668 ha) of State land, 707 ac (286 ha) of privately owned land, and 3,672 ac (1,486 ha) of federally owned land (Haleakala National Park), from Kealahou to Puualae, nearly circumscribing the summit of Haleakala on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Asplenium dielerectum, A. peruvianum var. insulare, Clermontia lindseyana, Cyanea horrida, C. obtusa, Cyrtandra ferripilosa, C. oxybapha, Diplazium molokaiense, Geranium arboreum, G. multiflorum, Huperzia mannii, Melicope adscendens, and Neraudia sericea. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 1 is not known to be occupied by the plants Alectryon macrococcus, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Cyanea glabra, C. hamatiflora ssp. hamatiflora, C. kunthiana, C. mceldowneyi, Phyllostegia bracteata, P. mannii, Santalum haleakalae var. lanaiense, Wikstroemia villosa, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 19— Montane Mesic: This area consists of 124 ac (50 ha) of State land at Helu and the upper reaches of Puehuehunui on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, mstockstill on DSK4VPTVN1PROD with RULES2 VerDate Sep<11>2014 20:48 Mar 29, 2016 Jkt 238001 PO 00000 Frm 00110 Fmt 4701 Sfmt 4700 E:\FR\FM\30MRR2.SGM 30MRR2Federal Register / Vol. 81, No. 61 / Wednesday, March 30, 2016 / Rules and Regulations 17899 Diplazium molokaiense, Lysimachia lydgatei, Remya mauiensis, and Santalum haleakalae var. lanaiense. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 2 is not known to be occupied by the plants Geranium hillebrandii, Huperzia mannii, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 20— Montane Mesic: This area consists of 174 ac (70 ha) of State land at Lihau on the southwestern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plant Geranium hillebrandii, and contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 3 is not known to be occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Huperzia mannii, Lysimachia lydgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 21— Montane Mesic: This area consists of 72 ac (29 ha) of State land at Halepohaku on the southern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). Although Maui—Montane Mesic—Unit 4 is not known to be occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Geranium hillebrandii, Huperzia mannii, Lysimachia lydgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 22— Montane Mesic: This area consists of 170 ac (69 ha) of State land at the upper reaches of Manawainui Gulch on the southeastern slopes of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). They are occupied by the plants Remya mauiensis and Santalum haleakalae var. lanaiense, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Montane Mesic—Unit 5 is not known to be occupied by the plants Ctenitis squamigera, Cyanea magnicalyx, Diplazium molokaiense, Geranium hillebrandii, Huperzia mannii, Lysimachia lydgatei, Stenogyne kauaulaensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 24— Subalpine: This area consists of 10,785 ac (4,365 ha) of State land, 1,622 ac (656 ha) of privately owned land, and 3,568 ac (1,444 ha) of federally owned land (Haleakala National Park), from Kanaio north to Puu Nianiau on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the subalpine ecosystem (see Table 5). They are occupied by the plants Bidens micrantha ssp. kalealaha and Geranium arboreum, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui— Subalpine—Unit 1 is not known to be occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Asplenium peruvianum var. insulare, Geranium multiflorum, Phyllostegia bracteata, Schiedea haleakalensis, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these subalpine species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 25— Subalpine: This area consists of 50 ac (20 ha) of privately owned land, and 9,836 ac (3,981 ha) of federally owned land (Haleakala National Park), from the summit north to Koolau Gap and east to Kalapawili Ridge on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the subalpine ecosystem (see Table 5). They are occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Geranium multiflorum, and Schiedea haleakalensis, and by the forest bird, the akohekohe (Palmeria dolei). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Subalpine—Unit 2 is not known to be occupied by the plants Asplenium peruvianum var. insulare, Bidens micrantha ssp. kalealaha, Geranium arboreum, Phyllostegia bracteata, or Zanthoxylum hawaiiense, or by the forest bird, the kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these subalpine species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 26— Dry Cliff: This area consists of 755 ac (305 ha) of federally owned land (Haleakala National Park), from Pakaoao to Koolau Gap on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). Although Maui—Dry Cliff— Unit 1 is not known to be occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Diplazium molokaiense, Geranium multiflorum, Plantago princeps, or Schiedea haleakalensis, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery. Maui—Dry Cliff—Unit 2 consists of 688 ac (279 ha) of federally owned land (Haleakala National Park) from Haupaakea Peak to Kaupo Gap on east Maui. This unit includes the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). It is occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Geranium multiflorum, Plantago princeps, and Schiedea haleakalensis, and contains unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Dry Cliff—Unit 2 is not known to be occupied by the plants Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, or Diplazium molokaiense, we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 27— Dry Cliff: This area consists of 200 ac (81 ha) of federally owned land (Haleakala National Park) near Papaanui on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). It is occupied by the plant Plantago princeps, and contains unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Dry Cliff—Unit 3 is not currently occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Diplazium molokaiense, Geranium multiflorum, or Schiedea haleakalensis, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 28— Dry Cliff: This area consists of 315 ac (127 ha) federally owned land (Haleakala National Park), along Kalapawili Ridge on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). Although Maui—Dry Cliff— Unit 4 is not currently occupied by the plants Argyroxiphium sandwicense ssp. macrocephalum, Bidens campylotheca ssp. pentamera, B. micrantha ssp. kalealaha, Diplazium molokaiense, Geranium multiflorum, Plantago princeps, or Schiedea haleakalensis, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 29— Dry Cliff: This area consists of 1,298 ac (525 ha) of State land, from Helu and across Olowalu to Ukumehame Gulch, on west Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the dry cliff ecosystem (see Table 5). They are occupied by the plant Tetramolopium capillare, and contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Dry Cliff—Unit 5 is not currently occupied by the plants Bonamia menziesii, Diplazium molokaiense, Hesperomannia arbuscula, Isodendrion pyrifolium, Kadua laxiflora, or Neraudia sericea, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these dry cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 30— Wet Cliff: This area consists of 290 ac (117 ha) of privately owned land along the wall of Keanae Valley on the northern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). Although Maui—Wet Cliff— Unit 1 is not currently occupied by the plants Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, Cyanea horrida, Melicope ovalis, Phyllostegia bracteata, P. haliakalae, or Plantago princeps, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 31— Wet Cliff: This area consists of 475 ac (192 ha) of State land, 20 ac (8 ha) of privately owned land, and 912 ac (369 ha) of federally owned land (Haleakala National Park), from Kalapawili Ridge along Kipahulu Valley and north to Puuhoolio, on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). They are occupied by the plants Bidens campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, Melicope ovalis, Phyllostegia bracteata, and Plantago princeps. These units also contains unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 2 is not known to be occupied by the plants Bidens campylotheca ssp. pentamera, Cyanea horrida, or Phyllostegia haliakalae, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 32— Wet Cliff: This area consists of 5 ac (2 ha) of State land and 433 ac (175 ha) federally owned land (Haleakala National Park) along the south rim of Kipahulu Valley on east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). Although Maui—Wet Cliff— Unit 3 is not currently occupied by the plants Bidens campylotheca ssp. pentamera, B. campylotheca ssp. waihoiensis, Cyanea copelandii ssp. haleakalaensis, C. horrida, Melicope ovalis, Phyllostegia bracteata, P. haliakalae, or Plantago princeps, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 33— Wet Cliff: This area consists of 184 ac (75 ha) of State land along the north wall of Waihoi Valley, on the northeastern slopes of east Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). They are occupied by the plant Bidens campylotheca ssp. pentamera and B. campylotheca ssp.

waihoiensis, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 4 is not known to be occupied by the plants Cyanea copelandii ssp. haleakalaensis, C. horrida, Melicope ovalis, Phyllostegia bracteata, P. haliakalae, or Plantago princeps, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 35— Wet Cliff: This area consists of 1,858 ac (752 ha) of State land, and 253 ac (102 ha) of privately owned land, at the summit ridges of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). They are occupied by the plants Alectryon macrococcus, B. conjuncta, Ctenitis squamigera, Cyrtandra munroi, Remya mauiensis, and Santalum haleakalae var. lanaiense. These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 6 is not known to be occupied by the plants Bidens campylotheca ssp. pentamera, Bonamia menziesii, Cyanea glabra, C. lobata, C. magnicalyx, Cyrtandra filipes, Dubautia plantaginea ssp. humilis, Gouania vitifolia, Hesperomannia arborescens, H. arbuscula, Isodendrion pyrifolium, Kadua laxiflora, Lysimachia lydgatei, Plantago princeps, Platanthera holochila, Pteris lidgatei, or Tetramolopium capillare, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 36— Wet Cliff: This area consists of 556 ac (225 ha) of State land along Honokowai ridge on the northwestern side of west Maui. These units include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). These units are occupied by the plants Cyrtandra filipes and C. munroi, and contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Maui—Wet Cliff—Unit 7 is not known to be occupied by the plants Alectryon macrococcus, Bidens campylotheca ssp. pentamera, B. conjuncta, Bonamia menziesii, Ctenitis squamigera, Cyanea glabra, C. lobata, C. magnicalyx, Dubautia plantaginea ssp. humilis, Gouania vitifolia, Hesperomannia arborescens, H. arbuscula, Isodendrion pyrifolium, Kadua laxiflora, Lysimachia lydgatei, Plantago princeps, Platanthera holochila, Pteris lidgatei, Remya mauiensis, Santalum haleakalae var. lanaiense, or Tetramolopium capillare, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 37— Lowland Mesic: This area consists of 3,489 ac (1,412 ha) of State land, and 5,281 ac (2,137 ha) of privately owned land, from Waianui Gulch to Mapulehu, in central Molokai. These units are occupied by the plants Alectryon macrococcus, Ctenitis squamigera, Cyanea dunbariae, C. mannii, C. profuga, Cyperus fauriei, Cyrtandra filipes, Gouania hillebrandii, Labordia triflora, Neraudia sericea, Santalum haleakalae var. lanaiense, Schiedea lydgatei, S. sarmentosa, Silene alexandri, S. lanceolata, Spermolepis hawaiiensis, and Zanthoxylum hawaiiense, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland mesic ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Lowland Mesic—Unit 1 is not known to be occupied by Asplenium dielerectum, Bonamia menziesii, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea procera, C. solanacea, Diplazium molokaiense, Festuca molokaiensis, Flueggea neowawraea, Isodendrion pyrifolium, Kadua laxiflora, Melicope mucronulata, M. munroi, M. reflexa, Phyllostegia haliakalae, P. mannii, P. pilosa, Sesbania tomentosa, Stenogyne bifida, or Vigna o-wahuensis, or the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 38— Lowland Wet: This area consists of 2,195 ac (888 ha) of State land, and 754 ac (305 ha) of privately owned land (partly within The Nature Conservancy's Pelekunu Preserve), from Pelekunu Valley to Wailau Valley, in north-central Molokai. These units are occupied by the plant Cyrtandra filipes, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of this species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Lowland Wet—Unit 1 is not known to be occupied by Asplenium dielerectum, Bidens wiebkei, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea dunbariae, C. grimesiana ssp. grimesiana, C. solanacea, Lysimachia maxima, Melicope reflexa, Peucedanum sandwicense, Phyllostegia hispida, P. mannii, Plantago princeps, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 39— Lowland Wet: This area consists of 1,356 ac (549 ha) of State land and 594 ac (241 ha) of privately owned land, from Kahanui to Pelekunu Valley, in north-central Molokai. These units are occupied by the plant Lysimachia maxima, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the lowland wet ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of this species by providing the

PCEs necessary for the expansion of the existing wild populations. Although Molokai— Lowland Wet—Unit 2 is not known to be occupied by Asplenium dielerectum, Bidens wiebkei, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea dunbariae, C. grimesiana ssp. grimesiana, C. solanacea, Cyrtandra filipes, Melicope reflexa, Peucedanum sandwicense, Phyllostegia hispida, P. mannii, Plantago princeps, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these lowland wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 40— Montane Wet: This area consists of 1,545 ac (625 ha) of State land, and 1,851 ac (749 ha) of privately owned land, from the headwaters of Waialelia Stream and above Pelekunu Valley, eastward along the summit area to Mapulehu, in northcentral Molokai. These units are occupied by the plants Bidens wiebkei, Clermontia oblongifolia ssp. brevipes, Cyanea mannii, C. profuga, Phyllostegia hispida, and Pteris lidgatei, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Montane Wet—Unit 1 is not known to be occupied by Adenophorus periens, Cyanea procera, C. solanacea, Hesperomannia arborescens, Lysimachia maxima, Melicope reflexa, Phyllostegia mannii, P. pilosa, Platanthera holochila, Schiedea laui, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 41— Montane Wet: This area consists of 871 ac (353 ha) of State land, and 39 ac (16 ha) of privately owned land, from Honukaupu to Olokui (between Pelekunu and Wailau valleys), in north-central Molokai. These units include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane wet ecosystem (see Table 5). Although Molokai— Montane Wet—Unit 2 is not known to be occupied by Adenophorus periens, Bidens wiebkei, Clermontia oblongifolia ssp. brevipes, Cyanea mannii, C. procera, C. profuga, C. solanacea, Hesperomannia arborescens, Lysimachia maxima, Melicope reflexa, Phyllostegia hispida, P. mannii, P. pilosa, Platanthera holochila, Pteris lidgatei, Schiedea laui, Stenogyne bifida, or Zanthoxylum hawaiiense, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane wet species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 42— Montane Mesic: This area consists of 257 ac (104 ha) of State land, and 559 ac (226 ha) of privately owned land from Kamiloloa to Makolelau in central Molokai. These units are occupied by the plants Alectryon macrococcus, Bidens wiebkei, Santalum haleakalae var. lanaiense, and Spermolepis hawaiiensis, and include the mixed herbland and shrubland, the moisture regime, and canopy, subcanopy, and understory native plant species identified as physical or biological features in the montane mesic ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai— Montane Mesic—Unit 1 is not known to be occupied by Asplenium dielerectum, Cyanea dunbariae, C. mannii, C. procera, C. solanacea, Cyperus fauriei, Kadua laxiflora, Melicope mucronulata, Neraudia sericea, Plantago princeps, or Stenogyne bifida, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these montane mesic species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 43— Wet Cliff: This area consists of 1,395 ac (565 ha) of State land, and 212 ac (86 ha) of privately owned land, and encircles the plateau between Pelekunu and Wailau valleys, in north-central Molokai. These units are occupied by the plants Brighamia rockii, Canavalia molokaiensis, Clermontia oblongifolia ssp. brevipes, Cyanea munroi, and Hibiscus arnottianus ssp. immaculatus, and include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations Although Molokai—Wet Cliff—Unit 1 is not known to be occupied by Cyanea grimesiana ssp. grimesiana, Hesperomannia arborescens, Phyllostegia hispida, Pteris lidgatei, or Stenogyne bifida, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Unit 44— Wet Cliff: This area consists of 462 ac (187 ha) of State land, and 806 ac (326 ha) of privately owned land (partly within The Nature Conservancy’s Pelekunu Preserve), along the rim of Pelekunu Valley from Kipapa Ridge to Mapulehu, in central Molokai. These units are occupied by the plants Clermontia oblongifolia ssp. brevipes and Phyllostegia hispida, and include the mixed herbland and shrubland, the moisture regime, and the subcanopy and understory native plant species identified as physical or biological features in the wet cliff ecosystem (see Table 5). These units also contain unoccupied habitat that is essential to the conservation of these species by providing the PCEs necessary for the expansion of the existing wild populations. Although Molokai—Wet Cliff—Unit 2 is not known to be occupied by Brighamia rockii, Canavalia molokaiensis, Cyanea grimesiana ssp. grimesiana, C. munroi, Hesperomannia arborescens, Hibiscus arnottianus ssp. immaculatus, Pteris lidgatei, or Stenogyne bifida, or by the forest birds, the akohekohe (Palmeria dolei) and kiwikiu (Pseudonestor xanthophrys), we have determined this area to be essential for the conservation and recovery of these wet cliff species because it provides the PCEs necessary for the reestablishment of wild populations within their historical range. Due to their small numbers of individuals or low population sizes, suitable habitat and space for expansion or reintroduction are essential to achieving population levels necessary for recovery.

Primary Constituent Elements/Physical or Biological Features

There are 41 critical habitat units designated for the Islands of Maui and Molokai in Maui County, Hawaii. Primary constituent elements of critical habitat for the Kiwikiu are (81 FR 17889-18110):

(i) In units 1 and 37: (A) Elevation: Less than 3,300 ft (1,000 m). (B) Annual precipitation: 50 to 75 in (130 to 190 cm). (C) Substrate: Shallow soils, little to no herbaceous layer. (D) Canopy: Acacia, Diospyros, Metrosideros, Myrsine, Pouteria, Santalum. (E) Subcanopy: Dodonaea, Freycinetia, Leptecophylla, Melanthera, Osteomeles, Pleomele, Psydrax. (F) Understory: Carex, Dicranopteris, Diplazium, Elaphoglossum, Peperomia.

(ii) In units 2, 3, 4, 5, 6, 7, 8, 9, 38, and 39: (A) Elevation: Less than 3,300 ft (1,000 m). (B) Annual precipitation: Greater than 75 in (190 cm). (C) Substrate: Clays; ashbeds; deep, well-drained soils; lowland bogs. (D) Canopy: Antidesma, Metrosideros, Myrsine, Pisonia, Psychotria. (E) Subcanopy: Cibotium, Claoxylon, Kadua, Melicope. (F) Understory: Alyxia, Cyrtandra, Dicranopteris, Diplazium, Machaerina, Microlepia.

(iii) In units 10, 11, 12, 13, 14, 15, 16, 40, and 41: (A) Elevation: Between 3,300 and 6,500 ft (1,000 and 2,000 m) (B) Annual precipitation: Greater than 75 in (190 cm). (C) Substrate: Well-developed soils, montane bogs. (D) Canopy: Acacia, Charpentiera, Cheirodendron, Metrosideros. (E) Subcanopy: Broussaisia, Cibotium, Eurya, Ilex, Myrsine. (F) Understory: Ferns, Carex, Coprosma, Leptecophylla, Oreobolus, Rhynchospora, Vaccinium.

(iv) In units 18, 19, 20, 21, 22, and 42: (A) Elevation: Between 3,300 and 6,500 ft (1,000 and 2,000 m). (B) Annual precipitation: Between 50 and 75 in (130 and 190 cm). (C) Substrate: Deep ash deposits, thin silty loams. (D) Canopy: Acacia, Ilex, Metrosideros, Myrsine, Nestegis, Nothocestrum, Pisonia, Pittosporum, Psychotria, Sophora, Zanthoxylum. (E) Subcanopy: Alyxia, Charpentiera, Coprosma, Dodonaea, Kadua, Labordia, Leptecophylla, Phyllostegia, Vaccinium. (F) Understory: Ferns, Carex, Peperomia.

(v) In units 24 and 25, the primary constituent elements of critical habitat for the Kiwikiu are: (A) Elevation: Between 6,500 and 9,800 ft (2,000 and 3,000 m). (B) Annual precipitation: Between 15 and 40 in (38 and 100 cm). (C) Substrate: Dry ash; sandy loam; rocky, undeveloped soils; weathered lava. (D) Canopy: Chamaesyce, Chenopodium, Metrosideros, Myoporum, Santalum, Sophora. (E) Subcanopy: Coprosma, Dodonaea, Dubautia, Geranium, Leptecophylla, Vaccinium, Wikstroemia. (F) Understory: Ferns, Bidens, Carex, Deschampsia, Eragrostis, Gahnia, Luzula, Panicum, Pseudognaphalium, Sicyos, Tetramolopium.

(vi) In units 26, 27, 28, and 29: (A) Elevation: Unrestricted. (B) Annual precipitation: Less than 75 in (190 cm). (C) Substrate: Greater than 65 degree slope, rocky talus. (D) Canopy: None. (E) Subcanopy: Antidesma, Chamaesyce, Diospyros, Dodonaea. (F) Understory: Bidens, Eragrostis, Melanthera, Schiedea.

(vii) In units 30, 31, 32, 33, 35, 36, 43, and 44: (A) Elevation: Unrestricted. (B) Annual precipitation: Greater than 75 in (190 cm). (C) Substrate: Greater than 65 degree slope, shallow soils, weathered lava. (D) Canopy: None. (E) Subcanopy: Broussaisia, Cheirodendron, Leptecophylla, Metrosideros. (F) Understory: Bryophytes, ferns, Coprosma, Dubautia, Kadua, Peperomia.

Special Management Considerations or Protections

Existing manmade features and structures, such as buildings, roads, railroads, airports, runways, other paved areas, lawns, and other urban landscaped areas, do not contain one or more of the physical or biological features. Federal actions limited to those areas, therefore, would not trigger a consultation under section 7 of the Act unless they may affect the species or physical or biological features in adjacent critical habitat.

The primary threats to the physical or biological features essential to the conservation of all of these species include habitat destruction and modification by nonnative ungulates, competition with nonnative species, hurricanes, landslides, rockfalls, flooding, fire, drought, and climate change. Additionally, the rosy wolf snail poses a threat to the Newcomb's tree snail and mosquito-borne diseases pose threats to the two forest birds. The reduction of these threats will require the implementation of special management actions within each of the critical habitat areas identified in this final rule.

Life History

Feeding Narrative

Adult: They forage mainly on the woody portions of shrubs and trees, using their powerful bill to dig, crush, and chisel bark and wood for arthropods, especially larvae and pupae of beetles and moths (Perkins 1903, Mountainspring 1987, Simon et al. 1997, Stein 2007). Perkins (1903) noted a preference for koa which is scarce in their current range.

Reproduction Narrative

Adult: Pairs defend year-round territories that average 2.3-5.1 ha (Pratt et al. 2001, Iknayan et al. 2010). The nesting season extends primarily from December to July, but nests have been found in all months except September. Most nests are built high (10.6 ± 3.0 m) in ʻohiʻa trees. Clutch size is one and pairs raise a single fledgling per year. The female incubates the egg and broods the chick; the male feeds the female on the nest and provides most food for the dependent young (Simon et al. 1997). Fledglings remain with their parents for up to 18 months post-fledging. Nest success averages 19%, with inclement weather resulting in most nest losses, although renesting is common after failure, and pair success (proportion of pairs observed with a fledgling) averages 46% per year (Mounce et al. 2011). Based on mark-recapture data, annual adult and juvenile survival are 0.84 ± 0.04 and 0.76 ± 0.09, respectively (Vetter et al. 2012).

Habitat Narrative

Adult: Kiwikiu occur in mesic and wet native montane forests dominated by ʻohiʻa, ʻolapa (Cheirodendron trigynum), kolea (Myrsine lessertiana), and kawaʻu (Ilex anomala), with a diverse understory of native plants including ʻakala (Rubus hawaiensis), ʻohelo (Vaccinium calycinum), ʻalani (Melicope spp.), pukiawe (Styphelia tameiameiae), and kanawao (Broussaisia arguta) (Simon et al. 1997, Stein 2007).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-Migratory

Population Information and Trends

Population Size:

421 birds (95% CI 209 - 674)

Population Narrative:

In 1980, the population was estimated to be 502 ± 116 birds based on surveys of the species' entire range (Scott et al. 1986). Population density (birds/km2) was estimated to be 17.2 ± 4.2, 17.0 ± 4.2, and 11.8 ± 2.6 from surveys conducted in 1980, 1992-1996, and 1997-2001, respectively, suggesting a possible decline in abundance (Camp et al. 2009, Gorresen et al. 2009). Brinck et al. (2102) estimated that abundance in the core of their range was 421 birds (95% CI 209 - 674); the areas surveyed did not include all occupied habitat. Low numbers and restricted distribution – Past population estimates were steady at ~500 from 1980 to 2011 (Scott et al. 1986, Gorresen et al. 2009, and USFWS 1984, 2006, 2011, and 2014). However, current population estimates of less than 312 from Maui forest bird surveys conducted in 2016 show a steep decline from previous population estimates (MFBRP 2017). Variable circular plots have been used to survey forest birds but according to Camp et al (2009), it is not an appropriate method for all species and provides poor estimates for extremely rare birds. Data from the surveys are currently being analyzed and more work needs to be completed before accurate population estimates and densities can be determined (MFBRP 2017) (USFWS, 2018). Captive breeding of kiwikiu at the Maui Bird Conservation Center (MBCC) and Keauhou Bird Conservation Center (KBCC) was not successful over the past twenty years due to low reporductive success and low survivorship. According to staff at MBCC (2017), captive breeding is difficult for the species and on average, kiwikiu only live about 6 years in captivity. Currently there is no reproduction taking place and only10 kiwikiu remain in captivity (MBCC 2017) (USFWS, 2018). Critical habitat for the kiwikiu was designated in 2016 for the protection of existing population sites and unoccupied but suitable habitat locations for possible translocation and relocation essential to the conservation of the species (USFWS 2016) (USFWS, 2018). Recent kiwikiu range size of 30 square kilometers (11.6 square miles) was delineated based on habitat, elevation layers, and current surveys (MFBRP 2017) compared to the previously known range size of 49 square kilometers (19 square miles) (USFWS 2014) (USFWS, 2018).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Prior to the arrival of humans, the Hawaiian archipelago supported a remarkable avifauna comprised of at least 107 endemic species, including flightless geese, ibis, and rails and a radiation of at least 59 species in the subfamily Drepanidinae (Olson and James 1991, James and Olson 1991, James 2004). In the years since human colonization, 67 bird species have been

confirmed lost, 46 prior to the arrival of Europeans and 23 since 1778 (Olson and James 1991, James and Olson 1991, Pyle 1997, Banko et al. 2001). Of the 42 extant endemic taxa, 31 are federally listed (29 species and 2 sub-species). Ten of these taxa have not been observed in as many as 40 years and their status is unknown (Service 2006). Habitat destruction, non-native diseases and predators, and habitat degradation by introduced ungulates and invasive plants are the main threats now facing Hawaii's remaining endemic birds (van Riper and Scott 2001, Service 2006).

Stressor: Habitat Loss and Degradation
Exposure:
Response:
Consequence:
Narrative: The loss, fragmentation, and degradation of native Hawaiian Island habitats began over 700 years ago when Polynesians settled the archipelago, and accelerated with the arrival of Europeans in 1778. As a result, all native Hawaiian birds have been adversely affected. European settlement not only caused the further loss and degradation of native forest but also initiated a long history of alien species introductions, including invasive plants, goats (Capra hircus), cattle, sheep (Ovis aries), and pigs (Sus scrofa) all of which have degraded native forest for centuries. Introduced ungulates have devastated Hawaiian forests which evolved without mammalian browsers and grazers and have no defenses against them. Ungulates also contribute to soil erosion, prevent regeneration of native plants, facilitate the invasion of alien plants, and create breeding habitat for mosquitoes (Service 2009). Non-native, invasive plants have profoundly altered native habitats in Hawaiʻi.

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Hawaiian birds evolved in the absence of mammalian predators and have little to no adaptive behavioral responses to their presence. The nests, adults, and fledglings of all Hawaiian bird species are vulnerable to feral cats (Felis catus), rats (Rattus spp.), small Indian mongoose (Herpestes auropunctatus), dogs (Canis familiaris), and feral pigs (Service 2009).

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: Avian malaria (Plasmodium relictum) and avian pox virus (Poxvirus avium) carried by the alien southern house mosquito (Culex quinquefasciatus) resulted in the extinction of many Hawaiian birds and currently limits the distribution of most extant native forest birds to high elevation forests where cool temperatures limit mosquitoes (van Riper et al. 1986, Atkinson et al. 1995, Atkinson and LaPointe 2009). The Kiwikiu is absent or rare in most areas of suitable forest below 1,350 m, likely because of introduced disease (Simon et al. 1997, Berlin and Vangelder 1999, Baker and Baker 2000, Service 2006). Although based on a small sample, the prevalence of malaria in the ʻAkikiki increased from zero between 1994-1997 to 40% between 2007-2009 (Atkinson and Utzurrum 2014). In addition, most of this species' decline has occurred at lower elevations on the edge of its range (Foster et al. 2004), suggesting that disease has contributed to these losses. Toxoplasmosis is a widespread disease caused by a protozoan parasite, Toxoplasma

gondii, and can affect all birds and mammals (Elmore et al. 2010, Innes 2010). Cats are the primary reservoir of infection and one cat can shed millions of oocytes that can persist for months in damp soil (Elmore et al. 2010, Innes 2010). West Nile virus is another mosquito-borne pathogen that infects a wide range of birds, including corvids (Kilpatrick et al. 2006). West Nile virus spread rapidly across North America from 2000 to 2005 (Marra et al. 2004), but it has not been recorded in Hawaiʻi.

Stressor: Climate Change
Exposure:
Response:
Consequence:
Narrative: Increasing air temperatures associated with climate change are likely to exacerbate the threat of disease to native Hawaiian birds by increasing the elevation at which regular transmission of avian malaria and avian pox virus occurs (Reiter 1998, Benning et al. 2002, Harvell et al. 2002, Hay et al. 2002, Giambelluca and Luke 2007, Giambelluca et al. 2008, Loiseau et al. 2012). GIS modeling indicates that malaria transmission currently occurs at least periodically across 20% of the Kiwikiu's range. An increase in temperature of 2°C, which is a conservative figure based on recent data (IPCC 2007), would decrease the area of disease-free forest in the species current range from 40 km2 to 9 km2 (Benning et al. 2002, Giambelluca et al. 2008, Hammond et al. 2009). Loss of such a large proportion of suitable habitat would likely result in the extinction of the Kiwikiu (Pounds et al. 1999, Still et al. 1999). A similar analysis indicated that a 2°C temperature increase would allow regular disease transmission in 85% of the area on Kauaʻi where it is now only periodic (Benning et al. 2002). Disease prevalence and the prevalence of mosquitos are increasing across the Alakaʻi (Atkinson and Utzurrum 2010, Atkinson et al. 2014. Drought reduces mamane seed production and likely contributes to the mortality of mature trees (Juvik et al. 1993), especially those stressed by browsing (Banko et al 2013), pathogens (Gardner and Trujillo 2001), and competition from invasive grasses and weeds (Banko et al. 2009). Drought conditions have persisted on Mauna Kea since 2000 but have been most severe since 2006 (Banko et al. 2014).

Stressor: Small Populations
Exposure:
Response:
Consequence:
Narrative: Small populations are more vulnerable to extinction than large populations because of the higher risks posed by random demographic fluctuations and localized catastrophes such as hurricanes, fires, and disease outbreaks (Wiley and Wunderle 1994), and potentially genetic issues (Keller and Waller 2002).

Stressor: Hurricanes
Exposure:
Response:
Consequence:
Narrative: Major hurricanes struck Kauaʻi in 1983 and 1992 and degraded native forests by destroying large trees, creating gaps into which alien plants could expand, and spreading invasive plants.

Recovery

Conservation Measures and Best Management Practices:

- Alien Ungulate Removal. Fencing and removal of alien ungulates from native habitats and from areas with restoration value are among the highest priority actions with the greatest potential benefit for Hawaiian bird species (Wallace and Leonard 2011). Removing ungulates, especially pigs, improves habitat quality and can reduce mosquito breeding sites (Goff and van Riper 1980). Such efforts will require a considerable influx of new funding and unprecedented outreach to gain the social and political support required for success, as projects will result in fewer hunting opportunities.
- Alien Predator Control. Keeping predators such as rodents, exotic snakes such as the brown treesnake, and cats away from crucial habitats of native Hawaiian birds can boost nesting success and survival of adult and young birds (VanderWerf 2008). Predator-proof fencing would protect critical nesting sites, although set-up costs are very high (e.g., $300 per meter of fencing). A more cost-effective option is use of rodenticides, such as diphacinone, which was recently approved for aerial application in Hawaiʻi. Though diphacinone application poses little threat to human health and most non-target species when applied according to label guidelines, we'll need to engage in education and outreach to gain widespread public approval for this approach. In addition, the federal and state government must be proactive in expanding biosecurity measures to prevent new invasive species from becoming established in Hawaiʻi (Kueffer and Loope 2009). One of the greatest potential biosecurity threats is the accidental introduction of the brown tree snake (Boiga irregularis), which has already devastated birdlife on Guam.
- Alien Plant Control. There is an urgent need for targeted efforts to reduce the spread of invasive, exotic plants in areas important to native Hawaiian birds. Fountain grass (Cenchrus setaceus), for example, a species indigenous to tropical Africa and Asia, is spreading in dry forest and grasslands where the grass increases wildfire risk.
- Captive Breeding and Translocation. Captive propagation is critical for several Hawaiian birds. Captive propagation provides individuals to bolster existing wild populations, and, combined with translocation of wild birds, allows managers to establish new populations in protected or restored habitats. Translocation has already been used to create "insurance" populations for species restricted to single sites (Reynolds and Klavitter 2006). Also see the summary of the results of captive propagation efforts for Hawaiian listed bird species provided by Switzer (2013).
- Disease Management. Reducing the incidence of avian malaria and avian pox is the greatest Hawaiian bird conservation challenge, as managers currently have few available tools to combat the diseases (Atkinson and LaPoint 2009). Strategies to reduce mosquitoes in discrete areas include: removing pigs to reduce habitat degradation that creates mosquito breeding habitat; insecticide application; and a new technique known as cytoplasmic incompatibility, which uses parasites to cause a sperm-egg incompatibility between the gametes of infected male and uninfected female mosquitoes. Fortunately, some bird species can evolve resistance to malaria over relatively short periods of time (Atkinson and LaPointe 2009). Captive propagation of disease-resistant individuals may help species weather the epidemics, as will reducing mortality from other factors, such as nest predation from feral cats and other introduced mammalian predators (Kilpatrick 2006).
- Climate Adaptation. To help native Hawaiian bird species avoid an upward-climbing mosquito-disease zone, we might consider planting forests above the current tree line, but this may be complicated by climate change-induced shifts in rainfall patterns (Giambelluca and Luke 2007). Assisted migrations and reintroductions of populations of the most endangered birds are other possibilities. And mitigating threats we can control—such as removing ungulates and controlling

predators and weeds—will make birds and their habitats more resilient to climate change (Hunter et al. 2010).

- Ungulate monitoring and control – Waikamoi Preserve, owned by The Nature Conservancy, is completely enclosed and fenced. As of 2016, there are no ungulates within the entirety of the preserve including the East Maui Irrigation addition that occurred in 2015. The total acreage of ungulate free habitat in Waikamoi is 8,951 acres (C. Wittenmyer Pers Comm 2018). Hanawī Natural Area Reserve is completely fenced with ongoing ungulate control. Most of the remaining leeward montane forests on east Maui currently are more highly degraded by ungulates but efforts to control ungulates with the construction of fencing and active restoration is ongoing (Warren et al. 2015 and Mounce et al. 2015). These areas, in addition to fencing and ungulate control, will require more intensive, long-term restoration to become suitable for kiwikiu and other endangered forest birds (USFWS, 2018).
- Habitat and natural process management and restoration – Habitat restoration and reestablishment of a population at Kahikinui on the leeward or western exposures of east Maui has been identified to promote natural demographic and evolutionary processes. This work should proceed to the east and west from Kahikinui, eventually relinking the remnant Kahikinui forest to other forests on east Maui, possibly including Manawainui, Kaupo, and remnant koa forests near Kula (USFWS, 2018).
- Predator/herbivore monitoring and control – Control of small mammalian predators is needed throughout the species' range with future management strategies focused on increasing female kiwikiu survival to prevent extinction of the species (Mounce et al. 2014 and Mounce 2015). Currently, intensive control of rats (Rattus spp.) is underway in a portion of Hanawī Natural Area Reserve, Waikamoi Preserve, and Kahikinui's Nakula Natural Area Reserve. An important component of kiwikiu recovery is evaluation of the effect of rodent control on the species' reproduction and survival, and an expansion of the scale of rodent control if warranted. Broad scale aerial application of rodenticides is likely needed to protect kiwikiu from rodent predation and reduce habitat damage caused by rats (USFWS, 2018).
- Disease monitoring and control – Identification of resistance or tolerance to avian diseases within the population is an important recovery strategy. Control of mosquitoes and their breeding sites is also needed as global climate change is increasing the elevation at which transmission of avian malaria (Plasmodium relictum) and avian pox virus (Avipoxvirus ssp.) occurs (Benning et al. 2002 and USFWS 2014). Much of the potential kiwikiu habitat on west Maui and east Molokaʻi is managed as native ecosystems mostly free of ungulates. However, much of this lies at elevations below 1,350 meters (4,500 feet), where mosquitoes may be common. Ongoing habitat management and removal of ungulates may reduce mosquito densities, but surveys of mosquitoes and disease prevalence are needed prior to the reintroduction of kiwikiu in these areas. The U.S. Geological Survey, National Wildlife Health Center, Honolulu Field Station, collaborates with USFWS and the State of Hawaiʻi in surveillance and interdiction efforts to detect and prevent the establishment of new avian diseases into the State, including surveillance for West Nile virus (USGS 2018). Continued support for this program is critical to prevent West Nile virus and other avian diseases from entering Hawaiʻi (USFWS, 2018).
- Captive propagation for genetic storage and reintroduction – Research on captive breeding for the kiwikiu was initiated in 1997, when eggs were removed to the MBCC and the KBCC on Hawaiʻi. Captive propagation was deemed unsuccessful due to low reporductive success and low survivorship over a twenty year period and may no longer be a viable role in recovery efforts for kiwikiu (MBCC 2017). Genetic diversity of kiwikiu in their current range is low but should not affect conservation translocation of kiwikiu once recovery areas are managed, allowing for the release and reestablishment of additional populations of this species (Mounce et al. 2015) (USFWS, 2018).

- Reintroduction/translocation – To establish a second population, current efforts should continue to focus on restoration and predator control for eventual reintroduction of the kiwikiu to southern Haleakalā, and to west Maui or east Molokaʻi. Ongoing restoration and invasive predator control in mesic koa forest on the leeward slope of Haleakalā where 170 hectares (420 acres) of Nakula Natural Area Reserve is fenced and ungulate free and kiwikiu are planned to be relocated (Warren et al. 2015, Mounce et al. 2015, and MFBRP 2017). Initial efforts of captive propagation of the kiwikiu have met with limited success, and due to difficulties breeding sufficient numbers of kiwikiu in captivity for release, translocation of the kiwikiu will need to be considered in addition to releasing the current captive kiwikiu to reestablish the species in areas of its former range (USFWS, 2018).

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SPECIES ACCOUNT: *Psittirostra psittacea* (`O`u (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

A chunky, 6.5-inch green bird with a thick hooked bill. Adult male has a bright yellow head; upperparts are slightly tinged with yellow; underparts grade from olive-green on the breast to whitish on the belly and undertail coverts; overall length is about 17 cm (Pratt et al. 1987, Hawaii Audubon Society 1993) (NatureServe, 2015).

Taxonomy

The `o`u is a member of the thick-billed Hawaiian honeycreeper tribe (Psittirostrini) (USFWS, 2006).

Historical Range

Formerly occurred on Oahu, Molokai, Lanai, and Maui. Formerly common in wet forests of Kona, eastern Hawaii, and Kohala; occasionally was found even in drier forests (Matthews and Moseley 1990). A few hundred were present in the late 1970s in small patches on Hawaii at elevations of 1,300 - 1,500 m in mid-elevation forests east of Mauna Kea and Mauna Loa, Hamakua region to Volcanoes National Park (Pratt et al. 1987, Scott and Kepler 1985, Matthews and Moseley 1990) (NatureServe, 2015). `O`u were found historically on the islands of Hawai`i, Maui, Moloka`i, Lana`i, O`ahu, and Kaua`i, with no known geographic variation (Amadon 1950) (USFWS, 2006).

Current Range

Occurs (at least formerly) in the Hawaiian Islands. In the mid-1980s, a few occurred in the Alakai Swamp (northern and southeastern regions), Kauai. Now possibly extirpated on Kauai and Hawaii (NatureServe, 2015). The very large area (approximately 30,000 hectares (75,000 acres) (Camp et al. 2009) on Hawaii Island with suitable habitat, and the many remote areas within this that are only rarely visited by qualified observers, increase the potential that a small population of ou could still exist on Hawaii Island. On Kauai, the extremely rough terrain and frequent wet weather make surveys difficult, and numerous steep valleys create many small pockets of habitat where the species could still exist (USFWS, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores, herbivores, frugivores, and nectarivores. Eats fruits of native and introduced plants; also flowers, leaf bracts, insects (especially caterpillars, which are fed to the young), and probably nectar (Berger 1981). Adults seem to prefer fruit of

Freycinetia arborea (Matthews and Mosely 1990). Forages mainly in the forest canopy (Ehrlich et al. 1992). This species exhibits a diurnal phenology (NatureServe, 2015). Perkins (1903) noted them feeding exclusively on caterpillars (Geometridae), feeding them to young during the summer months in the Ka`u/Kilauea area of the Big Island. `O`u are also known to feed on young koa (Acacia koa) leaves, nectar, and on alien fruits such as guava, mountain apple, banana, peach, and mulberry (Henshaw 1902, Perkins 1903, Munro 1960, Scott et al. 1986) (USFWS, 2006).

Reproduction Narrative

Adult: Females collected from late March to mid-May had enlarged ovaries, and large numbers of fledglings were noted in June by Perkins, suggesting a peak in nesting during April and May (Rothschild 1893 to 1900, Perkins 1903, Banko 1986) (USFWS, 2006).

Geographic or Habitat Restraints or Barriers

Adult: 3,000 - 5,000 ft. elevation (USFWS, 2006)

Spatial Arrangements of the Population

Adult: Family groups (NatureServe, 2015)

Habitat Narrative

Adult: Humid mountain forest, occasionally in drier or lowland forest (AOU 1983). Wet ohia forest; often perches in high tree over forest canopy (Pratt et al. 1987). Known to travel in family groups (Ehrlich et al. 1992) (NatureServe, 2015). Recent sightings on Kaua`i (Engilis and Pratt 1989) and Hawai`i (U.S. Fish and Wildlife Service, unpubl. data) show `o`u to be confined to mid-elevation (900 to 1,500 meters [3,000 to 5,000 feet]) mesic and wet `ohi`a forests (USFWS, 2006).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Low to moderate (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory. Daily movements to obtain food may be up to 6.5 to 8 kilometers (Sincock, pers. obs.) (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Possibly extinct (NatureServe, 2015); unknown (USFWS, 2015); last sighted in 1989 (Kauai) and 1987 (Hawaii) (USFWS, 2009)

Resiliency:
Low (inferred from USFWS, 2009)

Redundancy:
Very low (inferred from NatureServe, 2015)

Number of Populations:
0 - 3 (NatureServe, 2015)

Population Size:
0 - 50 individuals (NatureServe, 2015)

Resistance to Disease:
Low (USFWS, 2015)

Adaptability:
Low (inferred from NatureServe, 2015)

Population Narrative:
This species has experienced a long term decline of > 90%. In 1983, estimated population was a few on Kauai and a few hundred on the big island (Scott et al. 1986). Three individuals were recorded on Kauai during a 1989 survey (USFWS 1990). Current population size is unknown, but very few if any birds remain. No more than a few populations remain, and probably none remain. No detections of this species were made during recent intensive surveys during the 1990s (NatureServe, 2015). Hawaiian honeycreepers are known to be highly susceptible to introduced avian disease, particularly avian malaria (Plasmodium relictum) (Atkinson et al. 1995; Atkinson et al. 2000; Yorinks and Atkinson 2000; Banko and Banko 2009). The species status is unknown (USFWS, 2015). The species was last sighted on Kaua`i in 1989 and Hawai`i in 1987 (Pyle 1989) (USFWS, 2009).

Threats and Stressors

Stressor: Climate change (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: According to some climate change projections, temperature increases could present an additional threat specific to Hawaiian forest birds by causing an increase in the elevation below which regular transmission of avian malaria occurs, potentially reducing the remaining suitable habitat for these species. Lia et al. (2015) assessed how global climate change will affect future malaria risk for native Hawaiian bird populations and expect high elevation areas to remain mosquito free only to mid-century due to combined factors of increased rainfall and increasing temperatures. If climate change were to reduce the remaining suitable habitat for ou as predicted, it would likely contribute to the extinction of this species over time (USFWS, 2015).

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Recent natural disasters may have affected some of the last remaining `o`u populations. On the Island of Hawai`i, a large portion of the Upper Waiakea Forest Reserve, location of some of the last observations of `o`u and considered prime habitat for the species, was inundated by the 1984 Mauna Loa lava flow, destroying thousands of acres of forest and creating a treeless corridor over a kilometer (0.62 mile) wide. On Kaua`i, two strong hurricanes, Iwa in 1982 and Iniki in 1992, had devastating effects on native forest habitat and native bird species. Habitat degradation resulting from the invasion of pernicious nonnative weeds has drastically changed the forest structure and integrity since the two hurricanes in 1982 and 1992, with the invasion and expansion of noxious weeds such as Hedychium flavescens (yellow ginger), Erigeron karvinskianus (daisy fleabane), Tibouchina urvilleana (glorybush), Lonicera japonica (Japanese honeysuckle), and others (USFWS 2006). One of the primary threats to this species and to other Hawaiian forest birds is habitat loss and degradation by agriculture, urbanization, cattle (Bos taurus) grazing, browsing by feral ungulate species, timber harvesting, and invasion of nonnative plant species into native-dominated plant communities (USFWS 2006; USFWS, 2009).

Stressor: Nonnative species (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Feral pigs (Sus scrofa), and goats (Capra hircus) to a lesser degree, have had a long-term damaging effect upon native forests in the remaining `o`u range by consuming and damaging understory vegetation, creating openings on the forest floor for weeds, transporting weed seeds into the forest, and causing soil erosion and disruption of seedling regeneration of native plants. Impacts of nonnative birds are not well understood, but include aggressive behavior towards native bird species, possible competition for food, nest sites, and roosting sites, and possibly supporting elevated predator population levels (USFWS, 2009).

Stressor: Disease and predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Predation by nonnative mammals such as black rats (Rattus rattus) and Polynesian rats (Rattus exulans) and diseases such as avian malaria (Plasmodium relictum) and avian pox (Poxvirus avium) carried by nonnative mosquitoes have also been primary threats to this species (USFWS 2006; USFWS, 2009).

Stressor: Stochastic events (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: This species now occurs in such low numbers and in such restricted ranges, if it exists at all, that it is threatened by natural processes, such as inbreeding depression and demographic stochasticity, and by natural and man-made factors such as hurricanes, wildfires, and periodic vegetation die-back (USFWS 2006; USFWS, 2009).

Recovery

Reclassification Criteria:
1. The species occurs in two or more viable populations or a viable metapopulation that represent the ecological, morphological, behavioral, and genetic diversity of the species (USFWS, 2009).

2. Either (a) quantitative surveys show that the number of individuals in each isolated population or in the metapopulation has been stable or increasing for 15 consecutive years, or (b) demographic monitoring shows that each population or the metapopulation exhibits an average intrinsic growth rate (lambda) not less than 1.0 over a period of at least 15 consecutive years; and total population size is not expected to decline by more than 20 percent within the next 15 consecutive years for any reason (USFWS, 2009).

3. Sufficient recovery habitat is protected and managed to achieve Criteria 1 and 2 (USFWS, 2009).

4. The mix of threats that were responsible for the decline of the species have been identified and controlled (USFWS, 2009).

Delisting Criteria:
The downlisting criteria described above have been satisfied for at least 30 consecutive years (USFWS, 2009).

Recovery Actions:
- Protect Ecosystems for recovery of endangered forest birds, which includes recommendations for new partnerships, private and Federal conservation agreements on private lands, and land use and management goals (USFWS, 2006).
- Manage forest ecosystems for the benefit and recovery of endangered forest birds, which includes recommendations for reforestation of recovery areas, reducing or eliminating the detrimental effects of alien plants, feral ungulates, and introduced predators, and ways to decrease the threat of avian disease (USFWS, 2006).
- Develop captive propagation and related recovery strategies, which describes techniques and priorities for the captive propagation and release of Hawaiian forest birds into the wild (USFWS, 2006).
- Conduct Research as Needed, which describes general categories of research needed to better evaluate threats to Hawaiian forest birds and to develop and evaluate management strategies to address those threats (USFWS, 2006).

Conservation Measures and Best Management Practices:
- Surveys / inventories – One of the most important recovery actions for the ou is to intensively and systematically search areas of forest habitat where the species occurred historically (USFWS 2006). Statewide surveys of Hawaiian forest bird populations are conducted along widely spaced transects (Scott et al. 1986) and do not cover all areas where extremely rare Hawaiian forest birds are most likely to be. Additionally, these surveys do not spend the lengths of time needed to maximize the probability that extremely rare Hawaiian forest birds will be detected or rediscovered. Therefore, the Service recommend that an intensive search for ou be conducted on Hawaii and Kauai using

similar methodologies as those employed during the Hawaii Rare Bird Search 1994-1996 (Reynolds and Snetsinger 2001). In addition, the Service recommends that autonomous recording units, or ARUs (Fitzpatrick 2002; Wallace 2010), be deployed in suitable habitats for this species. These field recording units record vocalizations of forest birds. The tapes are then analyzed using computer programs to determine if the target species is present in the area. Use of this technology would greatly increase the amount of search time for this species (USFWS, 2015).

- Threats – disease control research – Of particular concern to the continued survival of many Hawaiian forest birds (particularly Hawaiian honeycreepers) is avian disease. Existing tools and approaches have proved largely ineffective in addressing this problem given mosquito dispersal distance and the abundance of mosquito breeding sites in most wet native forest habitats (LaPointe et al. 2009). Opportunities are emerging however based on new genetic tools as part of the fields of synthetic biology and genomic technology that have the potential to assist Hawaiian forest birds in developing genetic resistance to avian disease (LaPointe et al. 2009). In addition, recent progress has been made with the development of genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other transgenic insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future. The Service encourages continued research in the fields of genomic technologies and genetically modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds (USFWS, 2015).
- Habitat and natural process management and restoration – Ou would benefit in the long-term from habitat restoration to assist other endangered birds on Hawaii and Kauai. The Service therefore recommends continued habitat management in areas where the species may still exist (USFWS 2006). Hawaiian forest birds susceptible to avian disease may become extinct following a drastic reduction in disease free habitat, but ultimately forest might expand into higher elevations maintaining disease free refugia for some species. Acquisition and management of transmission-free high-elevation habitat is crucial to the preservation and restoration of native Hawaiian forest birds (Lapointe et al. 2009). As a long-term contingency against a warming scenario, the Service recommends securing deforested and pasture lands on Hawaii at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for ou and other Hawaiian forest birds (USFWS, 2015).
- Captive propagation for reintroduction and genetic storage – Should ou be rediscovered the Service recommends the Rare Bird Discovery Protocol in the revised recovery plan for Hawaiian forest birds (USFWS 2006) be followed with regard to decisions for whether to attempt to establish a captive population for propagation and reintroduction or to manage rediscovered population(s) in situ (USFWS, 2015).

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SPECIES ACCOUNT: *Pterodroma sandwichensis (=P. phaeopygia sandwichensis)* (Hawaiian (dark-rumped) petrel)

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Hawaiian petrel is a medium-sized seabird in the family Procellariidae (shearwaters, petrels, and fulmars). The Hawaiian petrel is a medium petrel; it is approximately 16 inches long and has a wing span of about three feet. The Hawaiian petrel was formerly treated as a subspecies of Pterodroma phaeopygia, and was commonly known as the dark-rumped petrel (Service 1983, pp. 1-2). The Hawaiian petrel was reclassified as a full species in 1993 because of differences in morphology and vocalization. In 1997 the evolutionary split was confirmed by genetic analyses.

Historical Range

See current range/distribution.

Current Range

Hawaiian petrels were abundant and at one time, widely distributed; their bones have been found in archaeological sites throughout the archipelago (Olson and James 1982a, p. 32). The species was once found on all of the main Hawaiian Islands, except Niihau. Today, Hawaiian petrels breed in high-elevation colonies, primarily on east Maui and Mauna Loa on Hawaii Island, on Lanai, and to a lesser extent, on Kauai, and probably Molokai, Lehua, and sea stacks off Kahoolawe.

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Hawaiian petrel spend much of their time at sea where they are known to feed on squid, small fish, and crustaceans displaced to the surface by schools of tuna (Larson 1967, Simons 1985).

Reproduction Narrative

Adult: Hawaiian petrel spend much of their time at sea where they are known to feed on squid, small fish, and crustaceans displaced to the surface by schools of tuna (Larson 1967, Simons 1985). Petrels have been recorded in the Philippines (Rabor et al. 1970), Japan (Nakamura 1979), the Gulf of Alaska (Bourne 1965), and off the coast of Oregon and California (Pyle et al. 1993). Hawaiian petrels have been tracked taking single trips exceeding 6,200 miles circumnavigating the north Pacific during the nestling stage. Like other procellariiformes, Hawaiian petrels are highly philopatric, returning to the same burrow and mate each year (Simons 1985, pp. 233-234). Beginning in mid-February to early-March, after a winter absence from Hawaii, breeding and non-breeding birds visit their nests regularly at night. After a period of social activity and burrow maintenance they return to sea until late April, when they return to the colony site and egg-laying commences. From mid-March to mid-April, birds visit their burrows briefly at night on several occasions. Then breeding birds return to sea until late April or early May, when they return to lay and incubate their eggs (Simons 1985). Non-breeding birds visit the colony from February until late July (Simons and Hodges 1998, pp. 13-14). Information provided by Bailey and Duvall (December 9, 2010), confirmed by Fein's analysis of burrow camera data for the ATST site (Fein, pers. comm. 2009) indicating birds intermittently occupy their burrows during the day during this period as well. Many non-breeders are young birds seeking mates and prospecting for nest sites, but some proportion is thought to be mature adults that will not breed. The mean date of egg-laying recorded on Haleakala in 1980 and 1981 was May 8 (Simons 1985, p. 234). Females lay their egg within 24 hours of returning to the burrow. Male and female birds alternate incubation attendance. Total incubation period ranges from 45 to 58 days (Simons 1985). Incubating adult Hawaiian petrels spend almost 95% of their time sleeping with their bills buried in their scapular feathers, 3% of their time resting quietly in their nest, and the final 2% of the time arranging nest material or preening (Simons 1985). Given weight loss measurements by Simons (1985), undisturbed birds lose 1.54% of their initial body weight per day when incubating an egg. Simons (1985) estimated that a male Hawaiian petrel, which he found taking a 23-day incubation shift, may have lost 35.5% of its body weight during the shift. Egg temperature and evaporative water loss are controlled by the incubating adult. Because the metabolism of awake, resting birds is almost twice that of sleeping birds (Simons 1985), disturbance of incubating birds' sleep could potentially result in more rapid weight loss and an inability of the adult to stay on the egg until its mate relieves it. Although one egg, neglected for three days during the middle of the incubation period, did successfully hatch, the duration to which eggs remain viable given the absence of an incubating adult is unknown (Simons 1985). The survivorship of juveniles given absent parents is also unknown. Adults depart from the nest to forage at sea within one to six days after the chick hatches (Simons 1985). Chicks spend 66% of their time alert, resting quietly, 26% of their time sleeping, 6% of their time preening or stretching, and 2% of their time walking around (Simons 1985). Nocturnal feeding by one parent occurs approximately every other day until the chick is 90 days old. After 90 days, adults appear to continue to feed chicks until the chick refuses food. Chicks fledge between late September and late October after an average of 111 days after hatching (Simons 1985). Although adults are occasionally observed to remain after fledglings depart, colonies generally are empty by the end of November. The percentage of the adult population that breeds each year is estimated to be 89% (Simons 1985). The percentage of years in which adult females laid eggs was estimated to be 89% (Simons 1985, p. 234). Fecundity (fledglings produced per egg laid) appears to be primarily dependent on rate of predation. Moderate predation is likely to depress fecundity to 0.49 (Simons 1985, p. 237). Although Hawaiian petrel nests may fail when birds abandon and crush eggs during incubation, higher fecundity (0.72 (Simons 1984, p. 1068)) occurs when predators are absent. Annual survival for juveniles at sea is 0.834 (Simons 1984, p. 1070). Cooper and Day found that Hawaiian petrels flew inland to their nesting areas primarily between sunset and the point of complete darkness. In the morning hours, Hawaiian petrels first move to sea while it was completely dark, starting 60 minutes prior to sunrise, and movement rates increased rapidly until they peaked just after the point of complete darkness had been crossed and movement continued at a decreasing rate until sunrise (Day and Cooper 1995, pp. 32-34). Peak fledging, when young seabirds make their first flight to sea, occurs between September 1 and December 1 (Penniman pers. comm. 2011).

Habitat Narrative

Adult: On Hawaii and Maui, Hawaiian petrels nest in the cold, xeric environment above 8,000 feet primarily in national parks. On Kauai, there is evidence that Hawaiian petrels nest at lower elevations in densely vegetated rainy environments (Ainley et al. 1997a, p. 24). Hawaiian petrels are colonial and nest in burrows, crevices in lava, or under ferns. Burrows detected on Haleakala occur almost exclusively on lava substrates; burrows are located within existing crevasses or excavated in softer material adjacent to rock to boulder-sized lava fragments. Their burrows are generally three to six feet long (from entrance to nest chamber), although some may be as long as 30 feet (Simons and Hodges 1998, p. 14).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory

Dispersal/Migration Narrative

Adult: Petrels have been recorded in the Philippines (Rabor et al. 1970), Japan (Nakamura 1979), the Gulf of Alaska (Bourne 1965), and off the coast of Oregon and California (Pyle et al. 1993). Hawaiian petrels have been tracked taking single trips exceeding 6,200 miles circumnavigating the north Pacific during the nestling stage. Like other procellariiformes, Hawaiian petrels are highly philopatric, returning to the same burrow and mate each year (Simons 1985, pp. 233-234).

Population Information and Trends

Population Size:

1,000-34,000. New in 2017: Croxall et al. (2012) estimated a population of 9,000 to 16,000 adult Hawaiian Petrels, based on data from the International Union for the Conservation of Nature. At Haleakala National Park, 2,505 known nests are known to occur (Bailey, pers comm 2017). (USFWS, 2017).

Population Narrative:

An accurate estimate of total numbers of Hawaiian petrels is not available; however, estimates range from thousands to about 34,000 (Ainley et al. 1995, Spear et al. 1995). Based on pelagic observations, the total population including juveniles and sub-adults was estimated at 20,000 with a breeding population of 4,500 to 5,000 pairs in 1995 (Spear et al. 1995, p. 629). There have been no total population estimates made since then. Maui Approximately 1,700 Hawaiian petrel burrows have been found in the Park (Bailey, pers. comm. 2011b), and an additional 600 breeding pairs are thought to occupy unsurveyed areas of the Haleakala Crater Rim (SWCA 2011). Based on breeding and Geographic Information System (GIS) data, the total population at Haleakala is estimated at 3,000 – 4,000 breeding pairs (Haleakala National Park, unpublished data). In addition, approximately 55 breeding pairs occupy the Advanced Technology Solar Telescope (ATST) mitigation site (ATST 2010) and the Auwahi project detected an additional 33 active burrows at Kahikinui (Tetra Tech 2012). Ainley (SWCA 2011, Appendix 25, p. 2) estimates there is a declining population of 600 breeding pairs of Hawaiian petrels nesting in the West Maui Mountains. Hawaii Dr. Hu (2009) located 115 active burrows within Hawaii Volcanoes

National Park in 2006. The colony on Mauna Loa is estimated to be approximately 75 breeding pairs (Hu pers. comm. 2008). Kauai Kauai populations are difficult to assess, and Cooper and Day (1995, p. iv) estimated there were between 1,400 and 7,000 individuals on that island in 1993. Ainley et al. (1997a, p. 28) estimated that there were 1,600 breeding pairs of Hawaiian petrel on Kauai. Lanai A breeding colony of the Hawaiian petrel was rediscovered on Lanai in 2006, near the summit of Lanaihale. Although the petrel colony was historically known to occur, its status was unknown and thought to have dramatically declined until surveys were conducted in 2006 (Penniman, pers. comm. 2007). The nesting habitat used by the Hawaiian petrel colony on Lanai is delineated by the approximate area of the uluhe ferns (Dicranopteris linearis). Monitoring and research on this population is ongoing, and its size has not been estimated with statistical confidence, but the population appears to be similar in abundance to the Haleakala population, where the largest number of breeding birds is currently known to exist (Penniman, pers. comm. 2011).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: This species has no natural terrestrial predators other than the Hawaiian short-eared owl (Asio flammeus sandwichensis). Early Polynesian hunting; predation by introduced mammals such as Polynesian rats, dogs (Canis lupus familiaris), and pigs; and habitat alteration caused initial decline of the Hawaiian petrel population and probably its extirpation from Oahu (Olson and James 1982b, p. 634). The introduction of cats, mongoose, and two additional species of rats (R. rattus and R. norvegiceus) since Euro-American contact along with accelerating habitat loss has led to small relict colonies of Hawaiian petrels in high-elevation, remote locations. The primary reason for the relatively large numbers of petrels and their successful breeding around Haleakala summit today is the fencing and intensive predator control maintained by the Park since about 1982. However, if current elevated levels cat of predation continue, significant declines in even the Park's relatively protected Hawaiian petrel population are likely (Bailey pers. comm. 2011b). Elsewhere on Maui and in Hawaii, the Hawaiian petrel faces severe threats from non-native predators including rats, cats, mongoose, and introduced barn owls. Ainley (SWCA 2011, Appendix 25, p. 2) modeled the declining population of 600 breeding pairs of Hawaiian petrels in the West Maui Mountains and predation impacts may render this relatively large population functionally extinct in 27 years (SWCA 2011, Appendix 24, p. 8). Other significant anthropogenic sources of Hawaiian petrel mortality are light attraction and collision with communications towers, power transmission lines and poles, fences, and other structures (Simons and Hodges 1998, pp. 21-22). Fallout of fledglings, making their first flight to the open ocean, is greatest during the week prior to and following the new moon between September 1 and December 1 (J. Penniman, pers. comm. 2011). These problems are likely to be exacerbated by continuing development and urbanization throughout Hawaii. Predator control in key habitat areas, the establishment of bird salvage-aid stations, and light attraction studies have been initiated to help conserve the Hawaiian petrel.

Stressor: Alternative Energy Development (USFWS, 2017).
Exposure:
Response:

Consequence:
Narrative: The Pacific Islands Fish and Wildlife Office has permitted Habitat Conservation Plans (HCP) for four wind energy projects that authorized take of a total of 143 adult Hawaiian Petrels and 37 chicks on Maui. To date, an estimated 18 birds have been taken on Maui. On Hawaii Island, negotiations for two wind projects are under development and will be seeking HCP permits for take of Hawaiian Petrels. (USFWS, 2017).

Recovery

Reclassification Criteria:
Downlisting Criterion 1: Viable Hawaiian petrel metapopulations that represent the ecological, morphological, behavioral and genetic diversity of the species occur within their current and historical distribution on seven of the eight main Hawaiian islands. (USFWS, 2019).

Downlisting Criterion 2: Quantitative surveys show that the population trend at locally monitored sites on each island has been stable or increasing over a period of at least 15 consecutive years, or demographic monitoring shows that each island metapopulation exhibits an average intrinsic growth rate not less than 1.0 over a period of at least 15 consecutive years. (USFWS, 2019).

Downlisting Criterion 3: Hawaiian petrel breeding sites throughout the current and historical distribution of the species are effectively protected and managed (e.g., ungulate/predator-proof fencing, intensive control of small mammals and avian predators) over an area sufficient to achieve Criteria 1 and 2 above. (USFWS, 2019).

Downlisting Criterion 4: The combination of threats responsible for the decline of Hawaiian petrels have been sufficiently managed to achieve Criteria 1 and 2 above, and the needed threat management will be in place for the foreseeable future. (USFWS, 2019).

Delisting Criteria:
Delisting Criterion 1: Viable Hawaiian petrel metapopulations that represent the ecological, morphological, behavioral and genetic diversity of the species occur within their current and historical distribution on seven of the eight main Hawaiian islands. (USFWS, 2019).

Delisting Criterion 2: Quantitative surveys show that the population trend at locally monitored sites on each island has been stable or increasing over a period of at least 30 consecutive years, or demographic monitoring shows that each island metapopulation exhibits an average intrinsic growth rate not less than 1.0 over a period of at least 30 consecutive years. (USFWS, 2019).

Delisting Criterion 3: Hawaiian petrel breeding sites throughout the current and historical distribution of the species are effectively protected and managed (e.g., ungulate/predator-proof fencing, intensive control of small mammals and avian predators) over an area sufficient to achieve Criteria 1 and 2 above. (USFWS, 2019).

Delisting Criterion 4: The combination of threats responsible for the decline of Hawaiian petrels have been sufficiently managed to achieve Criteria 1 and 2 above, and the needed management will be in place for the foreseeable future. (USFWS, 2019).

Recovery Actions:

- The recovery goals for the Hawaiian petrel include: (1) protect and enhance existing colonies; (2) create new colonies; (3) mitigate new and existing threats by a) implementing prioritized management actions, and b) undertaking research and outreach to support those actions. Actions identified to accomplish these goals for Hawaiian petrel include conducting surveys for existing colonies, controlling threats at the highest priority colonies, and minimizing and monitoring terrestrial threats away from the colonies (light attraction, power line collisions). The Kauai Seabird Habitat Conservation Plan is being prepared to address adverse human impacts to seabirds on that island. In addition, the Hawaii Department of Land and Natural Resources – Division of Forestry and Wildlife (DOFAW) has been conducting auditory surveys for new areas containing nesting Hawaiian petrels through the Kauai Endangered Species Recovery Program and will use colony ranking criteria to identify areas where recovery actions can be most successful. The State has developed a management plan for the Hono o Na Pali Natural Area Reserve that includes feral ungulate control, but little work has been implemented due to the lack of funding. A 400 acre portion of the privately-owned Upper Limahuli Preserve has been fenced to create an ungulate free area known to contain nesting Hawaiian petrels. Efforts to control feral cats within the Preserve has begun, but the landowner does not have funds to sustain the efforts (B. Standley, pers. comm. 2011). Since 1979 the Kauai District of DOFAW has supported the Save Our Shearwaters program to collect "downed" Newell's shearwaters and Hawaiian petrels (i.e., birds that have either collided with structures or fallen out, or have been injured or killed due to exhaustion caused by light attraction). According to the Save Our Shearwaters files, over 33,000 seabirds have been recovered to date (DOFAW 2008). The majority of the birds are Newell's shearwaters, which nest in greater numbers on Kauai than Hawaiian petrels. The lower number of Hawaiian petrels recovered is thought to be a function of their population size on Kauai, not due to differences in behavior or ability to detect structures in the dark (B. Standley, pers. comm. 2011). First Wind LLC is currently proposing a conservation project to mitigate for impacts to Hawaiian petrels and Newell's shearwaters from the Kaheawa Wind Power Facilities on east Maui. The mitigation project will involve the construction of two predator-free enclosures and implementation of colony management, including predator control, social attraction, and possibly the translocation of pre-fledgling juveniles to Makamakaole.
- 2017 Recommendation a): Conduct on the ground surveys for burrows at the locations Deringer and VanZandt (2011) and Young and VanderWerf (2016) detected Hawaiian Petrels. (USFWS, 2017)
- 2017 b): Identify other sites on each of the main Hawaiian Islands that might be suitable for Hawaiian petrels and survey using acoustic monitors, follow up with on the ground surveys for burrows. (USFWS, 2017).
- 2017 c): Maintain and expand predator control within and surrounding the Mauna Loa Hawaiian Petrel colony, particularly the colonies outside the cat-proof fence and at Hapai Mamo. (USFWS, 2017).
- 2017 d): Expand acoustic monitoring at Hapai Mamo to determine the extent of the colony. (USFWS, 2017).
- 2017 e): Conduct strategic and low impact surveys for occupied Hawaiian Petrel breeding habitat within the Nuu unit of Haleakala National Park in conjunction with ungulate fence construction, in order to prioritize predator control efforts in this area. (USFWS, 2017).

- 2017 f): Maintain support and oversight of the 1.8-hectare Makamakaole Seabird Predator-Proof Fence in West Maui, constructed by First Wind, Inc. and maintained by Kaheawa Wind Power LLC, specifically to create a new Hawaiian Petrel breeding colony within a protected predator-free area on Maui. (USFWS, 2017).
- 2017 g): Construct a predator exclusion fence to protect the largest known extant Hawaiian Petrel colony on Kauai at Hono o Na Pali while limiting the impact and restoring where possible the montane wet ecosystem of this area. (USFWS, 2017).
- 2017 h): Maintain and expand predator control at the Lanaihale Hawaiian Petrel colony, in conjunction with and prior to any additional ground surveys in order to limit vegetation trampling and predator ingress (USFWS, 2017).
- 2017 i): Assess feasibility of predator-fencing core colony areas on Lanaihale and pursue fence construction if possible (USFWS, 2017).
- 2017 j): Continue ongoing monitoring programs to obtain updated population demographic information and life history parameters. (USFWS, 2017).
- 2017 k): Increase the number of colonies that are monitored and actively managed. (USFWS, 2017).
- 2017 l): Construct a new predator proof enclosure as a social attraction site along the edge of the Kalalau Valley, as part of the Kauai Seabird Habitat Conservation Plan. (USFWS, 2017).
- 2017 m): Conduct large scale predator control programs in as many Hawaiian Petrel colonies as possible. (USFWS, 2017).
- 2017 n): Continue to work with the utility company on Kauai to decrease power line collisions (using techniques such as laser fences, bird diverters and line reconfiguration projects) and on other islands assess power lines for collision threats as power line collisions are poorly studied on islands outside of Kauai. (USFWS, 2017).

Conservation Measures and Best Management Practices:

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References

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SPECIES ACCOUNT: *Puffinus newelli (=P. auricularis newelli)* (Newell's shearwater)

Species Taxonomic and Listing Information

Listing Status: Threatened; 10/28/1975; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Newell's shearwater is a member of the genus Puffinus and utilizes open tropical seas and offshore waters for foraging, returning to land to breed atop forested mountain slopes. The Newell's shearwater is approximately 12 to 14 inches long, with a wingspan of 30 to 35 inches, and weighs approximately 14 ounces. Its plumage is glossy black above, and white below. It has a black bill that is sharply hooked at the tip. Its claws are well adapted for burrow excavation and climbing.

Current Range

Newell's shearwaters were once abundant on all of the main Hawaiian Islands. In 1995 the population estimate, based on at-sea surveys was 84,000 birds (Spear et al. 1995, p. 624), with approximately 90 percent of the population nesting on the island of Kauai. Newell's shearwaters also breed on several other Hawaiian islands, in mountainous terrain between 500-2,300 feet in elevation. This species is known to nest on the islands of Hawaii and Molokai, and may still nest on the island of Oahu. The occurrence on the island of Maui of injured, dead, or grounded adults in the summer, low numbers of radar-detected birds exhibiting Newell's shearwater-like timing of movements, and the presence of juveniles in autumn suggests that this species also nests on the island of Maui. Recent ornithological radar surveys, combined with returns of downed birds to the Save Our Shearwaters (SOS) program, show an apparent decline of 75 percent in Newell's shearwater between 1993 and 2009 (Day et al. 2003a, Holmes et al. 2009), resulting in a current population estimate of 21,000, with 18,900 on the island of Kauai. Significant range reductions as well as an overall decline in distribution are documented, and at least three colonies documented as being active between 1980 and 1994 are now abandoned (Holmes et al. 2009). As with other long-lived species with low reproductive rates, population modeling has documented that the survival rate of breeding age adults has the biggest impact on the population (Griesemer and Holmes 2011). Population models incorporating best estimates of Newell's shearwater breeding effort and success yielded a population decreasing at a rate of 3.2 percent annually (Ainley et al. 2001, p. 118). When threat factors resulting in Newell's shearwater mortality were included (predation, light attraction and collision), these models predicted a population decline of 30 to 60 percent over 10 years (Ainley et al. 2001, p. 122).

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Feeds on fishes, plankton, and sometimes ship garbage. Young are fed regurgitated ocean-caught squid and fishes.; Food Habits: Piscivore (Adult, Immature), Invertivore (Adult, Immature)Calling and flight activity at nesting areas are mainly nocturnal and/or crepuscular. On Kauai, movements were strongly nocturnal; movements were primarily inland in the evening, mainly seaward in the morning, and both directions in the middle of the night (Day and Cooper 1995).; (NatureServe, 2015)

Reproduction Narrative

Adult: Most of the life history information for this species is based on studies of the Kauai population; life histories of birds on other Hawaiian islands may differ slightly. During their nine-month breeding season from April through November, Newell's shearwaters live colonially in burrows under ferns on forested mountain slopes. These burrows are used year after year and usually by the same pair of birds. A single egg is laid in late May or early June (Ainley et al. 1997a, pp. 13-15). Both sexes incubate and this period lasts approximately 45 days. Fledging occurs between October and November. The Newell's shearwater needs an open downhill flight path to become airborne or combination of sustained wind and suitable topography. Daily flights of breeding adults to and from the colonies occur only at night and just before dawn. On the island of Kauai, Newell's shearwaters were found to exhibit movement 20-80 minutes after sunset, whereupon they moved inland in a wave that peaked at 35-70 minutes after sunset (KESRP 2014). This peak of movement steadily decreased until 110 minutes after sunset, at which time few birds are seen. In the morning, Newell's shearwaters begin moving to sea approximately 100 minutes before the first measurable light and movement rates increase rapidly and peak an hour before sunrise (KESRP 2014). Three age classes of Newell's shearwaters are recognized based on demographic factors and assumptions (from Ainley et al. 2001, p. 115): (1) young-of-year; (2) pre-breeding immature/adult (if recognizable); and (3) breeding adults. Only 46 percent of pairs that actively use a burrow actually breed in a given year on the island of Kauai (Ainley et al. 2001, p. 117). First breeding occurs at approximately six years of age (Ainley et al. 1997a, p. 17). A study of reproductive success at one Newell's shearwater colony on the island of Kauai documented an average annual production of 0.66 young per pair (Ainley et al. 2001, p.117). No specific data exist on the longevity for this species, but other shearwaters may reach 30 years of age or more.

Environmental Specificity

Adult: The Newell's shearwater needs an open downhill flight path to become airborne or combination of sustained wind and suitable topography.

Habitat Narrative

Adult: Pelagic. On the island of Kauai, Newell's shearwaters breed at elevations between 528 and 3,960 feet. Newell's shearwaters usually nest where the terrain is vegetated by an open canopy of trees with an understory of densely matted uluhe ferns (Dicranopteris linearis). Some Newell's shearwaters nest in other types of habitat such as on the walls of Waimea Canyon, Kauai, where a forest canopy is absent. Burrows used by Newell's shearwaters are most commonly placed at the base of trees, where the substrate may be easier for the birds to excavate.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory

Dispersal/Migration Narrative

Adult: Most depart Hawaiian waters by October-November, return by April (Pratt et al. 1987) (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decreasing

Population Growth Rate:

Apparently abundant in Hawaiian Islands at the time of Polynesian colonization; thought to be extinct there by 1908, but breeding was confirmed on Kauai in 1967 (Ainley et al. 1997). Decline of >70% (NatureServe, 2015)

Population Size:

~21,000

Population Narrative:

Newell's shearwaters were once abundant on all of the main Hawaiian Islands. In 1995 the population estimate, based on at-sea surveys was 84,000 birds (Spear et al. 1995, p. 624), with approximately 90 percent of the population nesting on the island of Kauai. Newell's shearwaters also breed on several other Hawaiian islands, in mountainous terrain between 500-2,300 feet in elevation. This species is known to nest on the islands of Hawaii and Molokai, and may still nest on the island of Oahu. The occurrence on the island of Maui of injured, dead, or grounded adults in the summer, low numbers of radar-detected birds exhibiting Newell's shearwater-like timing of movements, and the presence of juveniles in autumn suggests that this species also nests on the island of Maui. Recent ornithological radar surveys, combined with returns of downed birds to the Save Our Shearwaters (SOS) program, show an apparent decline of 75 percent in Newell's shearwater between 1993 and 2009 (Day et al. 2003a, Holmes et al. 2009), resulting in a current population estimate of 21,000, with 18,900 on the island of Kauai. Significant range reductions as well as an overall decline in distribution are documented, and at least three colonies documented as being active between 1980 and 1994 are now abandoned (Holmes et al. 2009). As with other long-lived species with low reproductive rates, population modeling has documented that the survival rate of breeding age adults has the biggest impact on the population (Griesemer and Holmes 2011). Population models incorporating best estimates of Newell's shearwater breeding effort and success yielded a population decreasing at a rate of 3.2 percent annually (Ainley et al. 2001, p. 118). When threat factors resulting in Newell's shearwater mortality were included (predation, light attraction and collision), these models predicted a population decline of 30 to 60 percent over 10 years (Ainley et al. 2001, p. 122). New in 2017: Recent surveys suggest birds may still be extant throughout its historical range, albeit in low numbers. On Hawaii Island, surveys by Deringer and VanZandt (2011) detected birds calling in Waipio and Pololu Valleys in the Kohala Mountains. Follow-up ground surveys by the authors did not locate burrows. Young and VanderWerf (2016) used song meters at three sites in the Kohala Mountains on Hawaii Island, and detected Newell's Shearwater calls at an additional site, Waimanu Valley, which was not surveyed by Deringer and

VanZandt (2011). On Maui, Newell's Shearwater ground calling is heard consistently by Haleakala National Park staff within Kipahulu Valley and along the northern slope of Mount Haleakala near Koolau Gap, indicating a probable breeding site (National Park Service [NPS] 2012). However, due to sensitive natural resources in the area and difficult terrain, no ground surveys have been conducted in this location (NPS 2012). Young and VanderWerf (2016) deployed song meters at 20 sites in the western Maui mountains, and detected Newell's Shearwaters at 2 sites, but with very low calling rates. Surveys using song meters at three sites on Molokai resulted in one detection of a Newell's Shearwater (Young and VanderWerf 2016). Although no Newell's Shearwater breeding colonies have been identified on the island of Oahu, downed Newell's Shearwaters have been recovered on Oahu since the 1950s (Pyle and Pyle 2009), and Young and VanderWerf (2016) documented a total of four calls at two sites in the Waianae mountains using song meters. More thorough surveys at sites on Oahu are being conducted during the 2017 breeding season (L. Young, pers. comm. 2017). However, it is likely that there are no breeding populations on Molokai and Oahu. (USFWS, 2017).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Threats to the Newell's shearwater and Hawaiian petrel have been steadily increasing. During the last 150 years, 75 percent of the forests in the main Hawaiian Islands were converted to agricultural, military, commercial or residential land uses, which led to a depletion of available nesting habitat for this species. The introductions of the mongoose (Herpestes auropunctatus), black rat (Rattus rattus), and Norway rat (Rattus norvegicus) have also played a primary role in the reduction of ground-nesting seabirds. Predation by feral cats (Felis domesticus) and barn owls (Tyto alba) have also been observed. In addition, feral pigs (Sus scrofa) are known to collapse seabird burrows as well as consume or prey upon shearwater adults and young. Another major threat is the species' attraction to light. Increasing urbanization and the accompanying artificial lights have resulted in substantial problems for fledgling Newell's shearwaters during their first flight to the ocean from their nesting grounds. When attracted to man-made lights, fledglings become confused and may suffer temporary night blindness. They often fly into utility wires, poles, trees, and buildings and fall to the ground, referred to as "fallout". Since 1979 the State's Division of Forestry and Wildlife (DOFAW) on the island of Kauai has supported the SOS program to collect "downed" Newell's shearwaters and Hawaiian petrels (i.e., birds that have either collided with structures or fallen out, or have been injured or killed due to exhaustion caused by light attraction). According to SOS files, over 33,000 seabirds were recovered to date (DOFAW 2008). The majority of the birds are Newell's shearwaters, which nest in greater numbers on the island of Kauai than Hawaiian petrels. The lower number of Hawaiian petrels recovered is thought to be a function of their population size on the island of Kauai, not due to differences in behavior or ability to detect structures in the dark.

Recovery

Recovery Actions:

- The Draft Newell's Shearwater and Hawaiian Petrel Five-year Action Plan describes a recovery strategy that will 1) protect and enhance existing colonies, 2) create new colonies,

3) mitigate existing and new threats by a) implementing and monitoring prioritized management actions at the species level, and b) undertaking research and outreach to support these actions (Holmes et al. 2011). Actions identified to accomplish this strategy include conducting surveys for existing colonies, controlling threats at the highest priority colonies, and minimizing and monitoring man-made threats (e.g., light attraction and power line collisions). DOFAW has been conducting auditory surveys for new areas containing nesting Newell's shearwaters through their KESRP research program and is developing colony ranking criteria to identify where the objectives of the five-year action plan can be implemented. The minimum conditions necessary to effectively implement colony management that would be expected to achieve a measureable increase in seabird survival and/or reproduction include species presence, access to the areas occupied by breeding seabirds, and landowner authorization and commitment to maintain the managed area in a manner that is consistent with seabird conservation. To date, management actions focused on increasing seabird survival and reproduction are being carried out at only two known nesting colonies occupied by Newell's shearwater (Hono o Na Pali Natural Area Reserve (NAR) and Upper Limahuli Valley Preserve). The State has developed a management plan for the Hono o Na Pali NAR that includes fencing and feral ungulate removal. A 400-acre portion of the privately-owned Upper Limahuli Preserve was fenced to create an ungulate free area for nesting Newell's shearwaters. While some efforts to protect existing nesting colonies of Newell's shearwater have been implemented on the island of Kauai, they have been limited to constructing ungulate fencing around remaining areas of relatively intact habitat (e.g., Wainiha Valley, Upper Limahuli Valley, etc.). Habitat degradation due to feral ungulates is recognized as the primary threat to native ecosystems in Hawaii and the conservation and restoration of such areas is unsuccessful in the presence of ungulates (Hawaii Conservation Alliance 2005, p. 1). The only active control of cats and/or rats within an area occupied by nesting Newell's shearwaters on the island of Kauai on private property in Upper Limahuli Valley and the State of Hawaii Hono o Na Pali NAR began in 2010 and 2012 respectively. Funding for seabird conservation work is provided in part through the Kauai Island Utility Cooperative (KIUC) Short-term Seabird Habitat Conservation Plan. Efforts to reduce the level of light attraction and power line collisions began in the 1980's when KIUC began replacing unshielded street lights with full-cutoff (shielded) lights across the island as part of its normal maintenance program. All of the over 3,500 streetlights operated by KIUC are now shielded, as are the lights at the facilities it operates. In 2002 KIUC prepared an assessment of the power line segments originally identified by Ainley et al. (1995) as causing the most collisions (David and Day 2002). In 2007, KIUC began reconfiguring the lines along one of the "hotspot" areas near Kealia Beach by temporarily changing the uppermost electrical circuit from a vertical to a horizontal arrangement which eliminated three of four wire layers in the circuit and reduced the height by about 10 feet. KIUC has been coordinating with the Federal Highways Administration, Hawaii Department of Transportation, and Hawaii Department of Land and Natural Resources to identify and plan for the undergrounding of certain line segments that pose the most collision risk to seabirds. DOFAW, in conjunction with the Service, is currently developing an island-wide HCP, known as the Kauai Seabird Habitat Conservation Program (KSHCP). This HCP will provide non-federal entities the opportunity to apply for incidental take of listed seabirds. KSHCP is developing a plan to assist landowners to avoid, minimize, and monitor take at their facilities. To offset take that cannot be avoided, applicants would combine funds to conduct landscape scale conservation actions to benefit listed seabirds. KSHCP is designed to accept multiple applicants in order to mitigate for the island-wide level of take; however

given the number of entities believed to have on-going take and scope and scale of potential covered activities, some proportion of current seabird take on the island of Kauai is likely to continue unmitigated even after the completion of the KSHCP.

- Recommendations in 2017: a) Maintain support and oversight of the two 1.8-hectare (4.4-acre) Makamakaole Seabird Predator-Proof Fences in West Maui, constructed by First Wind, Inc. and maintained by Kaheawa Wind Power LLC, specifically to create a new Newell's Shearwater breeding colony within a predator-free area on Maui. Efforts at this site should be focused on restoring native montane habitat, since this site was previously used for agricultural purposes. (USFWS, 2017).
- 2017, b): Conduct additional acoustic surveys within remote areas of Haleakala National Park in southeastern Maui, to identify the areas of Newell's breeding habitat and the relative colony population size, and manage those colonies. (USFWS, 2017).
- 2017, c): Identify at least one Newell's shearwater colony of sufficient size for management on each island other than Kauai, and implement management actions such as ungulate fencing and removal, and predator control. (USFWS, 2017).
- 2017, d); Construct predator exclusion fences to fully enclose and protect colonies within the Hono o Na Pali Natural Area Reserve (NAR) and the entirety of the Upper Limahuli colony. (USFWS, 2017).
- 2017, e): Construct a predator-proof fence to protect the Honopu seabird colony to manage depredation by pigs and habitat damage from pigs and goats. (USFWS, 2017).
- 2017, f): Construct a cat-exclusion fence located in the State's Hono'o'Na Pali NAR, enclosing the Hono o Na Pali colony. (USFWS, 2017).
- 2017, g): Construct a new predator-proof enclosure as a social attraction site along the edge of the Kalalau Valley, as part of the Kauai Seabird Habitat Conservation Plan. (USFWS, 2017).
- 2017, h): Conduct large-scale predator control programs in as many Newell's Shearwater colonies as possible. (USFWS, 2017).
- 2017, i): Continue to work with the utility company on Kauai to decrease power line collisions (using techniques such as laser fences, bird diverters and line re-configuration projects). On other islands, assess power lines for collision threats as power line collisions are poorly studied on islands outside of Kauai. (USFWS, 2017).
- 2017, j): Implement erosion control measures, best management practices (e.g., area closures) and native vegetation restoration to prevent damage to sensitive montane habitat by ungulates and nonnative plants. (USFWS, 2017).

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SPECIES ACCOUNT: *Rallus longirostris levipes* (Light-footed clapper rail)

Species Taxonomic and Listing Information

Listing Status: Endangered; October 13, 1970 (35 FR 16047).

Physical Description

The light-footed clapper rail is a hen-sized marsh bird; it is approximately 36 centimeters (cm) (14 inches [in.]) in length, with a slightly down-curved bill longer than the head, and a short, upturned tail. It has long legs and long toes that are dull yellowish-gray. Males and females are identical in plumage. The cinnamon breast contrasts with the streaked plumage of its grayish-brown back and gray and white barred flanks. Most of the side of the head, including the cheeks, is gray. The chin and throat, and a line from the base of the bill to the top of the eye, are very light buff (USFWS 2009). Although similar to the California clapper rail (R. l. obsoletus), the light-footed clapper rail is slightly smaller, its bill is more slender, its back is less gray (darker, browner, or more olive), its breast is a richer cinnamon color, and the stripe over its eye is more whitish (less rusty) (USFWS 1985).

Taxonomy

When first described, the light-footed clapper rail was considered a king rail (Rallus elegans) (USFWS 1985). Later, it was listed as a California clapper rail, which at that time was designated a full species, Rallus obsoletus (USFWS 1985). The light-footed rail became recognized as a unique entity in 1899 when Bangs named it Rallus levipes (USFWS 1985). It remained classified as a full species until 1929, when Van Rossem showed that all Pacific Coast clapper rails were at most geographical races of one species, and the light-footed rail became Rallus obsoletus levipes (USFWS 1985). In 1937, Oberholser lumped all North American clapper rails into one species, and the name of this subspecies became Rallus longirostris levipes, which has been the recognized name ever since (USFWS 1985). This subspecies is one of three in California (USFWS 1985; USFWS 2009). Although similar to the California clapper rail (R. l. obsoletus), the light-footed clapper rail is slightly smaller, its bill is more slender, its back is less gray (darker, browner, or more olive), its breast is a richer cinnamon color, and the stripe over its eye is more whitish (less rusty) (USFWS 1985). The California clapper rail and the light-footed clapper rail occur in coastal salt marshes of northern and southern California, respectively. The third subspecies, the Yuma clapper rail (R. l. yumanensis), occurs inland along the Salton Sea and lower Colorado River.

Historical Range

The historical range of the light-footed clapper rail was originally described as extending from Santa Barbara County, California, United States, to San Quintin Bay, Baja California, Mexico (USFWS 2009).

Current Range

The range of the light-footed clapper rail in California now extends from Ventura County in the north to the Mexican border in the south. Light-footed clapper rails have not been detected in Santa Barbara County since 2004, or in Los Angeles County since 1983 (USFWS 2009). Surveys in the 1980s detected light-footed clapper rails in Baja California, Mexico; however, the current status and abundance of populations south of the United States border are unknown (USFWS 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Light-footed clapper rails are omnivorous opportunistic foragers. Foraging methods of the light- footed clapper rail include surface gleaning, probing, diving, and scavenging. Foraging occurs in all parts of the salt marsh, but is typically concentrated in the lower marsh when the tide is out and higher marsh as the tide advances (USFWS 2009). Foraging occasionally occurs in habitats surrounding the salt marsh, including vegetation-mud flat interfaces, along mud banks of intertidal creeks, in freshwater vegetation and ditched/ponded water, and to a lesser extent on open mudflats and upland hillsides (USFWS 1985). Light-footed clapper rails mostly eat salt marsh invertebrates such as beetles (Coleoptera), garden snails (Helix spp.), California hornsnails (Cerithidea californica), salt marsh snails (Melampus olivaceus), fiddler and hermit crabs (including Pachygrapsus crassipes, Hemigrapsus oregonensis, and probably Uca crenulata), crayfish, isopods, and decapods (USFWS 2009).

Reproduction Narrative

Adult: The pair bond among light-footed clapper rails endures throughout the season, and often from year to year. Nests are placed to avoid flooding by tides, yet in dense enough cover to be hidden from predators and to support the relatively large nest. Typical nests are elevated 10 to 46 cm (4 to 18 in.) above the ground. The outside edges of nesting platforms are typically woven into the surrounding live cordgrass (Spartina spp.), which secures the nest as it floats during high tide. Nests typically include one or two ramps of vegetation leading to the ground, and a loosely woven canopy of live stems and leaves. Light-footed clapper rails build several types of nest, including those used for incubation and those used for brooding the young (USFWS 1985; USFWS 2009). Nesting usually begins in March, and late nests hatch by August (USFWS 2009).First-year birds (adults) claim their breeding territories and most egg-laying takes place from early April to early May (USFWS 1985). Females lay approximately four to eight eggs, which hatch in 18 to 27 days. Both parents attend to the nest, which is constantly incubated during daylight hours, and both parents perform maintenance of the nest. In addition, both parents care for the young; one forages while the other adult broods the chicks (USFWS 1985; USFWS 2009). Adults have been observed feeding fully grown chicks of at least 6 weeks of age (USFWS 1985). Potential predators on eggs, nestlings, or adults include California ground squirrels (Spermophilus beecheyi), old world rats (Rattus spp.), striped skunk (Mephitis mephitis), feral house cats (Felis catus), dogs (Canis familiaris), gray fox (Urocyon cinereoargenteus), red fox (Vulpes vulpes), Virginia opossum (Didelphis marsupialis), and a variety of raptors. Clapper rails have been known to renest after the failure of the first nest (NatureServe 2015; USFWS 1985; USFWS 2009).

Geographic or Habitat Restraints or Barriers

Adult: Limited habitat; distribution has been discontinuous because salt marsh habitats occur sporadically along the coastline (USFWS 2009).

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Narrow/specialist.

Tolerance Ranges/Thresholds

Adult: Low

Site Fidelity

Adult: High

Dependency on Other Individuals or Species for Habitat

Adult: No

Habitat Narrative

Adult: Light-footed clapper rails use coastal salt marshes, lagoons, and their maritime environments. Nesting habitat includes tall, dense cordgrass (Spartina foliosa) and pickleweed (Salicornia virginica) in the low littoral zone; wrack deposits in the low marsh zone; and hummocks of high marsh in the low marsh zone. Light-footed clapper rails are usually year-long residents in their home marshes. They forage in all parts of the salt marsh, concentrating their efforts in the lower marsh when the tide is out, and moving into the higher marsh as the tide advances. Distribution within the range of the light-footed clapper rail has been discontinuous because salt marsh habitats occur sporadically along the coastline. Light-footed clapper rails require shallow water and mudflats for foraging, with adjacent higher vegetation for cover. In general, the presence of small freshwater streams, ponds, and rushes is beneficial for nesting, foraging, and cover (NatureServe 2015; USFWS 1985; USFWS 2009).Severe storms and excessive runoff can adversely affect light-footed clapper rail habitat, because patches of cordgrass and pickleweed can be towed away or matted down to the extent that rails cannot use them for nesting (USFWS 1985).

Dispersal/Migration

Motility/Mobility

Adult: Low/moderate; mobility less than 457 m (1,500 ft.) (USFWS 2009).

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Moderate

Immigration/Emigration

Adult: Unlikely

Dispersal/Migration Narrative

Adult: Light-footed clapper rails are nonmigratory, unlikely to emigrate, and have limited mobility. The light-footed clapper rail is mostly sedentary, prefers walking or running, and seldom flies; and when it does fly, its flight is slow and labored and appears clumsy when landing. Light-footed clapper rails have moderate dispersal and need continuous salt marsh habitat for dispersing. The light-footed clapper rail is resident in its home marsh except under unusual circumstances. Within-marsh movements are also generally confined and usually of no greater spread than 400 m (1,312 ft.) (USFWS 2009). The minimum home range size of light-footed clapper rails varies from 0.36 to 1.66 hectares (ha) (0.89 to 4.10 acres [ac.]). Territorial rails maintain small home ranges all year, with younger birds moving more than established adults. Rails usually cover only small portions (approximately 30 percent) of their entire ranges on a daily basis; larger movements are associated with chases, predator alarms, and high tides (Zembal et al. 1989).

Additional Life History Information

Adult: The light-footed clapper rail is resident in its home marsh except under unusual circumstances. Within-marsh movements are also generally confined and usually of no greater spread than 400 meters (m) (1,312 feet [ft.]) (USFWS 2009).

Population Information and Trends

Population Trends:

Varied: some populations are at record highs, while others are either expanding, holding, or fluctuating (Zembal et al. 2015).

Species Trends:

Increasing; population numbers in California increased annually beginning in 2001, with the exception of the population crash of 2008 (Zembal et al. 2015).

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Growth Rate:

Slow

Number of Populations:

22; however, 15 of the 22 subpopulations have fewer than 12 breeding pairs (Zembal et al. 2015).

Population Size:

1 to 1000 individuals (NatureServe 2015). A total of 633 breeding pairs in 22 marshes was counted in 2015 (Zembal et al. 2015).

Resistance to Disease:

Unknown (USFWS 2009).

Adaptability:

Moderate

Additional Population-level Information:

Preliminary data for 2008 show a steep decline in light-footed clapper rail numbers in the largest California populations. In Upper Newport Bay, 88 pairs were detected—a 53 percent decline from 2007. In Tijuana Slough NWR, only 47 pairs were detected—a 33 percent decline from 2007 (USFWS 2009).

Population Narrative:

Light-footed clapper rails have a varied population trend; some populations are at record highs, while others are either expanding, holding, or fluctuating. However, population numbers in California have increased annually beginning in 2001, with the exception of a population crash of 2008 (Zembal et al. 2015). Preliminary data from 2008 showed a steep decline in light-footed clapper rail numbers in the largest California populations. In Upper Newport Bay, 88 pairs were detected—a 53 percent decline from 2007. In Tijuana Slough NWR, only 47 pairs were detected—a 33 percent decline from 2007 (USFWS 2009).Since that time, populations appear to have rebounded; a total of 633 breeding pairs in 22 marshes was counted in 2015. This is the highest count on record, representing an increase of 105 pairs from the breeding population detected in 2014, and a 43 percent increase from the former high count in 2007. The tally at Upper Newport Bay was the highest ever recorded, at 234 pairs. The Newport subpopulation was once again the largest in California, with 5.4 percent more rails exhibiting breeding behavior than in 2014; this total surpassed, for the third year in a row and by 34.5 percent, the long-standing record of 174 pairs manifested in 2005 (Zembal et al. 2015). However, due to the small population size, light-footed clapper rails are susceptible to stochasticity, and random naturally occurring events such as wildfires, floods, droughts, or disease epidemics (USFWS 2009). Many of the extant subpopulations today remain too small for long-term viability; in 2015, 15 of 22 subpopulations comprised 12 pairs or fewer.

Threats and Stressors

Stressor: Development
Exposure: Urbanization
Response: Reduced quality habitat.
Consequence: Decreased population size.
Narrative: Destruction of suitable marsh habitat is no longer the primary threat to the light-footed clapper rail. Acquisition of land and conservation easements have resulted in the preservation of salt marsh habitat for the species. However, degradation or modification of light-footed clapper rail habitat is likely to remain a threat from dredging actions, changes to tidal influences or siltation, and contaminants from urban runoff (USFWS 2009).

Stressor: Siltation
Exposure: Urban runoff.
Response: Reduced quality habitat.

Consequence: Decreased population size.
Narrative: Siltation of lagoons and river mouths from urban runoff have contributed to the degradation and modification of light-footed clapper rail habitat in southern California. Degradation of light-footed clapper rail habitat by siltation has the potential to be a significant threat to the species' long-term survival (USFWS 2009).

Stressor: Contaminants
Exposure: Pollution from industrial sources such as sewage, industrial waste, and herbicides.
Response: Illness, reduction in food availability, and reduction in quality habitat.
Consequence: Reduction in population numbers.
Narrative: Environmental contaminants may adversely impact light-footed clapper rail habitats. Nonpoint source pollution such as organochlorines is a primary cause for the loss of light-footed clapper rail habitat. Sources for this type of contamination in southern California have historically been sewage, industrial wastes, herbicides, and pesticides. Marshes are also the recipients of unregulated "emerging" contaminants, including polybrominated diphenyl ethers (PBDEs), and new-generation pesticides such as pyrethroids. Absent any natural sources, releases of PBDEs are expected to be greatest in areas where their use is greatest, such as areas with dense residential and industrial development. Contaminants may reach light-footed clapper rail habitat by tidal influences, surface and groundwater sources, or direct application of pesticides in marsh habitats. In the marsh, contaminants may absorb or attach to sediment and negatively impact light-footed clapper rail food sources (USFWS 2009).

Stressor: Predation
Exposure: Presence of predators at breeding sites.
Response: Increased predation of eggs.
Consequence: Reduced breeding success, and reduction in population numbers.
Narrative: Predation of light-footed clapper rail eggs by raccoons (Procyon lotor), red foxes (Vulpes vulpes), feral cats (Felis cattus), and a variety of raptorial birds have been recorded. At Seal Beach National Wildlife Refuge (NWR), heavy predation occurred over several years as mesopredator release resulted from the elimination of native top carnivores, most likely the coyote (Canis latrans), and an increase in the local population of nonnative foxes. This resulted in the near elimination of light-footed clapper rail breeding at Seal Beach NWR. New studies are needed to gather information on the effect of predation on rail population sizes. Light-footed clapper numbers have fluctuated and are currently down again. The stimulus for the decline is unknown, but one possibility is raptor predation (USFWS 2009).

Stressor: Small population size
Exposure: Inbreeding, loss of genetic variation, high variability in and sex ratios, demographic stochasticity, and random naturally occurring events.
Response: Allee effect or depensation.
Consequence: Diminished reproduction and further reduction in population numbers; extinction.
Narrative: Small populations have higher probabilities of extinction than larger populations because their low numbers make them susceptible to inbreeding, loss of genetic variation, high variability in age and sex ratios, demographic stochasticity, and random naturally occurring events such as wildfires, floods, droughts, or disease epidemics. Small, single populations are vulnerable to extirpation when opportunities for reproduction diminish because of reduced opportunity of individuals to find each other (Allee effect or depensation). Because the majority

of light-footed clapper rail populations are small, it is reasonable to consider these smaller populations at risk due to these effects of small population size (USFWS 2009).

Stressor: Isolation
Exposure: Stochastic events and urbanization.
Response: Habitat destruction.
Consequence: Reduction in population numbers; extirpation and inbreeding.
Narrative: Another factor commonly understood to make populations vulnerable to stochastic events is isolation. Isolation often acts in concert with small population size to increase the probability of extinction. Isolated populations are more susceptible to long-term/permanent extirpation by accidental or natural catastrophes, because the likelihood of recolonization following such events is negatively correlated with the extent of isolation. Urbanization and wetland conversion have resulted in a more fragmented range for the light-footed clapper rail, so that remaining occupied marsh habitat likely now functions more independently of each other (i.e., are more isolated), where they formerly had other marsh habitat in closer proximity. This increased isolation can increase the susceptibility of light-footed clapper rail populations to extirpation (USFWS 2009).

Stressor: Automobile strikes
Exposure: Roads and cars.
Response: Habitat intersected, and injury.
Consequence: Mortality, and reduction in population numbers.
Narrative: Death of light-footed clapper rails by automobile strikes has been documented both on major roadways and in lightly travelled wildlife refuge areas. The light-footed clapper rail prefers walking or running and seldom flies; when it does fly, its flight is slow and labored and appears clumsy when landing. The locomotion characteristics of the light-footed clapper rail likely make this species susceptible to road kill deaths in areas where roads bisect or are near suitable habitat (USFWS 2009).

Stressor: Climate change
Exposure: Sea-level rise.
Response: Less quality habitat.
Consequence: Reduction in population numbers.
Narrative: Since listing the light-footed clapper rail, it has become apparent that the potential exists for threats to biota from ongoing accelerated climate changes. The light-footed clapper rail is generally restricted in coastal salt marshes, and prefers to nest in the lower marsh areas. Also, many of the marshes currently occupied by light-footed clapper rails are immediately surrounded by urban landscapes with little room to expand if water levels were to rise (USFWS 2009).

Recovery

Reclassification Criteria:
When the breeding population in California has increased to 800 pairs within 4,000 ha (9,884 ac.) of adequately protected, suitably managed, secure wetland habitat consisting of at least 50 percent appropriate marsh vegetation in at least 20 marsh complexes, the subspecies can be considered for reclassification to threatened status (USFWS 1985).

Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range A1: Coastal marsh areas where the light-footed Ridgway's rail is present are conserved and managed to maintain sufficient tidal flushing and freshwater influence to sustain rails' food and habitat resources. A2: Occupied marsh areas maintain at least 50 percent appropriate marsh vegetation in the low littoral zone and include upper marsh habitats with sufficient cover to support rails year-round. These marsh areas have buffer zones to accommodate at least a century of projected sea level rise and have adjacent and appropriate high-water refugia and foraging habitat. At least 20 separate marsh areas of above-described suitable habitat or suitable freshwater habitats, are conserved, managed, occupied, and comprise a total of at least 4,000 ha (9,884 acres) to provide redundancy and the ability to withstand catastrophic events. A3: Clean water is maintained within the occupied marshes such that siltation does not significantly change the vegetation community or that contaminants do not measurably affect the benthic community (forage) or health of light-footed Ridgway's rail (USFWS, 2018).

Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes. There are no known current threats under this factor; therefore, no criteria are necessary (USFWS, 2018).

New in 2018: Downlisting Recovery Criteria for Factor C - C1: Impacts from nonnative and/or subsidized predators (e.g., feral cats, raccoons, domestic dogs, avian predators, etc.) are sufficiently minimized or managed through ongoing predator management. Management is funded in perpetuity such that predation no longer poses a threat to the persistence of light-footed Ridgway's rail. (USFWS, 2018).

New in 2018: Downlisting Recovery Criteria for Factor E - E1: At least 800 breeding pairs can be detected, rangewide in the United States, to increase subspecies' resilience. At least 10 of the protected marshes comprise a minimum average of 20 breeding pairs (i.e., not including newly augmented populations) over at least 5 years. (USFWS, 2018).

E2: Light-footed Ridgway's rail are distributed across sites in each of the U.S. counties to provide redundancy and retain representation to be able to adapt to environmental changes and ensure there is sufficient genetic diversity to avoid potential inbreeding depression. (USFWS, 2018)

E3: An outreach program is implemented to educate the public about the plight of, and conservation efforts for, light-footed Ridgway's rail. (USFWS, 2018)

Delisting Criteria:
Once the subspecies qualifies for threatened status, it may be possible (although at the present time it appears unlikely) to devise additional actions that, when implemented, may warrant consideration of the light-footed clapper rail for delisting (USFWS 1985; USFWS 2009). This recovery plan was prepared prior to guidance for writing recovery plans in a threats-based format (USFWS 2009).

New in 2018: Delisting Criteria A - A4: Occupied habitat is conserved and managed (including maintaining tidal influence of saltwater marshes, ensuring adequate forage in freshwater marshes, adequate and appropriate vegetation, and adjacent upland habitat refugia) to maintain and increase, where possible, the carrying capacity of marshes to ensure resiliency of the rail. (USFWS, 2018).

A5: Conserve and manage three freshwater systems to support three separate populations of light-footed Ridgway's rail (each with at least 30 actively breeding pairs) within the historical range. (USFWS, 2018).

New in 2018: Delisting Criteria E - E4: At least 20 of the protected marshes (from A2 and A5) have a minimum average of 30 breeding pairs over 15 years, with a combined minimum of 100 pairs in each of the five counties across light-footed Ridgway's rail's historical range (Santa Barbara, Ventura, Orange, LA, and San Diego). These figures provide sufficient redundancy to prevent extinction due to catastrophic events and sufficient representation to help promote adaptation to shifting environmental pressures. (USFWS, 2018).

E5: The overall population is self-sustaining and growing, without augmentation from captive rearing, such that monitoring detects a statistically significant upward trend in adult population numbers over the course of at least 15 years. (USFWS, 2018).

Recovery Actions:

- Manage habitat to preserve and/or enhance existing populations (USFWS 1985).
- Increase the carrying capacity and stability of existing habitat, thereby increasing the size of each population unit (USFWS 1985).
- Preserve and manage habitat to reestablish former populations (USFWS 1985).
- Obtain information on the biology of the light-footed clapper rail and its ecosystem to enhance recovery (USFWS, 1985).
- Maintain and revise essential habitat maps and descriptions (USFWS 1985).
- Inform the public of the status of the rail and its habitat, and solicit support for necessary conservation actions (USFWS 1985).
- Use existing laws and regulations pertaining to the protection of the rail and its habitat (USFWS 1985).
- Work with partners to help conserve and manage occupied light-footed clapper rail habitat (USFWS 2009).
- Consider revising the Recovery Plan to incorporate threats-based recovery criteria and guide conservation actions that reduce threats. Incorporate Sea Level Affecting Marshes Model assessments of sea-level change (USFWS 2009).
- Identify opportunities through the U.S. Fish and Wildlife Service's Partners for Fish and Wildlife and Coastal Programs to promote conservation and restoration of light-footed clapper rail habitat (USFWS 2009).
- Protection of marshes in Mexico occupied by light-footed clapper rail (USFWS 2009).
- Continue monitoring of occupied and potential habitat (USFWS 2009).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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SPECIES ACCOUNT: *Rallus longirostris obsoletus* (California clapper rail)

Species Taxonomic and Listing Information

Listing Status: Endangered; 1970

Physical Description

The California clapper rail is in the family Rallidae and the genus Rallus, which consists primarily of marsh-dwelling birds with short, rounded wings, large feet, and long toes. It is one of the largest rails, measuring between 13 to 19 inches (33 to 48 centimeters) from bill to tail. Males are slightly larger than females, but otherwise, the sexes are indistinguishable. California clapper rails have a greenish-brown upper body, a solid light-brown breast, and dark flanks crossed with white bars. They have long, orange, slightly downturned bills. Juveniles have lighter-orange bills, darker bodies, gray/black flanks, and fainter white bars and under-tail coverts (CDFW 2005; USFWS 2013; USFWS 2014).

Taxonomy

The California clapper rail (Rallus longirostris obsoletus) belongs to the order Gruiformes, in the family Rallidae, which includes rails, gallinules, and coots. The genus Rallus consists primarily of marsh-dwelling birds with short rounded wings, large feet, and long toes (Ridgway, 1974)

Historical Range

Although San Francisco Bay has historically been the region with the highest California clapper rail abundance, the species also occurred in Tomales Bay(Marin County), Humboldt Bay (Humboldt County), Morro Bay (San Luis Obispo County), and Elkhorn Slough (Monterey County). In San Francisco Bay, the highest populations of California clapper rail occurred in the salt marshes of the South San Francisco Bay (NatureServe 2014).

Current Range

The California clapper rail inhabits coastal wetlands and brackish areas around San Francisco Bay. The species currently occurs only in the marshes of San Francisco Bay and inhabits less than 10 percent of its former geographic range. In San Francisco Bay, approximately 90 percent of the population occurs in the South San Francisco Bay region. Populations are found in remnant salt marshes such as those on Bair and Greco Islands, along Coyote Creek, and throughout the marshes in the Don Edwards San Francisco Bay National Wildlife Refuge. Smaller populations are located in western Contra Costa, eastern Marin, and northern Alameda Counties. California clapper rails are also found in northern San Pablo Bay, along the Petaluma River as far north as Schultz Creek, along major creeks and marshes in both Sonoma and Napa Counties and on Bull Island on the Napa River. During the spring breeding season smaller numbers occur in Suisun Bay marshes, Napa Marsh, and the southern end of South San Francisco Bay. (CDFW 2005; NatureServe 2014; USFWS 2013).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The California clapper rail is an omnivore with a relatively broad feeding niche. Animal matter has been consistently emphasized as a major component of the diet (Moffitt 1941, Heard 1982, Zembal and Fancher 1988). Food items found in California clapper rails stomachs include introduced ribbed horse mussel (Ischadium demissum), spiders (Lycosidae spp.), clams (Macoma balthica), yellow shore crabs (Hemigrapsus oregonensis), amphipods (shrimp-like crustaceans), a polychaete worm (Nereis vexillosa), and striped shore crab (Pachygrapsus crassipes; Williams 1929, Applegarth 1938, Test and Test 1942, Varoujean 1972). California clapper rails occasionally have been seen capturing and consuming rodents, particularly during higher tides; small birds are also occasionally taken (Spendelow and Spendelow 1980, Jorgenson and Ferguson 1982).

Reproduction Narrative

Adult: California clapper rails are at least seasonally monogamous, and defend overlapping year-round territories (Zembal et al. 1989, Albertson 1995, Garcia 1995). It is not known whether California clapper rails retain their mates between years. Pair bonding and nest building (usually performed by the male) are generally initiated by mid-February. Nesting may begin as early as late February or early March (Evens and Page 1983), and extend through July in the South Bay, and into August in the North Bay (DeGroot 1927, U.S. Fish and Wildlife Service unpubl. data 1990). Nests must be built at an elevation that protects the bowl from complete inundation during high tides (Evens and Collins 1992, Collins et al. 1994). However, some nests are built directly on the ground. Inundated nests result in abandonment and failure (U.S. Fish and Wildlife Service unpubl. data 1990). Both sexes share in incubation, which lasts from 18 to 29 days (Taylor 1996). Mean clutch sizes of 7.1 (U.S. Fish and Wildlife Service unpubl. data 1990) to 7.5 (Foerster et al. 1990) have been reported. An average of 2.5 eggs are hatched per nesting attempt. Hatchability for California clapper rails in varies with marsh, ranging from 60 to 75.6 percent (Jorgensen 1975). Chicks soon depart the incubation nest, and one to three brood nests are typically constructed nearby (Applegarth 1938, Johnson 1973). Brood nests are high tide refuges for young rails, and consist of a platform of woven stems without a substantial canopy (Harvey 1980). Adults remain with the chicks to forage with them for up to 5 to 6 weeks (Applegarth 1938, Meanley 1985).

Environmental Specificity

Adult: High

Site Fidelity

Adult: High

Habitat Narrative

Adult: California clapper rails build nests in marshlands dominated by cordgrass (Spartina spp.), pickleweed (Salicornia spp.), gumplant (Grindelia sp.), and salt grass (Distichlis spicata) near tidal pools, and require high marsh during flood tides (CDFW 1999; NatureServe 2014). California clapper rails require an intricate network of sloughs to provide abundant invertebrate populations (Grinnell et al. 1918, DeGroot 1927, Harvey 1988, Collins et al. 1994) and escape routes from predators, particularly for vulnerable flightless young (Taylor 1894, Adams 1900, DeGroot 1927, Evens and Page 1983, Foerster et al. 1990, Evens and Collins1992). In addition, the small natural berms along tidal channels with relatively tall vegetation, such as Grindelia stricta var. angustifolia (gumplant), provide elevated nesting substrate. Nests must be built at an elevation that protects the bowl from complete inundation during high tides (Evens and Collins 1992, Collins et al. 1994). However, some nests are built directly on the ground. Inundated nests result in abandonment and failure (U.S. Fish and Wildlife Service unpubl. data 1990).

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: Post-breeding dispersal has been documented during the fall and early winter (Lindsdale 1936, Orr 1939, Albertson 1995).

Immigration/Emigration

Adult: Low; vagrant subadults

Dispersal/Migration Narrative

Adult: Post-breeding dispersal has been documented during the fall and early winter (Lindsdale 1936, Orr 1939, Albertson 1995). There is no clear evidence of migratory behavior in the California clapper rail. However, infrequent long distance dispersal does occur. Vagrant California clapper rails have been found in areas not known to support individuals throughout the year, such as the Farallon Islands (Bryant 1888), the rocky shores of Pacific Grove (Kimball 1922), and Pescadero Marsh (Orr 1942). These birds have been found primarily in late summer and fall, and are assumed to be dispersing subadults.

Population Information and Trends

Population Trends:

Decline

Species Trends:

Declline

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Number of Populations:

1 to 5 (NatureServe 2014)

Population Size:

~1,425 rails (2005-2008 survey), declining by 20 percent over the survey period due to habitat loss

Population Narrative:

The estimated population from 2005-2008 was 1,425 rails, with the population declining by 20 percent over the survey period due to habitat loss. Population estimates have ranged from 4,200 to 6,000 (1971-1975) to 300 to 500 individuals (1990-1991) (USFWS 2013). Resiliency, representation, and redundancy are all considered to be low for the following reasons: Resiliency - (1) individuals require several specific and complex habitats within a relatively small area ;(2) populations require large, healthy tidal marsh habitat; (3) much of the tidal marsh habitat necessary for the survival of the species has been lost or severely degraded; (4)and major efforts are under way to restore and enhance tidal marsh habitat in the region; Representation - (1) current species range is limited to the San Francisco Bay Area, so a catastrophic regional event could devastate the species; and (2) although the species has recovered from its lowest numbers, populations in San Francisco Bay are still at 24 to 34 percent of their historical size (USFWS 2013); Representation - (1) the species has been extirpated from several areas in its historic range; and (2) although the species has historically been most abundant in the San Francisco Bay region, it is now limited to the region. As a result of the above, overall species' viability is also considered to be low.

Threats and Stressors

Stressor: Habitat loss
Exposure:
Response:
Consequence:
Narrative: The primary limiting factor in the recovery of the California clapper rail is the lack of suitable habitat. These birds require large pieces of tidal marsh habitat with low, middle, and high marsh zones, as well as complex tidal slough networks. Eighty-four percent of the original habitat for this species has been lost as tidal marshes were converted to agriculture, urban development, and salt production (NatureServe 2014; USFWS 2013).

Stressor: Habitat degradation
Exposure:
Response:
Consequence:
Narrative: The degradation of remaining habitat is a significant threat to the species. Although levees are no longer being constructed in tidal wetlands, existing levees are being maintained and threaten the California clapper rail in a number of ways. Levees provide access for predators, displace high marsh vegetation, fragment marsh habitat, reduce and simplify tidal slough networks, and introduce excessive sedimentation. Pollution is another factor contributing to habitat degradation. Sewage effluent, industrial discharge, and urban runoff can contaminate food resources, and urban freshwater discharge has caused tidal marshes in South San Francisco

Bay to become brackish-fresh marshes. Contaminants that may negatively affect California clapper rails include mercury, selenium, polychlorinated biphenyls, and petroleum hydrocarbons. These contaminants have the potential to directly affect California clapper rails, particularly methylmercury (a significant factor affecting egg viability), or indirectly affect them by reducing prey or altering vegetation.

Stressor: Invasive plant species
Exposure:
Response:
Consequence:
Narrative: California clapper rails have experienced habitat degradation as a result of non-native plant invasions; particularly non-native cordgrass (Spartina alterniflora) and cordgrass hybrids in low marsh and non-native broadleaved pepperweed (Lepidium latifolium) in high marsh, which cause structural changes to tidal marsh habitat (CDFW 1999; NatureServe 2014; USFWS 2013).

Stressor: Non-native predators
Exposure:
Response:
Consequence:
Narrative: The introduction of the red fox in the 1980s caused a significant decline in the California clapper rail population of the San Francisco Bay Area. Fox control alleviated this threat, and the clapper rail population increased in the mid-1990s as a result. Other non-native predators include feral cats and Norway rats (NatureServe 2014; USFWS 2013).

Stressor: Small population
Exposure:
Response:
Consequence:
Narrative: The species declined due to hunting during the period from the California Gold Rush until 1913. Their current small, centralized range makes the species as a whole vulnerable to catastrophic events in the region. The remaining population is also threatened by inbreeding depression and the loss of genetic variability (NatureServe 2014; USFWS 2013).

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: Sea-level rise may be particularly damaging to California clapper rail habitat, especially in areas of central and South San Francisco Bay (USFWS 2013).

Recovery

Reclassification Criteria:
A. Protection and management of the following marsh complexes where core populations exist: Central/Southern San Francisco Bay Recovery Unit (San Rafael Crrek-Richardso's Bay, Bair-Greco-Ravenwood, East Palo Alto-Guadalupe Slough, Guadalupe Slough-Warm Springs, Mowry-Dumbarton, and Hwy 84 to Hwy 92 [Coyote Hills/Eden Landing, Hwy 92-Arrowhead Marsh]); San Pablo Bay Recovery Unit (China Camp to Petalulma River, Petaluma River marshes, Petaluma

River to Sonoma Creek, and Napa marshes [Sonoma Creek to southern tip of Mare Island], and Point Pinole marsh; Suisun Bay Recovery Unit (Western Grizzly and Suisun Bays and marshes of Suisun, and Hill and Cutoff sloughs; and 800 acres (324 ha) of habitat at Tomales Bay.

B. Control of future invasive species: Spartina infestations and implementation of a system for its early detection; reduction in extant Lepidium latifolium populations to less than ten percent cover (in and down-gradient of the high marsh-upland ecotone) for five years in each marsh complex described above; implementation of site-specific management plans on lands owned by U.S. Fish and Wildlife Service, California Department of Fish and Game, East Bay Regional Park District, and Mid-Peninsula Open Space District to reduce recreation-based (human-caused) disturbance to rails, both by reduction of physical disturbance and predation to rails from domestic animals and humans and by elimination of litter and feeding stations which serve to attract predators, thereby degrading habitat quality.

C. Reduce predation pressures: A predator management plan is developed and implemented at all sites with significant predation issues.

D. Provide sufficient resilience to stochastic events, criteria under Criteria A-C have been met and have resulted in at least the following average number of rails over a 10-year period, sprad over a large geographic area: Central/Southern San Francisco Bay = 1,062 rails; San Pablo Bay = 936 rails; Suisun Bay = 100 rails.

Delisting Criteria:
A. When all downlisting Criterion A actions have been achieved at all sites.

B. Implementation of the Habitat Management, Preservation, and Restoration Plan for Suisun Marsh (in preparation by the Suisun Marsh Charter Group), San Pablo Bay National Wildlife Refuge Comprehensive Conservation Plan (in preparation by San Pablo Bay National Wildlife Refuge), and the South Bay Salt Pond Restoration Plan (U.S. Fish and Wildlife Service 2009).

C. When all downlisting Criterion C have been achieved. In addition, predator monitoring indicates that for 5 consecutive years, predation pressure on California clapper rails falls below a level at which it negatively affects long-term population persistence.

D. To provide sufficient resilience to stochastic events, criteria under downlisting A-C have been met and have resulted in at least the following average number of rails over a 10-year period, spread over a large geographic area: Central/So SF Bay = 3,180 rails; San Pablo Bay = 2,048 rails; Suisun Bay = 200 rails; Tomales Bay = 32 rails.

E. To minimize impacts sustained after oil spills occurring at or near core populations, the San Francisco Bay and Delta Area section of the Sector San Francisco-Area Contingency Plan must be revised to place high priority on the emergency protection of California clapper rails.

F. A map must be developed that identifies sources and extents of mercury exposure in rails and a plan must be in place to remediate the most significant point sources of mercury. In addition, exposure of rails to mercury must be reduced such that mercury concentrations in every rail egg sampled throughout its range must fall below 0.2 ppm (fresh wet weight), the point above which it is believed developmental abnormalities and reproductive harm occur.

G. High marsh/upland transition lands, when and wherever possible, must be preserved or created as part of new marsh restoration efforts and managed to provide opportunity for landward migration of species in response to sea level rise. In addition, there must be a partnership developed, involving resource agencies, public landowners/managers and private landowners, to implement Strategic Habitat Conservation (SHC), specifically to guide future habitat acquisition and management goals given the challenge of local sea level rise.

Recovery Actions:

- Acquire/protect or restore/protect tidal marsh habitat according to Figures III-8 through III-26 in the Draft Recovery Plan for Tidal Marsh Ecosystems of Northern and Central California.
- Implement site-specific management plans on lands adjacent to the Bay to reduce human-caused disturbance to rails.
- Conduct a population viability analysis on the California clapper rail.
- Study the effects of the Invasive Spartina Project on California clapper rail movement.
- Conduct research into toxicity of mercury to rails, mercury exposure pathways and potential means to interrupt those pathways.

References

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SPECIES ACCOUNT: *Rallus longirostris yumanensis* (Yuma clapper rail)

Species Taxonomic and Listing Information

Listing Status: Endangered, March 11, 1967 (32 FR 4001).

Physical Description

Yuma clapper rails (Rallus longirostris yumanensis) are a smaller subspecies of clapper rail. Adult males are about 20 centimeters (cm) (8 inches [in.]) tall, and a little over 267 grams (g) (9 ounces [oz.]) in weight, while adult females are slightly smaller, 193 to 226 g (7 to 8 oz.). Both sexes have similar plumage; they possess a long, slender slightly de-curved bill, a laterally compressed body, and relatively long legs and toes compared to body size. The upper mandible is dark grey, fading to orange at the base and the tip. The head and scapular area are grey, with browns and oranges appearing on the sides of the neck and under the head; the chin and upper throat is white, and there is a light eyebrow stripe extending from above the eye to the upper mandible. The breast is tawny- or burnt-orange in the male, and a brick-orange in breeding females; the upper body is light grey to dark brown, becoming blotchy and dominant on the rump and distally on the wings. The underside and flanks forward of the legs are dark grey with vertical white stripes (USFWS 2009). The tail is dark brown above and white below. Legs are unfeathered and orange-flesh in color (USFWS 2009). Adult rails have a basic pre-body molt in May-August, with flightless birds found between mid-July and the end of September. A second, pre-alternate molt occurs from September to December and does not involve the flight or tail feathers (USFWS 2009). The Yuma clapper rail is differentiated from other clapper rails by its paler, duller underparts and the grayish edging of its dorsal feathers; its cheeks and postoculars are bluish or ashy gray (USFWS 2014). Yuma clapper rail hatchlings are downy black with white on their bellies, then become dark gray-buffy in their juvenile stages. Young are in the mature plumage by September (USFWS 2009).

Taxonomy

The first documentation of a clapper rail on the Lower Colorado River (LCR) was a specimen taken in 1902 from Yuma, Arizona. This specimen was described as Rallus levipes, the light-footed clapper rail of the southern California coastal marshes, by Herbert Brown. In 1923, the Yuma clapper rail was described as a full species, R. yumanensis. Later taxonomic work described the Yuma clapper rail as a subspecies of R. obsoletus, then as a subspecies of R. longirostris. Currently, the Yuma clapper rail is considered a subspecies of the clapper rail R. longirostris. This group includes the California clapper rail (R. l. obsoletus) of the San Francisco Bay area and the light-footed clapper rail (R. l. levipes) of the Pacific coast of southern California through Baja California, Mexico. The Yuma clapper rail is recognized as Rallus longirostris yumanensis. There has not been a comprehensive study of genetic relationships between the Yuma clapper rail and the California or light-footed clapper rails. Microsatellite and RAPD DNA analysis on four light-footed clapper rail populations and the Salton Sea Yuma clapper rail population indicate that the two subspecies have highly significant differences in variability. Based on neighbor-joining trees, the Yuma individuals cluster together somewhat distantly from the light-footed individuals (USFWS 2009).

Historical Range

The pre-1900 distribution of the Yuma clapper rail in the United States is unclear. With the limited amount of dedicated survey work prior to the listing of the Yuma clapper rail in 1966, it is difficult to confirm whether the present distribution of the species along the LCR reflects the true historical range, or whether the changes in the LCR caused by the creation and operation of the small diversion dams (Laguna, Imperial, Palo Verde, and Headgate Rock) and the large water storage dams (Parker, Davis, and Hoover) are responsible for the hypothesized “expansion” of the distribution of Yuma clapper rails upriver from the 1930s to the present. The hypothesis is that the presence of the large dams controlled the floods once common to the LCR, and the small dams provided a constant water level that promoted deposition of sediments that promoted the growth of marshes in their upstream pools. The listing of the Yuma clapper rail under the 1966 legislation spurred interest in determining the range and population status of the species. In 1966, the Yuma clapper rail was documented at Topock Marsh, Havasu National Wildlife Refuge. Between 1968 and 1970, Yuma clapper rails were found on the LCR between Topock Marsh and the Southerly International Boundary with Mexico. Yuma clapper rails were confirmed on the lower Gila River (LGR) upstream as far as the Phoenix metropolitan area during the late 1960s and 1970s. In 1982, a pair was documented north of Needles, California, in the Mohave Valley. Since 1986, Yuma clapper rails were found on Lake Mead in Las Vegas Wash and, beginning in 1998, the Virgin River above Lake Mead (USFWS 2009).

Current Range

The Yuma clapper rail occurs along the LCR and tributaries (Virgin River, Bill Williams River, and LGR) in Arizona, California, Nevada, and Utah; the Salton Sea in California; and the Ciénega de Santa Clara and Colorado River Delta in Mexico (USFWS 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

<u>Adult:</u> Yuma clapper rails are sight-feeders with an excellent sense of smell. Prey items are taken by surface gleaning or shallow probing on open mudflats, shallow (7.5-cm [3-in.]) open waters, vegetated areas with low emergent stem densities, and the water/emergent vegetation interface. During periods of low prey availability, daily foraging movements are over a larger home range (USFWS 2009). They are invertivores and piscivores, eating crayfish (Procamberus clarki and Orconectes virilis), small fish, tadpoles, clams, and other aquatic invertebrates (NatureServe 2015; USFWS 2009).Yuma clapper rails are active most of the daylight hours, with little to no activity after dark. Daily movement was lowest during the late breeding period (May to July) and highest during the late winter (January to February) (USFWS 2009).

Reproduction Narrative

<u>Adult:</u> In February, male Yuma clapper rails begin advertising with “kek” calls from heavily vegetated freshwater marshes with coverage of cattail (Typha domingensis) and bulrush (Scirpus spp.), and pair bonding occurs shortly thereafter (Patten 2005; USFWS 2009). The pair bond lasts for the breeding season, but it is unknown whether the same birds bond in subsequent years. Nesting begins in March, with a peak in mid-May on the LCR and from May to June at Salton Sea. Along the Gila River in Maricopa County, the first birds do not begin to call

until mid- to late March. Clutch size is from five to 14 eggs. Incubation ranges from 23 to 28 days, with the males generally incubating at night and females during the day. Chick mortality is high, with usually only two fledglings surviving per pair. Adults remain with the chicks, protecting them at night in brooding nests and accompanying them on foraging trips for approximately 6 weeks post-hatching (USFWS 2009). Pairs may renest after the failure of a previous nest (USFWS 2014). The male will make several nests, generally of dead vegetative matter, and the female chooses one for egg laying. The alternate nests are used for preening, loading, and brooding. If the primary nest is disturbed, the adults will carry eggs in their bills to a new nest (Conway and Eddleman 2000). Nests are constructed on stable substrates (bases of emergent plant clumps or trees, on or in deep mats of residual vegetation) and may be near-shore in shallow water or in the interior of marshes over deeper water (USFWS 2009).

Geographic or Habitat Restraints or Barriers

Adult: Habitat destruction and limited distribution of marshes.

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Moderate

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: High

Dependency on Other Individuals or Species for Habitat

Adult: No

Habitat Narrative

Adult: Historically, cattail/bulrush marshes in the Colorado River Delta were the likely stronghold for the species. That habitat was destroyed by the virtual elimination of freshwater flows down the LCR to the Delta, due to diversions from the river for agriculture and municipal uses. Existing habitats are primarily either human-made, like the managed ponds at Salton Sea or the effluent-supported marshes at the Ciénega de Santa Clara; or were formed behind dams and diversions on the LCR at the time those structures were created (USFWS 2009).The Yuma clapper rail is the only subspecies of clapper rail found in freshwater marshes. The amount of Yuma clapper rail habitat in the United States totals 4,260 hectares (ha) (10,551 acres [ac.]), compared to 7,500 ha (18,532 ac.) in Mexico. The Yuma clapper rail lives in freshwater marshes dominated by cattail (Typha sp.) and bulrush (Scirpus sp.), with a mix of riparian tree and shrub species along the shoreline of the marsh, including willows (Salix exigua, S. gooddingii), tamarisk or saltcedar (Tamarix sp.), arrowweed (Pluchea [=Tessaria] sericea), and coyotebrush (Baccharis sp.). Along the LCR, such habitats are generally found in backwaters or in the impoundments behind small dams. At the Salton Sea, marsh habitats are created in fields or cells with managed water levels. Along the lower Gila, Virgin, and Muddy rivers, marshes are found along the margins of the river and wetted floodplain. At the Ciénega de Santa Clara, the marsh is large and dense, with vegetated areas interspersed with shallow open water areas. The specific physical conditions in each of these habitat areas are different and likely define the quality of the habitat available at each site relative to desirable patch size and configuration (USFWS 2009).Optimum Yuma clapper rail habitat consists of a mosaic of emergent vegetation averaging greater than 2 meters (6 feet) high; shallow open water (less than 30 cm [12 in.]) areas either as channels or pools with minimal daily water fluctuation; open dry ground (slightly higher than the water level) between water, vegetation, or marsh edge for foraging and movement; and a band of riparian vegetation on the higher ground along the fringes of the marsh that provides cover and buffer areas that may be used seasonally (USFWS 2009). Early successional marshes with little residual vegetation may be preferred as well (USFWS 1983).Depending on the season, adult Yuma clapper rails select microhabitats based on a number of physical factors, such as prey availability, predator avoidance, ease of movements by chicks (USFWS 2009). Nest sites selected by this subspecies are near upland areas in shallow sites dominated by mature vegetation, often in the base of a shrub (USFWS 2014). Yuma clapper rails move into different cover types in winter, showing a preference for denser cover than in summer (USFWS 2014).

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Partially migratory. Most Yuma clapper rail remain on the breeding grounds throughout the year; however, some winter in brackish marshes along the Gulf of California and Mexico. Most of the LCR and Salton Sea Yuma clapper rail populations are not migratory, but remain in the area all year. There is some indication that the population near Phoenix on the Gila River may be more migratory than the other populations (Patten 2005; USFWS 2009).

Dispersal

Adult: There may be a migratory or dispersal component, but the extent of the exchange is unknown (USFWS 2009).

Immigration/Emigration

Adult: Immigrates/emigrates. It is possible that Yuma clapper rails have immigrated to new locations in the past due to new habitat locations created as a result of construction of dams, and because the crayfish that have spread in the LCR provide a more abundant and secure food supply (USFWS 2009).

Dispersal/Migration Narrative

Adult: The extent of migration or dispersal between the populations is not known. It is assumed that most of the LCR birds do not seasonally migrate, and the rates or extent of dispersal is unknown. It is also unclear if some areas are “sinks,” where birds dispersing from other areas appear to maintain a population when in fact there is limited or no recruitment from that site. With the degree of separation between sites, the ability of Yuma clapper rails at one core area to disperse to another area is unclear. There is evidence of movements within habitats, and the presumed spread of rails northward along the LCR requires a degree of dispersal that has not been documented. It is possible that Yuma clapper rails have immigrated to new locations in the past due to new habitat locations created as a result of dams and water diversions; and the crayfish that have spread in the LCR may have been pivotal to the expansion of Yuma clapper rail, because they provide a more abundant and secure food supply (USFWS 2009).The current belief is that most of the LCR and Salton Sea populations are not migratory. There is some indication that the population near Phoenix on the Gila River may be more migratory than the other populations, because individuals are seemingly not present outside of the breeding season (USFWS 2009). Individuals from the Mexican population may disperse to the United States, potentially serving as important sources of genetic variance within the species, because they constitute the largest population unit; however, it is documented that at least some of this population is nonmigratory (USFWS 2006).Home ranges are generally smallest during the early and late breeding seasons (March through July) at 7 to 8 ha (17 to 20 ac.), and largest in the post-breeding season (August through October) at 15 ha (37 ac.) and the late winter period (January through February) at 24 ha (59 ac.) (USFWS 2009).

Additional Life History Information

Adult: Most of the breeding population in the United States is resident. Some birds may winter in Mexico along the coasts of Sonora, Simaloa, and Nayarit (USFWS 2014).

Population Information and Trends

Population Trends:

Stable (NatureServe 2015). Populations have fluctuated 46 percent in the period of 1995 through 2005, in part due to changes in survey effort, survey protocol and observer experience, and habitat (USFWS 2006).

Species Trends:

Stable (NatureServe 2015)

Resiliency:

Moderate

Representation:

High; the species has expanded its historic range and is still relatively common within a small range.

Redundancy:

Moderate

Population Growth Rate:

Stable

Number of Populations:

Unclear (USFWS 2009)

Population Size:

Survey detections in habitats in the United States have fluctuated between 467 and 809 individuals over the last 10 years (USFWS 2014). 1,000 to 2,500 (NatureServe 2015).

Minimum Viable Population Size:

700 (USFWS 2009)

Resistance to Disease:

Unknown (USFWS 2009)

Adaptability:

Moderate

Additional Population-level Information:

Clapper rail populations in the United States are concentrated along the LCR, from the vicinity of Laughlin, Nevada, to Yuma, Arizona (USFWS 2006). Population numbers in Mexico are not well known, nor are there regulatory measures to protect the Yuma clapper rail in Mexico. Most of the population in Mexico occurs Ciénega de Santa Clara in Mexico (USFWS 2009).

Population Narrative:

The Yuma clapper rail population is stable (NatureServe 2015). Survey detections for the United States habitats have fluctuated between 467 and 809 individuals over the last 10 years; the species has expanded its historic range, and is still relatively common within a small range (USFWS 2009; USFWS 2014). Populations have fluctuated 46 percent in the period of 1995 through 2005, in part due to changes in survey effort, survey protocol and observer experience, and habitat (USFWS 2006). Because of the change of methods, the populations of the Yuma clapper rail are unclear (USFWS 2009). Clapper rail populations in the United States are concentrated along the LCR, from the vicinity of Laughlin, Nevada, to Yuma, Arizona (USFWS 2006). Population numbers in Mexico are not well known, nor are there regulatory measures to protect the Yuma clapper rail in Mexico. Most of the population in Mexico occurs Ciénega de Santa Clara in Mexico (USFWS 2009).

Threats and Stressors

Stressor: Habitat destruction
Exposure: Dams, reroute of water channels.
Response: Elimination and degradation of habitat.
Consequence: Reduction in population numbers.
Narrative: Beginning in 1905, a series of small and large dams began to disrupt the natural hydrograph; this reduced flows incrementally downstream, especially in the LCR and the LGR. Since completion of the dams and diversions, water is only released in response to water requirements by agricultural and municipal users, limiting the amount of available water. The destructive nature of the floods must also be considered in concert with actions taken to channelize the LCR and portions of the LGR to provide for flood protection and improved water conveyance. Channelization and bank stabilization detaches the floodplain and backwaters from the main channel, eliminates marsh and riparian vegetation from the banks and shallow water areas that are dredged, and often results in lower water tables that dry up adjacent marshes. Much of the former floodplain of the LCR and LGR that contained marsh habitats associated with backwaters and riparian areas has been disconnected from the river through channelization, bank stabilization, levee construction, and control of water flows. The remaining floodplain along the LCR now has considerable agricultural development. Additional floodplain development may result in the loss of additional marsh habitats. The detachment and elimination of marsh habitat has limited the amount of available habitat for Yuma clapper rails (USFWS 2009). Increasing development along the LCR and interior Arizona rivers may have direct and indirect effects on

clapper rail and habitat conditions; and water management regimes have the potential to impact clapper rail habitat (USFWS 2006).

Stressor: Human disturbance
Exposure: Noise and lights from human disturbance.
Response: Altered behavior, relocation, increase the risk of predation by nocturnal predators, and affected nest-site selection.
Consequence: Reduction in quality habitat, reduction in population numbers.
Narrative: Human activities result in disturbances that can take several forms, primarily affecting the behavior of individual birds; however, the quality of habitat can be degraded by chronic disturbances to the extent that an area may no longer support rails. Noise from vehicles (including cars, trucks, boats, and jet skis), radios, and human voices, and other sounds may disturb rails in their habitats. The threshold for noise disturbance that results in behavioral disturbance or abandonment of the area is unknown, and some areas with significant noise sources maintain healthy rail populations. The degree of risk of abandonment likely varies significantly based on the size of the habitat area, the volume and frequency of the noise, and the pattern of the noise (continuous, intermittent, occasional, or sporadic). Artificial lighting that shines into a habitat area may alter normal behavior patterns (foraging, vocalizations), increase the risk of predation by nocturnal predators, and affect nest-site selection (USFWS 2009).

Stressor: Selenium accumulation
Exposure: Selenium exposure from irrigated waters that are transported to LCR.
Response: Acute toxicity, tissue damage, reproductive impairment, reduced survival.
Consequence: Reduction in population numbers.
Narrative: Selenium is a potential threat to the survival and recovery of the clapper rail. High levels of selenium can result in acute toxicity, chronic poisoning and tissue damage, and reproductive impairment (e.g., developmental abnormalities, embryo mortality, and reduced survival or growth of young) in birds. The LCR (including the Salton Sea and Mexico) does not contain local sources of selenium that contribute to selenium levels in the biological environment. However, the Colorado River in the Upper Basin (Utah, Wyoming, and Colorado) picks up selenium from the seliniferous soils of the Mancos shale formations (return flows of irrigation water are the primary vector), and transports it to the LCR. Selenium is concentrated in the water through evaporation, and then becomes deposited into the sediments and can be accumulated by vegetation, invertebrates, and fish. Clapper rails become contaminated through their diet of crayfish, other invertebrates, and fish. Levels of selenium in LCR-supported clapper rail habitats in the United States and Mexico may have increased over the last 10 to 15 years due to irrigation returns (historic data on predevelopment selenium levels are not available), and are at levels above that considered of concern for reproductive impairment (USFWS 2006).

Stressor: Inadequacy of existing regulatory mechanisms.
Exposure: Lack of regulations to protect the Yuma clapper rail.
Response: No laws to protect the Yuma clapper rail from actions that would further reduce population numbers.
Consequence: Reduction in population numbers.
Narrative: The Ciénega de Santa Clara population (the biggest population of Yuma clapper rails in Mexico) has no regulatory mechanism to protect Yuma clapper rails found in Mexico. Until Mexico creates a regulatory mechanism to protect Yuma clapper rails, then the lack of regulations will continue to be a threat (USFWS 2006).

Recovery

Reclassification Criteria:
In 1983, the breeding populations of Yuma Clapper rails had been stable at 700 to 1,000 individuals for 10 years, so the 1983 Recovery plan recommend that Yuma clapper rail be reclassified to Threatened (USFWS 1983). The population size listed in the 1983 reflects the clapper rail survey results between 1969 and 1981; a population viability analysis or other scientific rationale is not present in the plan to further explain or support the recommended population size. Downlisting of the Yuma clapper rail was considered in 1983 but never finalized (USFWS 2006).

Based on the draft recovery plan in 2009, the Yuma clapper rail will be considered for downlisting when the following criteria are met:

Annual rail surveys document a stable or increasing trend in population, based on a minimum of 824 rails in the United States for at least 5 consecutive years (USFWS 2009).

Management plans for all important federal and state-owned habitat areas are developed. For the LCR, these areas are Havasu National Wildlife Refuge (NWR), Bill Williams NWR, Cibola NWR, Imperial NWR, Mittry Lake State Wildlife Area, and Imperial Division lands of the Bureau of Land Management; for the Salton Sea, they are Sonny Bono Salton Sea NWR and Imperial State Wildlife Area (USFWS 2009).

Long-term contracts are in place to provide for a quality and quantity of water to support the Yuma clapper rail habitats at the Salton Sea. The amount and quality of the water supply should be sufficient to maintain healthy cattail marsh habitat at Sonny Bono Salton Sea NWR and Imperial State Wildlife Area (USFWS 2009).

Delisting Criteria:
Based on the 1983 Recovery Plan, the Yuma Clapper Rail can be considered for delisting when:

Its breeding and wintering status in Mexico is clarified and evaluated (USFWS 1983).

Surveys for the species and its habitat are established (USFWS 1983).

Management plans are developed for important federal and state-controlled breeding areas (USFWS 1983).

Written agreements are effected with agencies having control or responsibility over Yuma clapper rail habitat in the United States and Mexico, to protect sufficient wintering and breeding habitat to support a population of 700 to 1,000 breeding birds in the United States (USFWS 1983).

Consideration for delisting the Yuma clapper rail will be based on an assessment of the status of the populations in the United States and Mexico (USFWS 1983).

According to the draft recovery plan, delisting can be considered when:

The Yuma clapper rail will be considered for delisting when the downlisting criteria and the following additional criteria have been met (USFWS 2009).

Annual rail surveys document a stable or increasing trend in population, based on a desired population of 824 individuals (or a higher minimum population size established through research and modeling) in the United States for at least 5 years beyond that needed for downlisting (USFWS 2009).

The amount of habitat needed to support a minimum population size (as determined from the annual rail surveys, above) is established, protected, and managed to ensure adequate breeding and wintering habitat in the United States (USFWS 2009).

An assessment of the degree of threat from existing and predicted selenium levels to adult rails and recruitment of young rails is completed, and, if necessary, management actions are implemented to control this threat in rail habitats (USFWS 2009).

A water supply of sufficient quality to ensure the continuation of current levels of rail habitat, in terms of both quantity and quality, has been secured for the long term for the Ciénega de Santa Clara. This water supply can be of the current quantity (approximately 100,000 acre-feet per year), and quality (averaging less than 2,660 parts per million [ppm]); or that needed to maintain salinities in the Ciénega below that needed for cattail growth [5,000 to 6,000 ppm]) over the long term (USFWS 2009).

An evaluation is completed of potential migration pathways between the LCR, Salton Sea, and Mexican core habitat areas that provide for connectivity to support population viability; and, if appropriate, management plans are developed to protect stopover habitats (USFWS 2009).

Recovery Actions:

- Recovery actions from the 1983 Recovery Plan include:
- To maintain a minimum population of 700 to 1,000 rails in the United States (USFWS 1983).
- To preserve winter habitat of the Yuma clapper rail so that population survival is assured (USFWS 1983).
- To carry out a program of public conservation education and planning advice directed toward preservation of rail habitat (USFWS 1983).
- Future actions determined by the 5-Year Review:
- The U.S. Fish and Wildlife Service (USFWS) should convene a group of species experts to revise the recovery plan tasks and criteria. Criteria should be revised based on a detailed five-factor analysis of current threats, including a reassessment of adequate population numbers. Revision of tasks should focus on those items from the 1983 recovery plan that are still relevant but have not been completed, as well as identification of additional tasks needed to support revised downlisting and delisting criteria. Recommended tasks include telemetry studies to identify clapper rail migration patterns, and expansion of survey efforts to include areas not currently surveyed. To expand surveys, additional efforts from cooperating entities would be required. The Arizona Ecological Services office (AESO) will have the lead for revising the recovery plan (USFWS 2006).

- The USFWS should be involved in the Bypass Flow Restoration or Replacement Program to work toward a secure, dedicated water source for the Ciénega de Santa Clara in Mexico. The Ciénega supports the majority of the Yuma clapper rail population in Mexico. The AESO will have the lead for this action (USFWS 2006).
- Implement new survey protocol and training for all agency personnel who volunteer for the surveys, and monitor consistency and use of the new protocol. Use the data to assess trends in local populations and assess the adequacy of management actions. The AESO will have the lead for this action (USFWS 2006).
- Complete development of management plans on federal and state lands supporting containing populations of breeding Yuma clapper rails. Work with other federal agencies on Resource Management Plan revisions or other planning documents to ensure that management activities to maintain clapper rail habitat are included. Priority for planning activities should be focused on areas of declining clapper rail populations and/or marsh habitat quality. Develop Safe Harbor Agreements and Habitat Conservation Plans that include protection for and maintenance of clapper rail habitat on private lands. This effort should be coordinated by AESO with other cooperating USFWS offices, Arizona Game and Fish Department, California Department of Fish and Wildlife, and Nevada Department of Wildlife (USFWS 2006).
- Develop proposals and obtain funding for research to document the presence of selenium in various life stages of the clapper rail and its environment (including water, substrate, and forage base); assess the effects to reproduction and potential for mortality; and develop strategies to address possible adverse effects. This effort should be coordinated by the AESO Environmental Contaminants Division, with cooperating USFWS offices and state wildlife agency input (USFWS 2006).
- Recovery actions from the draft 2009 recovery plan include:
- Define the minimum population size that must be maintained for the Yuma clapper rail in the United States to achieve recovery and document progress toward meeting that population size (USFWS 2009).
- Define the physical parameters of and document the amount of Yuma clapper rail habitat in the United States needed to support the minimum viable population size needed to achieve recovery (USFWS 2009).
- Ensure that existing and new habitats for Yuma clapper rail are protected and managed for long-term habitat suitability (USFWS 2009).
- Provide a mechanism for coordination and implementation of recovery actions (USFWS 2009).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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SPECIES ACCOUNT: *Rallus owstoni (=Gallirallus)* (Guam rail (=Gallirallus))

Species Taxonomic and Listing Information

Listing Status: Endangered/Experimental Population, Non-Essential on Rota; 4/11/1984, 10/30/1989; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Guam rail is endemic to the island of Guam in the Mariana Islands. The species is derived from the closely related barred rail (Gallirallus torquatus) of the Philippines and Indonesia (Ripley 1977). No closely related species occur in Micronesia. The rail is medium-sized and capable of short burst of flight (1 to 2 m), but is seldom observed in flight (Jenkins 1979, p. 404). Rails are about 28 cm (11 in) in total length (Taylor 1998, p. 258). Guam rails have elongated and laterally compressed, particularly in the neck and breast regions, bodies allowing the birds to move rapidly through dense vegetation.

Current Range

The rail is extirpated in the wild on Guam but persists in captivity at the Guam DAWR facility and twelve U.S. mainland zoos (AZA 2014, p. 1). Efforts to establish a nonessential experimental population on the island of Rota has been underway since 1989. The establishment of a wild population on Rota will ensure that a source wild population is available for future repatriation of rails to Guam when brown treesnakes have been controlled or eradicated on Guam (USFWS 1989, p. 43967). On Cocos Island (a small islet approximately 1.6 km (1 mi) off the southern coast of Guam), breeding pairs of rails have become established in a predator-controlled habitat through efforts associated with a Safe Harbor Agreement and activities permitted under section 10(a)(1)(A) of the ESA (USFWS 2008b; USFWS 2008c, p. 1-2). This agreement, signed in 2008, has allowed for the establishment of Guam rails on private land owned and managed by Cocos Island Resort and public land owned by the Government of Guam and managed by the Guam Department of Parks and Recreation. The rails are monitored to learn more about survivorship, breeding behavior, habitat preference and nesting success.

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

<u>Adult:</u> The diet of the Guam rail is comprised of snails, slugs, lizards, insects, and vegetable matter such as seeds and palm leaves; the rail feeds on food items from the surface of the ground, especially snails and slugs after rain showers (Jenkins 1979, pp. 405-406). They chase low-flying insects and feed on seeds and flowers from low grasses and shrubs, stretching up to reach items 40 cm above the ground. They often forage along edge habitat but seldom venture far from cover (Jenkins 1979, p. 404; Taylor 1998, p. 259). During the dry season the rails were reported to damage crops such as tomatoes, cucumbers and melons, but such damage probably resulted from their obtaining moisture rather than food. Rails also ingest coral chips and pieces

of small shell for grit (Jenkins 1979, p. 405-406). They are able to forage at night, but are most active during the dawn and dusk (Jenkins 1979, p. 404-406; Taylor 1998, p. 259).

Reproduction Narrative

Adult: Guam rails are monogamous and breed throughout the year (Jenkins 1979, p. 406; USFWS 1990a, p. 9), with a possible peak breeding period during the rainy season (May-October) (Perez 1969 as cited in the USFWS 1990a, p. 9). They can lay two to four eggs per clutch and both parents share in the construction of the nest. Nests are located on dry ground in dense grass, are a shallow cup of interwoven loose and rooted grass, and are built by both sexes (Jenkins 1979, p. 406; Taylor 1998, p. 260). Incubation of eggs is 21 days (Beck 1985, unpubl. data cited in USFWS 1990a, p. 9) with both sexes sharing the nesting duties. The eggs hatch asynchronously, and the young are precocial, leaving their nests within 24 hours of hatching to forage with the aid of their parents (Jenkins 1979, p. 406). In captivity, Guam rails can live up to 17 years, while females can reach 16 years old. Median life expectancy for captive males is 9.5 years; captive female median life expectancy is slightly lower at 5.7 years (AZA 2014, p. 5). The median life expectancy of Guam rails in the wild is unknown. Both males and females can begin reproducing at approximately 5 months old. Males have bred until the age of 11, and females as old as 9 years old have successfully reproduced. Breeding in captivity is complex, as males can be extremely aggressive and have at times injured or killed females. In captivity, clutch sizes range from one to six eggs, averaging 2.1 eggs, with an incubation period of 19 days.

Habitat Narrative

Adult: The Guam rail formally occurred in most habitat types on Guam, including forest, savanna, secondary grassland, agricultural areas, mown grass bordering scrub communities, mixed woodland and scrub, and fern thickets (Jenkins 1979, p. 405-406; Taylor 1998, p. 259). Guam rails were predominantly observed using scrubby secondary growth area and the edges of mixed forest areas (Jenkins 1979, Engbring and Ramsey 1984). Jenkins (1979) reports that they were seldom observed in the interior of mature limestone forests or savanna areas and did not occur in wetlands. As Guam was probably mostly limestone forest before the arrival of humans (Forsberg 1960), the rail may have become more common after much of the mature forest had been converted to scrubby second-grown or mixed forest (Engbring and Ramsey 1984).

Dispersal/Migration

Population Information and Trends

Population Trends:

Extinct in the wild

Population Narrative:

Guam rails were once distributed throughout Guam (USFWS 1990a, p.7). They first disappeared from southern Guam in the early 1970's (Jenkins 1979). In 1981, the population was reduced to approximately 2,300 individuals and only existed in northern Guam (Engbring and Ramsey 1984, p. 28). In 1983, estimates of the population size indicated that fewer than 100 individuals remained on Guam and 22 individuals were moved to captive propagation facilities (Haig and Ballou 1995, p. 446). The rail was extirpated on Guam by 1987 (Wiles et. al. 1995, p. 38). There have been two releases of rails on Guam since this species has been listed as endangered. In 1998, 16 rails were released in "Area 50" at AAFB in northern Guam (Beauprez and Brock

1999). A temporary brown treesnake barrier was constructed around Area 50 and snake populations in the barrier were reduced through snake control. Breeding was documented, although the small population was extirpated by predators, mainly feral cats. In 2003, a second release of 44 rails occurred in a brown treesnake-reduced area of the Munitions Storage Area on AAFB (P. Wenninger, DAWR, pers. comm. 2008). Efforts to reduce cat predation on the rails were limited due to difficulty in obtaining approval to control cats in the area. By 2008, rails no longer were present in the Munitions Storage Area (P. Wenninger, DAWR, pers. comm. 2008; USFWS 2009b, p. 5). On Rota, over 800 captive-bred Guam rails have been released between 1989 and 2008 in an effort to establish an experimental wild population (Witteman and Beck 1990, Beck 1991, Brock and Beck 1995, Beauprez and Brock 1996-1999a, P. Wenninger, DAWR, pers. comm. 2008). The introduction to the island of Rota, which is outside the historical range of the species, was justified because primary habitat on Guam had been altered through the establishment of the introduced, predatory brown treesnake (USFWS 1989, p. 43966). Improvements in managing the captive flock have increased the number of rails available for each release and the larger release cohorts have increased the likelihood of population establishment. Population estimates in 2002 indicated 100 rails were present on the northeast end of Rota near two release sites, Duge and Saguagaga. Based on surveys conducted in July 2013, there are approximately 125 rails on Rota (S. Medina, DAWR, pers. comm. 2013). However, released birds still suffer mortality primarily due to feral cat predation, which slows population establishment. Current release strategies include intensive cat trapping and a review and update of monitoring protocol for rails on Rota. On Cocos Island, sixteen captive bred rails were released in November 2010. Prior to the release, rats (Rattus spp.) were eradicated on Cocos Island. Guam rails are successfully breeding (16 nests and 12 chicks have been observed) on Cocos Island. Sightings of unbanded adults have been documented, which suggests that chicks are surviving into adulthood (S. Medina, DAWR, pers. comm. 2013). As of December 30, 2014, the Guam rail captive population is distributed among 14 institutions, with the Guam DAWR facility holding 116 birds and the 13 Association of Zoos and Aquariums (AZA) facilities housing 46 birds. At that time, current gene diversity was 88 percent in the DAWR facility and 83 percent at the AZA facilities (AZA 2014, p. 4). When gene diversity falls below 90 percent in a founding population, it is expected that reproduction will be compromised by, among other factors, lower hatch rates, small clutch sizes, and greater neonatal mortality (Ross et al. 2006). However, there still remains the potential to increase the gene diversity in DAWR and AZA facilities over the long term (AZA 2014, p. 6). The DAWR and AZA work cooperatively and closely coordinate on the transfer of birds to facilities, as needed, in order to manage the genetic diversity within the captive Guam rail population (AZA 2014, p. 4). These facilities also support the releases of individuals into the wild on Rota.

Threats and Stressors

Stressor: Agricultural and urban development
Exposure:
Response:
Consequence:
Narrative: Agricultural and urban development is a factor in habitat loss and degradation on Guam.

Stressor: Nonnative smake predation
Exposure:

Response:
Consequence:
Narrative: Nonnative snake predation. The brown treesnake continues to limit efforts to reestablish rails on Guam.

Stressor: Cat predation
Exposure:
Response:
Consequence:
Narrative: Cat predation. Feral cats continue to limit efforts to reestablish rails on Guam and impact the rail experimental population on Rota.

Stressor: Rodent predation
Exposure:
Response:
Consequence:
Narrative: Rodent predation. Because rats have been eradicated and are absent from Cocos Island, there is continued efforts to prevent the reintroduction of rats to this island. Rats can negatively impact rails by consuming eggs and preying on chicks.

Stressor: Stochastic events
Exposure:
Response:
Consequence:
Narrative: Stochastic events – Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam rail.

Recovery

Reclassification Criteria:
Draft Downlisting Recovery Criterion 1: Guam rail populations in captive propagation programs on Guam and in the mainland United States maintain adequate population size, demographic characteristics (sex ratio, age structure, and reproductive success), and representation of genetic diversity to support reintroduction to Guam. (USFWS, 2018).

Draft Criterion 2: Guam rails occur in three or more viable populations in the wild, with at least one population in northern Guam, exhibiting ecological, morphological, behavioral, and genetic diversity representative of the species. (USFWS, 2018).

Draft Criterion 3: Over a minimum 15-year period, Guam rail population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring. (USFWS, 2018).

Draft Criterion 4: Habitat is protected and management has been established to the extent that Criteria 2 and 3 above are achieved. (USFWS, 2018).

Draft Criterion 5: Threats to the species, including the identified primary threat of predation by introduced predators such as the brown treesnake and feral cats, are effectively managed to minimize mortality and meet population targets in Criterion 3. (USFWS, 2018).

Delisting Criteria:
Draft Delisting Criterion 1: Guam rails occur in five or more viable populations in the wild, with at least two populations in northern Guam, exhibiting ecological, morphological, behavioral, and genetic diversity representative of the species. (USFWS, 2018).

Draft Criterion 2: Over a minimum 30-year period, Guam rail population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring. (USFWS, 2018).

Draft Criterion 3: Habitat is protected and management has been established to the extent that Criteria 1 and 2 above are achieved. (USFWS, 2018).

Draft Criterion 4: Threats to the species, including the identified primary threat of predation by introduced predators such as the brown treesnake and feral cats, are sufficiently managed to minimize mortality and meet population targets in Criterion 2. (USFWS, 2018).

Recovery Actions:
- Before the Guam rail is considered for downlisting from endangered to threatened, the repatriation of 1,000 birds to northern Guam and 1,000 birds to southern Guam (total = 2,000 individuals; USFWS 1990a, p. 33) would need to occur and brown treesnakes would need to be controlled on Guam (USFWS 1990a, p. 33-34). No criteria were defined for delisting. Traill et al. (2009) proposed a minimum population target of 5,000 individuals as an appropriate target for species conservation.
- • Brown treesnake eradication and control using acetaminophen, as a toxicant to the snake, is being conducted within the approximately 136-acre (55-hectare) Habitat Management Unit on AAFB. In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study indicate that development of a scalable automatic bait application system could be used in the near future for large landscape scale brown treesnake control and suppression (Dorr et al. 2014, unpublished data). The project may result in the reduction of snake numbers to a low enough level to allow for rails to survive and reproduce within this snake-proofed area on Guam.
- • Management unit planning – On Guam, a management plan, funded by DoD, is currently being developed for the HMU on AAFB. The plan will consider the reintroduction of Guam rails to this site.
- • Predator control – Cat control is conducted on Rota and will continue with increased efforts from additional funding by the Service in fiscal year 2015.

Conservation Measures and Best Management Practices:

- Maintain or increase genetic diversity in captive rail population – Implement management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.
- Predator monitoring and control o Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam. o Continue and increase efforts to control and eradicate brown treesnakes on Guam and prevent introduction of brown treesnakes on other Mariana Islands. o Implement large-scale cat control and/or eradication.
- Reintroduction / translocation o Consider alternative sites for establishing other experimental populations. o Develop reintroduction plan for Guam rails on Guam and set aside and protect recovery areas for these rails on Guam.
- Revise recovery objectives and criteria – Revise recovery plan.
- Population monitoring and viability analysis – Continue population and demographic monitoring on Rota and Cocos Island.
- Protection and restoration of Guam rail recovery habitat including in-perpetuity protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

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SPECIES ACCOUNT: *Rhynchopsitta pachyrhyncha* (Thick-billed parrot)

Species Taxonomic and Listing Information

Listing Status: Endangered; 06/02/1970; Southwest Region (Region 2) (USFWS, 2016)

Physical Description

The thick-billed parrot has a wide yellow wing stripe visible from below, which the maroon-fronted parrot lacks. The thick-billed parrot is approximately 38 cm (15 in) in length, while the maroon-fronted parrot is slightly larger at 40 to 45 cm (16 to 18 in) long (CONANP 2009). The appearance of females and males is virtually identical in both species. The thick-billed parrot's long, tapered wings allow for fast flight and maneuvering, and they are excellent fliers (Snyder et al. 1999). (USFWS, 2013)

Taxonomy

Thick-billed parrots are members of the parrot family, Psittacidae. The genus Rhychopsitta is found only in Mexico, and the two members of the genus, Rhychopsitta pachyrhyncha (Swainson 1827), thick-billed parrot, and R. terrisi, maroon-fronted parrot, are similar in appearance. The genus is believed to be related to macaws, based on a similar body shape (Forshaw 1989). (USFWS, 2013)

Historical Range

Historically, the thick-billed parrot's range in the U.S. extended as far north as the mountains of southeastern Arizona and possibly southwestern New Mexico (Snyder et al. 1999; Map 1 in Appendix A). The extent of the historical range in the U.S. may have been tied in large part to the distribution of Chihuahua pine (Pinus leiophylla) (Snyder et al. 1994, 1995, 1999); see Food Resources section). (USFWS, 2013)

Current Range

The now extinct Carolina parakeet (Conuropsis carolinensis) and the thick-billed parrot are the only parrot species with a known distribution that once ranged into the continental U.S. (Snyder et al. 1999). (USFWS, 2013)

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Diet includes mostly pine seeds (mainly Pinus arizonica and P. ayacahuite) but also other pine species and seeds of Douglas-fir); parrots also have been observed eating buds, acorns, juniper fruits, and a few other items (Lanning and Shiflett 1983, Snyder et al. 1994). (USFWS, 2013)

Reproduction Narrative

Adult: The thick-billed parrot has a relatively long life-span in captivity of over 30 years. Young develop slowly, are cared for by both parents, remain dependent on their parents for over a year, and exhibit the learning of behaviors (Snyder et al. 1999). As an obligate cavity nester, the thick-billed parrot requires large-diameter trees and snags; with pines, Douglas-fir, quaking aspen, and white fir used as nest-trees (Lanning and Shiflett 1983, Monterrubio-Rico and Enkerlin-Hoeflich 2004). Eggs are laid from mid-June to late July or August, sometimes as early as May; nesting season corresponds with maturing of pine seeds. Clutch size usually is 2-4 (average = 3). Incubation, by female, lasts 24-28 days. Young leave the nest in late summer or early fall (Lanning and Shiflett 1983). (USFWS, 2013; NatureServe, 2015)

Geographic or Habitat Restraints or Barriers

Adult: Nests are 8-28 meters above ground in trees 12-35 meters tall; nests in standing snag/hollow tree (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: Patchy (USFWS, 2013)

Environmental Specificity

Adult: Medium (NatureServe, 2015)

Habitat Narrative

Adult: Habitat includes highland pine-oak forest, but some foraging occurs in pine forest at low elevations or in deciduous forest (AOU 1983). In winter, this parrot forms large nomadic flocks that move in response to variations in cone crop; it requires extensive areas of suitable habitat. Durango pine (Pinus durangensis), teocote pine (Pinus teocote), Chihuahuan pine (Pinus leiophylla), and Apache pine (Pinus engelmannii) are important food sources (Snyder et al. 1999). Roosts are in densely crowned trees or on cliffs (Collar et al. 1992). In Arizona, the conifer species of the greatest importance include Chiricahua, ponderosa, and Arizona pines (Snyder et al. 1994). Nesting occurs in mature and old-growth conifer-dominated forests. In Chihuahua, common tree species in one of the species' primary remaining nesting areas incuded Douglas-fir (Pseudotsuga menziesii), white fir (Abies concolor), Mexican white pine (Pinus ayacahuite), and quaking aspen (Populus tremuloides) (Monterrubio et al. 2006). Nests usually are cavities (natural or abandoned by woodpecker) in standing dead or live trees; some nests may be as close as 2 meters apart in the same tree; nests are 8-28 meters above ground in trees 12-35 meters tall (Lanning and Shiflett 1983, Collar et al. 1992). (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: High (NatureServe, 2015)

Immigration/Emigration

Adult: Immigrates and emigrates (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Breeding occurs in the northern part of the annual range, in winter, most individuals are on high volcanoes in the southern part of the range (Lanning and Shiflett 1983). The usual absence of thick-billed parrots from Chihuahua and Sonora in winter suggests that some populations migrate more than 1,000 kilometers between wintering and summering areas (Snyder et al. 1999). Preliminary studies indicate that the home range of reproductive pairs may vary from an estimated average of 17,861 ha (44135 ac) in the Madera breeding area (5 pairs tracked) to 50,305 ha (124,306 ac) in Papigochic breeding area (2 pairs tracked) (Pronatura 2012). Foraging habits are nomadic depending on food and water availability, and thick-billed parrots are capable of flying distances from 3.6 to 15.8 km (2.2 to 9.8 mi), averaging 9.7 km (6 mi) per foraging trip, and totaling an average of 50 km (31 mi) in daily movements (Snyder et al. 1999). Flocks ranged from approximately 12 to 110 parrots. (USFWS, 2013; NatureServe, 2015)

Population Information and Trends

Population Trends:

Extinct (USFWS, 2013)

Species Trends:

Extinct (USFWS, 2013)

Resiliency:

Not applicable.

Representation:

Not applicable.

Redundancy:

Not applicable.

Population Growth Rate:

Not applicable.

Number of Populations:

0 (USFWS, 2013)

Population Size:

0

Population Narrative:

The now extinct Carolina parakeet (Conuropsis carolinensis) and the thick-billed parrot are the only parrot species with a known distribution that once ranged into the continental U.S. (Snyder et al. 1999). (USFWS, 2013)

Threats and Stressors

Stressor: Habitat loss (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: The thick-billed parrot has experienced significant historical declines in Mexico, corresponding to loss of high elevation mixed conifer forests from extensive logging of large, mature pines, removal of nesting snags (Snyder et al. 1999), and to a lesser degree, high-severity forest fires (CONANP 2009). Habitat loss and modification continue to be the main threats to the species (CONANP 2009). The estimates of remaining mature and old-growth forest vary. For example, Lammertink et al. (1996) estimated that less than one percent of the old-growth forests in the Sierra Madre Occidental remain. However, this estimate, based on the mapped area above the 2,000 m (6,562 ft) elevational contour lines, was assumed to represent the historical cover of old-growth temperate forest habitat. The estimate is not based on structure data and assumes that all forests found at or above that altitude were old-growth. The lack of "old-growth" definitions for temperate forests in the Sierra Madre Occidental poses another problem to assertions about the extent of its cover. Perhaps a more useful approach is that of Sánchez Colón et al. (2009), estimating that between the 1970s and 2002, México's temperate forest cover decreased by 25 percent and became increasingly fragmented, mostly due to agricultural clearing. Commercial forestry has been the most important agent of human induced change in the Sierra Madre Occidental since the early1900s and Chihuahua remains one of the most important timber producing states in Mexico (Challenger et al. 2009, CONAFOR 2009 in Cortés-Montaño et al. 2012). (USFWS, 2013)

Stressor: Forest management (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: In the U.S., with the recognition that these heavy fuel loads need to be reduced, and fire needs to be reintroduced as a natural process to restore the ecological balance, the FireScape program (AZFirescape 2012) has taken a landscape-scale approach for fire management across multiple land ownerships in the mountains of southeastern Arizona including the Forest Service, The Nature Conservancy, the University of Arizona, Bureau of Land Management, National Park Service, and other southeastern Arizona land managers. Because the 2011 Horseshoe 2 fire has altered the mosaic of vegetation on the landscape, projects that were planned to be implemented through the Firescape program are being re-evaluated (Fisher 2012). Sanitation/salvage has been performed since commercial logging first began prior to the 1900s. This type of intermediate treatment has declined in recent years; however, today salvage harvesting treatment is getting greater attention due to the increasing number of large, high intensity fires and increased insect-induced mortality in ponderosa pine and mixed conifer forests. Those treatments are generally located in high-severity burned areas and areas of extensive beetle-killed trees. In addition, Forest Service salvage operations in Arizona and New Mexico generally involve no new road construction, logging only on slopes <30–40 percent, and removing only trees that are completely dead or determined to be dying (USFWS 2011). (USFWS, 2013)

Stressor: White pine blister rust (USFWS, 2013)
Exposure:
Response:

Consequence:
Narrative: White pines in New Mexico and Arizona are threatened by an invasive fungus, white pine blister rust (Cronartium ribicola) (Conklin et al 2009). First found in the southwest on the Lincoln National Forest in 1990, it has now been discovered on the Alpine District of the ApacheSitgreaves National Forest. It has not been found in Southwestern white pine on the Coronado but it is expected to appear within the next several decades (Wilcox 2012). This exotic disease is a significant threat to white pines and has become a major tree disease in many parts of the US and is expected to become a major disease of white pines throughout their range in North America (Tomback and Achuff 2010) including Mexico. Zeglen et al. (2010) provides an excellent review of silvicultural practices for addressing this disease in white pine stands in the west. (USFWS, 2013)

Stressor: Management benefitting both thick-billed parrots and Mexican spotted owls (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Extensive overlap exists between the range and habitat used by the Mexican spotted owl and thick-billed parrot in Mexico. The maintenance and creation of large diameter trees and snags are an important factor in managing for nesting and roosting habitat for both species. Collaborating on conservation actions in Mexico that promote and maintain habitat in mature mixed conifer forest and reduce the risk of high-severity fire will benefit both species where their ranges overlap (USFWS 2012). (USFWS, 2013)

Stressor: Shootings (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Disappearance of the thick-billed parrot from the U.S. has been attributed to excessive shooting. Various accounts from the early 1900s indicate that shooting of birds was probably a frequent occurrence (Wetmore 1935; Snyder et al.1994, 1999). Accounts of shooting thick-billed parrots have been reported in the literature (Lusk 1900 and Smith 1907 in Snyder et al. 1994, Wetmore 1935). Flocks of noisy, gregarious, and relatively tame thick-billed parrots were likely an easy target. Wetmore (1935) reported 75 or possibly 100 thick-billed parrots were believed to be shot out of curiosity in one canyon of the Chiricahua Mountains in 1917-1918. In addition, many residents in the remote southeastern Arizona mountains in the late 1800s and early 1900s relied on subsistence-hunting and likely shot thick-billed parrots for food (Snyder et al. 1994). Concern over the risk to the bird's long-term survival was even reported by Vorhies (1934 in Snyder et al. 1994). Arizona Game and Fish Department agent Ralph Morrow, who lived in the Chiricahua Mountains from 1903 to the mid-1970s, provided convincing testimony that shooting may have led to the thick-billed parrot's disappearance (Snyder et al. 1994). He observed widespread shooting of thick-billed parrots in the early 1900s and willingly participated by killing "many dozens of individuals." A 1904 National Park Service photograph from the Chiricahua Mountains provides some evidence of loss by shooting, showing armed soldiers with dead thick-billed parrots (in Snyder et al. 1994). (USFWS, 2013)

Stressor: Illegal trade (USFWS, 2013)
Exposure:

Response:
Consequence:
Narrative: The trapping of adults, and on occasion the taking of nestlings, for the local pet trade has been more of a threat (Lanning and Shiflett 1983 in Snyder et al. 1999, Cantu-Guzman et al. 2007, CONANP 2009). In some areas mature nest trees have been cut down to access the nests, not only reducing the number of young from the population, but also the number of available nest trees (CONANP-Pronatura Sur 2008). From 1984 to 1994 more than 1,000 thick-billed parrots were estimated to be captured and illegally smuggled into the U.S. for the pet market (Snyder et al. 1994; SEMARNAP-INE 2000). Although other parrot species are in much higher demand for the illegal U.S. pet trade, thick-billed parrots were 8th in a list of the top 10 parrot species seized at the southern border by USFWS for the period 1995-2005, with 26 thick-billed parrots seized by authorities during these years (Cantu-Guzman et al. 2007). However, most of the illegal trapping of parrot species in Mexico is for the domestic trade, not for exporting to the U.S. (Cantu-Guzman et al. 2007). Mexico's General Wildlife Law (Decree 60 Bis 2) bans the capture and export of all native parrots (Gobierno Federal 2008), and the species is listed in CITES Appendix I (UNEO-WCMC2012). The removal of birds from the wild for the illegal pet trade remains a threat to the population (CONANP2009). (USFWS, 2013)

Stressor: Disease (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Health assessments on wild thick-billed parrot populations have not been extensive, and the role of disease in wild population declines is not known (Snyder et al. 1999, Lamberski 2010). Although no information is available on wild populations, other diseases significant to captiveheld parrots that may also adversely impact wild birds include West Nile virus (WNV), and salmonellosis (Lamberski 2005). In 1995-1996, institutions comprising the 1Thick-billed Parrot Species Survival Plan (SSP) Management Group conducted health assessments on 70 percent of their captive population (i.e. 73/105 birds). Thirty-nine birds were tested for Pacheco's disease (37 percent of the SSP population). Of the birds tested, 7 (18 percent) tested positive for Pacheco's disease antibodies. Although Pacheco's disease, a psittacid herpesvirus, has not been identified as a cause of death in any of these captive birds, it has been implicated in the death of birds involved in the Arizona releases (1986-1993). Disease can occur when a non-adapted Pacheco disease virus enters a new bird host; host-adapted strains cause a mild, latent, and subclinical infection in their host. Birds that recover from the virus may develop low levels of virus-neutralizing antibodies as well as long lasting immunity to the same strain of virus. Viral shedding occurs during times of stress. Diseases such as WNV are linked to habitats with human disturbance. WNV has been spreading in the U.S and Mexico since 1999, and captive thick-billed parrots are susceptible to this infection. In 2003, almost 20 percent of the captive population mortalities were confirmed cases of WNV (Lamberski 2005). WNV in wild birds in the Sierra Madre could have a devastating impact on the populations. Mosquito vectors for WNV and St. Louis encephalitis occur in some thick-billed parrot habitat. Serum samples from 24 wild chicks were negative for both these diseases (Lamberski et al. 2010). Additionally, cases of salmonella septicemia have resulted in acute death in captive thick-billed parrots. Salmonella arizona was identified as the specific organism in three cases (Lamberski 2005). While salmonella is ubiquitous, close association of parrots with poultry, reptiles, livestock, and contaminated environments can increase exposure. Two birds of these three mentioned cases were housed in an enclosure with reptiles. (USFWS, 2013)

Stressor: Disease risk using captive-bred or wild-caught birds (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: The thick-billed parrot reintroduction program in the late 1980s and early 1990s demonstrated the high risk in releasing captive-bred and confiscated wild birds without the ability to detect some dangerous and untreatable diseases in carrier birds, even with extended quarantine periods (Snyder et al. 1994). Diseases that cannot be reliable detected include parrot wasting disease (psittacine pro-ventricular dilation syndrome) and Pacheco's disease (Derrickson and Snyder 1992). Rigorous disease prevention and screening procedures may be sufficiently expensive to preclude captive breeding as a recovery approach for many species (Snyder et al. 1996). Based on the Arizona parrot release results, the disease risk is too great to attempt reestablishment with captive-bred or confiscated wild birds (Snyder et al. 1994). The presence of pasteurella (avian cholera), and possibly parrot wasting disease and Pacheco's disease among the released birds in Arizona may have been a contributing factor to poor survival (see 1.8.1. Reintroductions). (USFWS, 2013)

Stressor: Predation (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Naturally-occurring thick-billed parrot populations in Mexico exhibit sentinel, flocking, and social behavior to avoid potential predators (Snyder et al. 1994). Birds released in Arizona, many of which were held in captivity for years, lacked these learned skills. Raptors, mainly redtailed hawks (Buteo jamaicensis) and northern goshawks (Accipiter gentilis), were the primary source of mortality for wild-flighted, released birds in Arizona. Ring-tailed cats (Bassariscus astutus) have been documented preying on adult parrots at roosts sites (Snyder et al. 1999). Less abundant than the ring-tailed cat in most of the parrot's range, the raccoon (Procyon lotor) is known to prey upon nestlings, based on a single record (Cruz-Nieto 1998 in Snyder et al. 1999). Predators at nests are an unusual occurrence; for example, Monterrubio et al. (2002) documented only eight known predation events by ringed-tailed cats and avian predators. (USFWS, 2013)

Stressor: Population size (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: The parrot exhibits a patchy distribution across its vast range in Mexico and many of these areas are difficult to access because of their remoteness and potential danger; therefore accurately estimating range-wide population numbers for the species has been challenging (Snyder et al. 1999, Monterrubio et al. 2002). Estimates vary on the number of thick-billed parrots. Lammertink et al. (1996, in BirdLife International 2012) estimated between 1,000 and 4,000 birds. Key breeding areas are periodically surveyed, and parrot counts from 3 areas (including the 2 most important breeding sites of Madera and Tutuaca) in 2008 totaled close to 3,500 individuals (CONANP-Pronatura Sur 2008 in CONANP 2009). Monthly surveys (July-October) in 2012 across 5 breeding areas (including Madera and Tutuaca) counted a minimum of 1,870 and a maximum of 2,097 individuals (Pronatura 2012). However, this number may be a

conservative estimate because not all known breeding areas are surveyed annually and other more remote or potential breeding areas have not yet been inventoried (Cruz-Nieto, pers. comm. 2012). Productivity and nest success in the breeding populations are high (Monterrubio et al. 2002), but only a small percentage of the individuals are breeding pairs (CONANP 2009). In Chihuahua in 1995 and 1996, 5 of 18 and 28 of 58 pairs using cavities in respective breeding seasons did not produce eggs (Cruz-Nieto 1998 in Snyder et al. 1999). In Chihuahua in 1998, one-third of 160 pairs using cavities did not produce eggs (T. Monterrubio, pers. comm. in Snyder et al. 1999). Additionally, recruitment rate is believed to be low (CONANP 2009), although the rate of mortality for juveniles or adults has not been quantified (Monterrubio et al. 2002). Reduced population size is considered a threat to the species, because the breeding populations are relatively small and concentrated in a handful of sites, which makes them vulnerable to catastrophic events (CONANP 2009). Large areas of old-growth forest are no longer found in the Sierra Madre Occidental and as the average age of trees and conifer forest decreases, so do parrot nesting sites and food resources. The reduced seed production in these younger forests is accompanied by an increase in the frequency of sterile cones, further exacerbating the inadequate food supply (Monterrubio-Rico and Enkerlin-Hoeflich 2004, Monterrubio-Rico et al. 2006). Thus, the thick-billed parrot is further threatened by small population size and the low number of breeding pairs in the remaining old-growth and mature forests. (USFWS, 2013)

Stressor: Climate change (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Exactly how climate change will affect precipitation within the range of the thick-billed parrot in the Southwest is uncertain. Increases in drought and heat stress associated with climate change could alter the future composition, structure, and biogeography of forests (Allen et al. 2010), including old-growth forests thick-billed parrots depend on. Sky Islands in the Southwest and Mexico are already being affected by processes associated with climate change, by increases in drought, fire, and invasive insects (Williams et al. 2010in U.S. Forest Service 2011a). Sky Island forests could become even more fragmented in the future as forest habitats shift upward in elevation (U.S. Forest Service 2011a). Temperature increases of as little as a few degrees could cause forest habitats to shift to higher elevations, reducing their area, altering phenologies of food availability, and potentially causing local extinction of endemic taxa and unique genetic and phenotypic diversity (Kupfer et al. 2005, U.S. Forest Service 2011a). A recent assessment of climate change in the Southwest found that many Sky Islands forest systems are among the most vulnerable to climate change because of the combination of recent temperature increases and a high number of species of conservation concern (Robles and Enquist 2010, U.S. Forest Service 2011a). We expect long-term climate trends associated with a hotter, drier climate to have an overall negative effect on the available habitat and food resources in the historical and current range of the thick-billed parrot. (USFWS, 2013)

Recovery

Reclassification Criteria:
1. A self-sustaining population of thick-billed parrots is maintained, sufficient to ensure the species' survival and to address threats of small population size, such as demographic and genetic stochasticity. A stable or increasing trend over a 20-year period is documented in at least 5 known wild thick-billed parrot breeding populations. (USFWS, 2013)

2. Sufficient thick-billed parrot habitat (patch size, forest composition and structure, distribution) is conserved (protected, managed, and restored) that includes foraging, breeding, and wintering habitat to ensure the species' survival despite environmental alteration and the threat of climate change. (USFWS, 2013)

3. Illegal timber harvesting, tree clearing, and high-intensity wildfires in thick-billed parrot habitat have been reduced to the point that they are no longer threats to thick-billed parrots. (USFWS, 2013)

4. Threats of illegal collecting and poaching of thick-billed parrots for the pet trade have been reduced to the point that they no longer impact thick-billed parrots. (USFWS, 2013)

Delisting Criteria:
Delisting criteria are not available.

Recovery Actions:
- Identify home ranges and migration patterns of reproductive and non-reproductive thick-billed parrot groups during the breeding and non-breeding season and evaluate habitat use and availability. (USFWS, 2013)
- Conduct studies on the relationship between food availability, forest altitude and composition, and thick-billed parrot movement and nesting. (USFWS, 2013)
- Develop predictive parrot occurrence models such as ecological niche modeling and verify, evaluate, and quantify occurrence sites. (USFWS, 2013)
- Characterize the habitat requirements of thick-billed parrots based on all aspects of the species' life history, and develop a habitat suitability model to understand, manage, and restore habitat areas and features for the parrot. (USFWS, 2013)
- Complete and implement a long-term thick-billed parrot habitat conservation plan (encompassing the current range of the species in Mexico), based on sound science, species expert knowledge, and predicted effects of climate change. (USFWS, 2013)
- Permanently protect core areas (nesting, drinking, roosting, and perching sites). (USFWS, 2013)
- Identify and map unprotected, occupied breeding and wintering habitat and priority areas within those; evaluate their potential for protection under appropriate conservation schemes (e.g., Wildlife Management and Use Unit (UMAs), voluntary landowner cooperatives, land purchase, long-term conservation easements, acquisition of lumbering rights, or protected area designation). (USFWS, 2013)
- Effectively protect, restore, and manage currently designated protected areas within the winter range (with significant numbers of verified thick-billed parrot occurrence). (USFWS, 2013)
- Develop (or revise) and implement site-specific forest management plans that incorporate habitat and foraging needs, including longer rotational cycles and maintenance of mature trees, snags, fire management, and current and future states of forest health and vegetation distribution, including climate change scenarios of future potential vegetation. (USFWS, 2013)
- Plan and implement prescribed burns where needed to manage thick-billed parrot habitat. (USFWS, 2013)

- Assess the potential for the U.S. to support naturally dispersing or actively relocated thick-billed parrots, including a review of U.S. historical habitat, current habitat management, and habitat connectivity with Mexico. Include the need and efficacy of translocating parrots in the assessment, and implement translocations if supported by Mexico and considered appropriate in the assessment. (USFWS, 2013)
- Reduce illegal collection and poaching of thick-billed parrots by enforcing existing environmental laws, regulations, plans, and policies for parrot protection. (USFWS, 2013)
- Emphasize importance of TBPA conservation to the public. (USFWS, 2013)
- Formulate a health assessment protocol for wild thick-billed parrot populations to better understand any impact of disease, and mitigate any disease risks. (USFWS, 2013)
- Develop effective tests and assess transmission risks for diseases carried by captive thick-billed parrot populations. (USFWS, 2013)
- Develop an ectoparasite management plan that identifies effective treatment protocols and control measures to reduce ectoparasite levels in the nest or local environment. (USFWS, 2013)
- Enforce existing laws, regulations, plans, and policies to protect thick-billed parrot habitat from illegal harvesting, clearing, and fires. (USFWS, 2013)
- Develop a statistically sound and peer reviewed parrot monitoring protocol to document population status and trends. (USFWS, 2013)
- Conduct a range-wide population survey for the species using standardized peer reviewed methodology. (USFWS, 2013)
- Determine the minimum viable population size, temporal and spatial distribution, and number of breeding colonies needed for recovery. Abundance estimates may be accomplished through occupancy surveys and integrating remotely sensed data (metrics of habitat). (USFWS, 2013)
- Create climate models predicting future suitable nesting areas and develop strategies that ensure the availability of keystone conifer species for use by thick-billed parrots in forest management plans. (USFWS, 2013)

Conservation Measures and Best Management Practices:

- Conservation measures are not available.

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SPECIES ACCOUNT: *Rostrhamus sociabilis plumbeus* (Everglade snail kite)

Species Taxonomic and Listing Information

Listing Status: Endangered; March 11, 1967; Southeast Region (R4) (USFWS 2007)

Physical Description

From USFWS (1999): The snail kite is a medium-sized raptor, with a total body length for adult birds of 36 to 39.5 cm and a wingspan of 109 to 116 cm (Sykes et al. 1995). In both sexes, the tail is square-tipped with a distinctive white base, and the wings are broad, and paddle-shaped. Adults of both sexes have red eyes, while juveniles have brown eyes (Brown and Amadon 1978, Clark and Wheeler 1987). The slender, decurved bill is an adaptation for extracting the kite?s primary prey, the apple snail; the bill is a distinguishing character for field identification in both adults and juveniles. Sexual dimorphism is exhibited in this species, with adult males uniformly slate gray and adult females brown with cream streaking in the face, throat, and breast. Most adult females have a cream superciliary line and cream chin and throat (Sykes et al. 1995). Immature snail kites are similar to adult females but are more cinnamon-colored with tawny or buff-colored streaking rather than cream streaking. The legs and cere of females and juveniles are yellow to orange; those of adult males are orange, turning more reddish during breeding (Sykes et al. 1995).

Taxonomy

From USFWS (1999): Three subspecies of the snail kite are currently recognized (Amadon 1975), but a larger sample size of body measurements is needed to confirm if the separation into three subspecies is valid (Sykes et al. 1995). These subspecies are: Rostrhamus . s. plumbeus, from peninsular Florida, Cuba, and northwestern Honduras; R. s. major, from Mexico, Guatemala, and the northern half of Belize; and R .s. sociabilis, from southern Nicaragua, through Panama and into South America as far south as northern Argentina. The plumbeus subspecies in Florida has a larger body size than that of R. s. sociabilis, with a beak of similar size. However, the validity of these subspecies remains a subject of debate; Beissinger (1988) is among those who question the validity of these designations.

Historical Range

From USFWS (1999): In Florida, the original range of the snail kite was larger than at present. Historically, snail kites were known to nest in Crescent Lake and Lake Panasoffkee in north-central Florida and as far west as the Wakulla River (Howell 1932, Sykes 1984).

Current Range

From USFWS (2007): The current distribution of the snail kite is limited to central and southern portions of Florida, though a kite may occasionally be reported outside of this area. Six large freshwater systems comprise the current range: Upper St. Johns marshes, Kissimmee Chain of Lakes, Lake Okeechobee, Loxahatchee Slough, the Everglades, and the Big Cypress basin (Beissinger and Takekawa 1983, Sykes 1984, Rodgers et al. 1988, Bennetts and Kitchens 1992, Rumbold and Mihalik 1994, Sykes et al. 1995).

Distinct Population Segments Defined

No (USFWS 2007)

Critical Habitat Designated

Yes; 8/1/1977.

Legal Description

On August 11, 1977, the Director, U.S. Fish and Wildlife Service determined critical habitat for the Florida everglade kite (Rostrhamus sociabilis plumbeus) pursuant to Section 7 of the Endangered Species Act Of 1973 (42 FR 47840 - 47845). A Correction and Augmentation Final Rule was issued on September 22, 1977 (42 FR 47840-47845).

Critical Habitat Designation

Florida. Areas of land (predominantly marsh), water, and airspace, with the following components (Tallahassee Meridian):

(1) St. Johns Reservoir, Indian River County: T33S R37E SW1/4 Sec. 6, W1/2 Sec. 7, Sec. 18, Sec. 19;

(2) Cloud Lake Reservoir, St. Lucle County: T34S R38E S1/2 Sec. 16, N1/2 Sec. 21;

(3) Strazzulla Reservoir, St. Lucie County: T34S R38E SW1/4 Sec. 21;

(4) western parts of Lake Okeechobee, Glades and Hendry Counties, extending along the western shore to the east of the levee system and the undiked high ground at Fisheating Creek, and from the Hurricane Gate at Clewiston northward to the mouth of the Kissimmee River, including all the Eleocharis flats of Moonshine Bay, Monkey Box, and Observation Shoal, but excluding the open water north and west of the northern tip of Observation Shoal, north of Monkey Box, and east of Fisheating Bay;

(5) Loxahatchee National Wildlife Refuge (Central and Southern Florida Flood Control District Water Conservation Area 1), Palm Beach County, including Refuge Management Compartments A, B, C, and D, and all of the main portion of the Refuge as bounded by Levees L-7, L-39, and L-40;

(6) Central and Southern Florida Flood Control District Water Conservation Area 2A, Palm Beach and Broward Counties, as bounded by Levees L-6, L-358, L-36,638, and L-39;

(7) Central and Southern Florida Flood Control District Water Conservation Area 2B, Broward County, as bounded by Levees L-35, L-35B. L-36, and L-38;

(8) Central and Southern Florida Flood Conservation Area 3A, Broward and Dade Counties, as bounded by Florida Highway 84, Levees L-68A, L-67A (north of Miami Canal), L-67C (south of Miami Canal), L-29, and L-28, and a line along the undlked northwestern portion of the Area;

(9) that portion of Everglades National Park, Dade County, within the following boundary: beginning at the point where the Park boundary meets Florida Highway 94 ln T54S R35E Sec. 20, thence eastward, and southwest along the Park boundary to the southwest corner of Sec. 31 in T7S R37E, thence southwestward along a straight line to the southwest corner of Sec. 2 in T58S R35E, thence westward along the south sides of Sec. 3, 4, 5, and 6 in T58S R35E to the Dade-

Monroe county line, thence northward along the Dade-Monroe county line to the Park boundary, thence eastward and northward along the Park boundary to the point of beginning.

Primary Constituent Elements/Physical or Biological Features

PCES not described. With respect to the Florida Everglade snail kite, the areas delineated contain the best and largest remaining stretch of suitable habitat for the species. The areas support substantial numbers of a ple snails (Pomacea paludosa) upon which the kites depend for food. The snails, in turn, are dependent on maintenance of water levels in the marshes.

Based on the text above, it can be inferred that (i) apple snails and (ii) marsh water levels adequate to support apple snails are major constituent elements required by this species.

Special Management Considerations or Protections

Critical habitat excludes existing manmnade structures or settlements which are not necessary to the normal needs or survival of the species.

Life History

Feeding Narrative

Juvenile: From USFWS (1999): Young are fed through the nestling period and after fledging until they are 9 to 11 weeks old (Beissinger and Snyder 1987, Beissinger 1988). As the chicks mature, the food progresses from pieces of torn snail fed bill to bill, whole snails removed from the shell and with operculum removed, to completely intact snails (Beissinger 1988).

Adult: From USFWS (1999): The snail kite has a highly specific diet composed almost entirely of apple snails (Pomacea paludosa). Suitable foraging habitat for the snail kite is typically a combination of low profile (< 3 m) marsh with an interdigitated matrix of shallow (0.2-1.3 m deep) open water, which is relatively clear and calm. Snail kites require foraging areas that are relatively clear and open in order to visually search for apple snails. Therefore, dense growth of herbaceous or woody vegetation is not conducive to efficient foraging. Nearly continuous flooding of wetlands for > 1 year is needed to support apple snail populations that in turn sustain foraging by the snail kite (Sykes 1979, Beissinger 1988). The snail kite is known to feed on the introduced snail Pomacea bridgesi (Takekawa and Beissinger 1983). On rare occasions, snail kites in Florida prey on small turtles (Sykes and Kale 1974, Beissinger 1988, Bennetts et al. 1988). Snail kites have also been observed feeding upon crayfish (Procambarus spp.) and a speckled perch (Pomoxis nigromaculatus) (Bennetts et al. 1994). The snail kite uses two visual foraging methods: course-hunting, while flying 1.5 to 10 m above the water surface, or still-hunting from a perch.

Reproduction Narrative

Egg: In Florida, the incubation period lasts 24 to 30 days (Sykes 1987c) (USFWS 1999).

Adult: From USFWS (2007): The majority of nesting is concentrated within the large marsh and lake systems of the Greater Everglades and Upper St. John's marshes. From USFWS (1999): Nesting almost always occurs over water, which deters predation (Sykes 1987b). Nesting substrates include small trees (usually < 10 m in height). Nesting also can occur in herbaceous vegetation, such as sawgrass, cattail, bulrush, and reed (Phragmites australis) (Sykes et al. 1995). Pair bonds are formed by a series of behaviors with each nesting. Thirty-two species of plants are known to be used in nest construction, with sticks from willow and wax myrtle the most common material (Sykes 1987b). In Florida, most pair bonds form from late November to early June. The clutch size is 1 to 5 eggs, with a mode of three(Sykes 1987c, Beissinger 1988, Snyder et al. 1989a). The mating system of snail kites is characterized by sequential polygamy (ambisexual mate desertion). Desertion occurs in years with abundant food supply, but not during drought years. The deserted mate continues to tend the nest until independence of the chicks.

Geographic or Habitat Restraints or Barriers

Adult: Roosting and nesting occurs over or near water (USFWS 1999)

Spatial Arrangements of the Population

Adult: Clumped (inferred from USFWS 1999)

Environmental Specificity

Adult: Narrow (inferred from USFWS 1999)

Dependency on Other Individuals or Species for Habitat

Adult: Willow (inferred from USFWS 1999)

Habitat Narrative

Adult: From USFWS (2007): Snail kites may use nearly any wetland within southern Florida. From USFWS (1999): The combination of a range restricted to the watersheds of the Everglades, lakes Okeechobee and Kissimmee, and the upper St. Johns River, with a highly specific diet composed almost entirely of apple snails (Pomacea paludosa), makes the snail kite?s survival directly dependent on the hydrology and water quality of these watersheds. Snail kite habitat consists of freshwater marshes and the shallow vegetated edges of lakes (natural and man-made) where apple snails can be found. These habitats occur in humid, tropical ecoregions (Bailey 1978) of peninsular Florida and are characterized as palustrine-emergent, long-hydroperiod wetlands (Cowardin et al. 1979) often on an organic peat substrate overlying oolitic limestone or sand or directly on limestone or marl (Davis 1946). Roosting sites are also almost always located over water. In Florida, 91.6 percent are located in willows, 5.6 percent in Melaleuca, and 2.8 percent in pond cypress. Non-breeding snail kites use communal roosts throughout the year in association with other birds, particularly anhingas (Anhinga anhinga), herons, and vultures.

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS 1999)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Seasonal movement (USFWS 1999)

Dispersal

Adult: High (USFWS 1999)

Dispersal/Migration Narrative

Adult: From USFWS (1999): Snail kites in Florida are not migratory. They are restricted to South and central Florida. Snail kites are nomadic in response to water depths, hydroperiod, food availability, and other habitat changes (Sykes 1978, 1983a; Beissinger and Takekawa 1983; Bennetts et al. 1994). Radio-tracking and sighting of marked individuals have revealed that nonbreeding individuals disperse widely on a frequent basis (Sykes 1979, 1983a; Beissinger 1988; Snyder et al. 1989b; Bennetts and Kitchens 1992; Bennetts et al. 1994).

Population Information and Trends

Population Trends:
Decreasing (USFWS 2007)

Resiliency:
Low (inferred from USFWS 2007; see current range/distribution)

Redundancy:
Moderate (inferred from USFWS 2007; see current range/distribution)

Population Size:
562 (USFWS 1999)

Population Narrative:
From USFWS (2007): The low level of nesting and nest success that has been reported does not appear sufficient to support the kite population in the long term. Surveys from 1985 - 1994 resulted in a population count of 562 (10 year mean) (USFWS 1999).

Threats and Stressors

Stressor: Loss and degradation of wetlands (USFWS 2007)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2007): The principal threat to the snail kite is the loss or degradation of wetlands in central and southern Florida. Nearly half of the Everglades have been drained for agriculture and urban development (Davis and Ogden 1994). The C&SF Project has disrupted the volume, timing, direction, and velocity of freshwater flow. Water management actions continue to modify the habitat amount, suitability, and availability to kites, as well as the abundance and availability of apple snails, their primary prey. Degradation of water quality, particularly runoff of phosphorus from agricultural and urban source, is another concern for the snail kite because it can cause rapid encroachment of cattail (Typha sp.) and other undesirable specie into kite habitat, reducing its suitability for nesting and foraging.

Stressor: Exotic and invasive plants (USFWS 2007)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2007): Exotic and invasive aquatic plants have had an impact on snail kite habitat within lake systems and other areas. Species such as water hyacinth and water lettuce can rapidly within lake littoral completely obscuring kite foraging areas, and can even affect littoral zone vegetation and cover by shading other species and competing for space.

Hydrilla (Hydrilla verticillata) is a submerged aquatic invasive that has become the dominant submerged species in some lakes

Stressor: Herbicides (USFWS 2007)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2007): Application of herbicides to control invasive plants species often cause detrimental impacts to non-target species. Inadvertent application of herbicides to snail kite nesting substrates has occurred, and herbicide treatments within kite foraging habitat has caused impacts to many native littoral vegetation species. Hydrilla control activities have similarly caused temporary impacts to vegetation in areas where kites forage. Herbicides can also kill submerged aquatic plants, resulting in reduced suitability for apple snails.

Stressor: Nest predation (USFWS 2007)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2007): Nest predation is a common cause of snail kite nest failure. While the occurrence of nest predation has increased, this is largely a result of hydrologic management in areas where snail kite nest. Rapid water level recession where kites are nesting can cause water levels under nests to drop rapidly, making nests vulnerable to mammalian nest predators.

Stressor: Non-native apple snails (USFWS 2007)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2007): Non-native apple snails have been introduced into areas of kite habitat in Florida and have the potential to significantly alters native freshwater habitats, reduced native apple snail populations, and reduce the suitability of wetlands for snail kites. The magnitude of this potentila threat remains poorly documented, but is potentially serious.

Stressor: Recreation (USFWS 2007)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2007): Increasing development and urbanization has also resulted in increased recreational use of some of the lakes where kites nest. An increase in boating in area frequented by kites has led to increased nest disturbance. Development of lakeshore communities further increase this disturbance by facilitating boat access to the lakes and increasing the amount of human activity immediately adjacent to kite nesting areas.

Recovery

Reclassification Criteria:
1. The 10-year average for the total population size is estimated as greater than or equal to 650, with a coefficient of variation less than 20 percent for the pooled data over the 10-year period (USFWS 2007).

2. No annual population estimate is less than 500 in the 10-year period (USFWS 2007).

3. The rate of increase of the population to be estimated annually or biannually, and over the 10-year period, will be greater than or equal to 1.0, sustained as a 3-year running average over 10 years (USFWS 2007).

4. The feeding range of snail kites will not decrease from its current extent, including as a minimum, the St. Johns Marsh, the Kissimmee Chain of Lakes, Lake Okeechobee, Loxahatchee Slough, Loxahatchee National Wildlife Refuge, all of the Water Conservation Areas (WCA), Everglades National Park, Big Cypress National Preserve, Fakahatchee Strand, Okaloacoochee Slough, and marshes surrounding the Corkscrew Swamp (USFWS 2007).

5. Snail kite nesting regularly occurs over the 10-year period in the St. Johns Marsh, Kissimmee Chain of Lakes, Lake Okeechobee, and at least one of the present compartments of the water conservation areas (USFWS 2007).

Delisting Criteria:
Delisting Criteria 1. Populations inhabiting the following three (3) areas exhibit a stable or increasing trend as evidenced by natural recruitment and multiple age classes. a. Northern range: St. Johns Marsh, Kissimmee Chain of Lakes, Kissimmee River Basin, and three (3) additional water bodies; b. Central range: Lake Okeechobee; and c. Southern range: Nine (9) water bodies, which include Loxahatchee Slough, Loxahatchee National Wildlife Refuge, Water Conservation Areas 2 and 3, Everglades National Park, Big Cypress National Preserve, Fakahatchee Strand, Okaloacoochee Slough, and marshes surrounding Corkscrew Swamp (Factor A and E). (USFWS, 2019).

Delisting Criteria 2. Threats to the snail kite's native prey, the Florida apple snail (Pomacea paludosa), are reduced or eliminated to a degree that the snail kite is viable for the foreseeable future (Factor E). (USFWS, 2019).

Delisting Criteria 3. Habitat loss associated with water and aquatic plant management is reduced such that enough suitable nesting and foraging habitat remains for the snail kite to remain viable for the foreseeable future (Factor A). (USFWS, 2019).

Conservation Measures and Best Management Practices:
- Conduct actions outlined in the MSRP (Service 1999) (USFWS 2007).
- Revise the recovery plan to incorporate refinements in population estimates and improvements in the understanding of the kite populations and the factors affecting it (USFWS 2007).
- Revise recovery criteria to include additional objective measures of recovery and correct or revise population threshold objectives (USFWS 2007).
- Implement a more extensive apple snail monitoring program to include all of the areas where snail kite surveys are being conducted. This program should be conducted annually for a minimum of 10 years in order to encompass long-term climate cycles (USFWS 2007).
- Continue to monitor and expand data collection and identification of the non-native apple snails and their effect on the native snail population and snail kite food availability (USFWS 2007).

- Continue or expand snail kite monitoring efforts to improve understanding of kite habitat use and demography throughout their range (USFWS 2007).
- Coordinate with researchers to analyze the data obtained from the Comprehensive Everglades Restoration Plan Monitor and Assessment Plan that pertain to Greater Everglades landscape pattern vegetation mapping. Vegetation mapping will monitor the spacial extent, pattern, and proportion of plant communities within major landscape regions of the Greater Everglades wetlands (USFWS 2007).

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SPECIES ACCOUNT: *Setophaga (=Dendroica) angelae* (Elfin Woods warbler)

Species Taxonomic and Listing Information

Listing Status: Threatened; 07/22/2016; Southeast Region (R4) (USFWS, 2017)

Physical Description

Setophaga angelae (elfin-woods warbler) is about 12.5 cm (4.9 in) in length, and entirely black and white. Adults have a thin, white eyebrow stripe, white patches on ear-covers and neck, incomplete eye ring, and black crown. Immature birds are similar to the adult, but black is replaced by grayish-green on the back, and yellowish-green on the head and underparts (Raffaele et al. 1998, p. 168).

Taxonomy

S. angelae was discovered in 1971 by Angela and Cameron Kepler from the Elfin, or Dwarf, forest type of the El Yunque National Forest in the Luquillo Mountains. Kepler and Parkes (1972, pp. 3-5) described it as a valid taxon. The elfin-woods warbler was originally classified under the genus Dendroica, but is now recognized as Setophaga (Lovette et al. 2010, p. 765) (USFWS, 2016).

Historical Range

U.S. Territories: Puerto Rico; Cayey, Las Marias, Luquillo, Maricao, Rio Grande counties. Although it was initially thought to occur only in the Luquillo Mountains (El Yunque National Forest), the species was later discovered in the Maricao, Toro Negro, and Carite Commonwealth forests (Gochfeld et al. 1973, p. 231; Cruz and Delannoy 1984a, p. 92; Raffaele et al. 1998, p. 406). Angela and Cameron Kepler discovered the species in 1971, in the Dwarf forest type at El Yunque National Forest (EYNF) (Kepler and Parkes 1972, p. 3– 5) (USFWS, 2016).

Current Range

U.S. Territories: Puerto Rico; Cayey, Las Marias, Luquillo, Maricao, Rio Grande counties. Once found in four sites, it is now restricted to two populations; one in the Maricao Commonwealth Forest (western Puerto Rico), and one in the El Yunque National Forest (eastern Puerto Rico). Both forests are located about 145 km apart. Arroyo-Vazquez (1991, p. 55) did not find the elfin-woods warbler at the Toro Negro Forest during surveys conducted following Hurricane Hugo in 1989. In 2003 and 2004, Anadon-Irizarry (2006, p. 34) conducted surveys for the elfin-woods warbler in the Carite, Toro Negro, Guilarte , Bosque del Pueblo, Maricao Commonwealth forests, and El Yunque National Forest, but only detected the species in the latter two. Delannoy (2007, p. 5) surveyed the Susua Forest and visited the Toro Negro Forest for more than 30 years after elfin-woods warblers were discovered in these forests but did not detect the species.

Distinct Population Segments Defined

No; full species

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The elfin-woods warbler is an extremely active warbler, moving among the dense vines of forest strata with more foliage cover or smaller branch tips, foraging insects, usually at intermediate foliage heights of 3 to 15 meter (m) (10 to 50 feet (ft)) (Colo´n-Merced 2013, p. 2). Opportunistic observations indicate the elfin-woods warbler feeds on moths, dragonflies, and other types of insects; however, its specific diet remains unknown (Colo´n-Merced 2013, p. 2).

Reproduction Narrative

Adult: Information related to the breeding biology of this species is limited. The breeding season extends from March to June (Raffaele et al. 1998, p. 406). Elfin-woods warblers build a compact cup nest, usually close to the trunk and well hidden among the epiphytes of small trees. Nests are associated with aerial leaf litter, which is unique among wood warblers, and is placed at moderate heights (1.3-7.6 m (4.3-24.9 ft)) above the ground (Wood 1992, p. 3). Rodriguez-Mojica (2004, p. 21) found one elfin-woods warbler nest with four hatchlings in a tree cavity of Palo Colorado (Cyrilla racemiflora) in the Maricao Commonwealth Forest. The species is thought to be monogamous, and maintains territorial defense through the year (Delannoy 2009, p. 1). Delannoy (2015, pers. comm.) stated that based on available information (i.e., Delannoy 2009), the breeding season of the elfin-woods warbler should include the entire months of July and August because family groups stay together as a cohesive unit during May, June, July, and August. Delannoy (2009, p. 1) reported that four pairs of elfin-woods warblers banded between 2004 and 2008 remained together in their territories in the Maricao Commonwealth Forest (MCF), suggesting that the species is monogamous. In addition, he reported that the elfin-woods warbler maintained territorial defense throughout the year and documented that calling activity increases from January to April and declines considerably during the time pairs are incubating eggs or brooding nestlings. Arroyo-Va´zquez (1992, p. 363) reported the first detailed observation of two nests found in March and April of 1990 in aerial leaf litter at heights between 1.3 to 7.6 m (4.3 to 25 ft) and documented a clutch size of two to three eggs. Also, he observed that the pair's cup nest was woven from rootlets and fibers obtained from tree ferns and lined with grass leaves and down feathers (USFWS, 2016).

Geographic or Habitat Restraints or Barriers

Adult: High elevation Elfin Woodland forests (640 to 1030 m)(2,099 to 3,378 ft).

Spatial Arrangements of the Population

Adult: No information

Environmental Specificity

Adult: High

Tolerance Ranges/Thresholds

Adult: Low

Site Fidelity

Adult: Territoritial

Habitat Narrative

Adult: Kepler and Parkes (1972, p. 5-6) described the elfin-woods warbler from the high elevation Elfin Woodland forests (640 to 1,030 m) (2,099 to 3,378 ft), and occasionally from the Palo Colorado forests in El Yunque National Forest. El Yunque National Forest is managed by the U.S. Forest Service. It covers approximately 11,300 ha (27,911 ac), with elevations ranging from 100 to 1,075 m (328 to 3,526 ft). The Elfin forest is found on the summits of mountains, and it is composed of dense stands of short, small diameter, twisted trees and shrubs. Mosses and epiphytes cover the plants and forest floor. The area is characterized by high rainfall (annual average of 453.3 cm [178.5 in]), high humidity, low solar insulations, low temperatures, and constant winds. Wiley and Bauer later (1985, p.12) reported the species from the Elfin forests at lower elevations (370 to 600 m (1,213 to 1,968 ft)) such as Palo Colorado and Sierra Palm forests in the El Yunque National Forest. Based on surveys conducted in 1989 and 1990, Arroyo-VÃ¡zquez (1991, p. 56) suggested that the species migrates vertically in elevation. In addition, the species seems to move towards the north facing valleys during the months of heaviest rainfall. The elfin-woods warbler was also reported from the Maricao Commonwealth Forest, located in the Cordillera Central, western Puerto Rico. This forest is comprised by a mixture of mature native trees and abandoned shade coffee and woodland plantations. It covers approximately 4,150 ha (10,250 ac) and overlies serpentine derived soils, low in water holding capacity, and low in fertility, resulting in more xeric vegetation than might be expected given the amount of annual rainfall (235 cm [92.5 in]). Vegetation types are described as dry slope forest, slope forest, mixed hardwood, exposed ridge woodland (Elfin forest), and Podocarpus (Caobilla) mixed woodland (DNER 1976, p. 185). In the Maricao Commonwealth Forest, the species is found in a variety of habitats, including disturbed sites, in elevations ranging from 650 to 900 m (2,132 to 2,952 ft) (Cruz and Delannoy 1984a, p. 90). These authors described the species from the Los Viveros area, where there is a Podocarpus-mixed woodland forest with a continuous canopy at 15 to 20 m (49.2 to 65.6 ft). The Rosario Alto and Campamento Santana sites have a mixture of plantations (Eucalyptus robusta and Calophyllum calaba), and Elfin forest (i.e. Podocarpus) on the ridges.

Dispersal/Migration

Motility/Mobility

Adult: No information

Migratory vs Non-migratory vs Seasonal Movements

Adult: Where found at lower elevations, the species migrates vertically in elevation; migrates to north-facing valleys during the months of heaviest rainfall.

Dispersal

Adult: No information

Immigration/Emigration

Adult: No information

Dependency on Other Individuals or Species for Dispersal

Adult: No informtion

Dispersal/Migration Narrative

Adult: Based on surveys conducted in 1989 and 1990, Arroyo-VÃ¡zquez (1991, p. 56) suggested that in the lower elevations, the species migrates vertically in elevation. In addition, the species seems to move towards the north facing valleys during the months of heaviest rainfall.

Population Information and Trends

Population Trends:
decline

Species Trends:
decline

Resiliency:
Low

Representation:
Low

Redundancy:
Low

Population Growth Rate:
Low

Number of Populations:
2

Population Size:
Maricao Commonwealth Forest: 8.7 individuals/ha El Yunque National Forest: .02 individuals/ha 1,800+ adults (USFWS, 2016)

Minimum Viable Population Size:
Unknown

Resistance to Disease:
Low

Adaptability:
Low

Population Narrative:
Maricao Commonwealth Forest: Cruz and Delannoy (1984a, p. 92) reported the highest densities in the Maricao Commonwealth Forest at Los Viveros (20.9 individuals/ha [51.6/61.7 ac]), and significantly lower densities at Rosario Alto (3.0/25 ha [7.4/61.7 ac]) and Campamento Santana (1.2/25 ha [2.9/61.7 ac]). Waide (1995, p. 9) found the highest densities of elfin woods warbler in Pueto Rico in the Maricao Commonwealth Forest (20.9 individuals/ha). Anadón-Irizarry (2006, p. 27) surveyed 102.4 ha (253 ac) of habitat in the Maricao Commonwealth Forest and recorded 778 elfin-woods warblers in 18 counts for an average of 0.42 warblers/ha/count (1

warbler/acre/count). Podocarpus forest had the highest density, and the dry slopes the lowest. Delannoy (2007, p. 13) did not estimate the overall number of individuals in the Maricao Commonwealth Forest and adjacent properties, but provided an average elfin-woods warbler abundance per point-count station. Of the 127 point count stations located within the Maricao Commonwealth Forest, 106 (83.5%) yielded positive results for presence of elfin woods warbler. Of the 234 point count stations located in lands adjacent to the Maricao Commonwealth Forest, only 58 (24.8%) yielded positive results for elfin-woods warbler presence. Gonzalez (2008, p. 16-18) determined the abundance of elfin-woods warblers in habitats of the Maricao Commonwealth Forest and adjacent areas. As with previous studies, species abundance was highest in Podocarpus forest (1.41 individuals per point count station), and lowest in dry adjacent forest (0.01 individuals per point count station). Within the Maricao Forest, Gonzalez (2008, p. 18) estimated 97.67 elfin-woods warblers in a 203.2 ha/count (502 acres/count) sampling area; whereas in areas adjacent to the Maricao Commonwealth Forest, he estimated 43.02 elfin-woods warblers in a 374.4 ha/count (925 acres/count) sampling area. Based on the above studies, the Maricao Commonwealth Forest sustains the highest number of elfin woods warblers per hectare (acre). Delannoy (2007, p. 24) stated that the Maricao Commonwealth Forest population is currently thriving, and there is no indication that these populations are declining in numbers. BirdLife International estimated the overall elfin-woods warbler population in Puerto Rico to be at least 1,800 mature individuals (Arendt et al. 2013, p. 2) (USFWS, 2016).

Threats and Stressors

Stressor: Urban development
Exposure: Not assessed.
Response: Not assessed.
Consequence: Not assessed.
Narrative: Within the Maricao Commonwealth Forest there are strong and continuous pressures to cut and replace Podocarpus forest for the development of infrastructure for the communications industry and for the expansion of recreational facilities and trails within the forest (Delannoy 2007, p. 21). The Maricao Commonwealth Forest has several private and government inholdings with communication towers and recreational facilities. Around 2004, about 4 ha (9.9 ac) of Podocarpus forest habitat, the equivalent of about four to five elfin-woods warbler territories, were cleared to create a picnic area; and in 2009, about 12 ha (29.6 ac) of Podocarpus forest were cleared to expand a camping ground, possibly eliminating 10 to 12 elfin-woods warbler territories (C. Delannoy, UPRM, pers comm. 2009). Waide (1995, p.17) suggested that areas of high pedestrian use have fewer birds. Therefore, the expansion of trail or road systems in either forest, or the increased use of those presently existing, pose a threat to the species. Elfin-woods warbler is also known to use lower elevation forested areas such as shade coffee plantations adjacent to the Maricao Commonwealth Forest. These areas have been identified as potential suitable habitat for the species. However, the conversion of shade coffee plantations into sun coffee has resulted in the elimination of the over story, decreasing the value of this habitat for wildlife, including the elfin-woods warbler.

Stressor: Lack of enforcement of regulatory mechanisms
Exposure: Not assessed.
Response: Not assessed.
Consequence: Not assessed.

Narrative: Despite regulatory mechanisms to protect the warbler, habitat modification still exists within the Maricao Commonwealth Forest, and adjacent private lands adjacent to both the Maricao Commonwealth Forest and El Yunque National Forest. Furthermore, shade coffee plantation may be converted into sun coffee without overview of natural resources agencies. Agricultural practices are exempt from compliance with DNER regulations. Therefore, we consider that inadequacy of existing regulatory mechanisms to be a threat to the elfin-woods warbler, as enforcement remains a challenge and existing regulatory mechanisms do not apply to agriculture lands.

Stressor: Hurricanes
Exposure: Not assessed.
Response: Not assessed.
Consequence: Not assessed.
Narrative: Catastrophic events such as hurricanes affect the abundance and distribution of the elfin-woods warbler. Arroyo-Vazquez (1991, p. 55) surveyed the Toro Negro and Carite Commonwealth forests after Hurricane Hugo in 1989 and did not detect the species. Tossas (2006, p. 84) found that the elfin woods warbler in Maricao Commonwealth Forest was one of three bird species that, after Hurricane Georges in 1998, decline in capture rates to zero. Nevertheless, the species recovered within a year to pre-hurricane population levels; suggesting that the warblers abandoned defoliated sites immediately after the hurricane and shifted to protected patches with adequate foraging substrate and prey until the defoliated sites recovered. It is possible that small populations of elfin-woods warbler may experience local extinction with these catastrophic events. More surveys are necessary to assess the impact of these events on habitat-use patterns of the species. There are no studies on the effects of hurricanes on the species habitat either. However, hurricanes have affected the composition of elfin-woods warbler habitat, and thus, degrade the habitat quality, particularly for the species in at El Yunque National Forest (Arendt et al., 2013, p.9). Thus, we believe that hurricanes are a current threat to the elfin-woods warbler.

Stressor: Small populations, limited distribution
Exposure: Not assessed.
Response: Not assessed.
Consequence: Not assessed.
Narrative: At the present time, the species is only known from two disjunctive areas of Puerto Rico. The El Yunque National Forest population represents approximately 38% of the total population and it has recently undergone a significant decline (Arendt et al., 2013, p.1); if this trend continues it could result in local extirpation, limiting the species just to the Maricao Commonwealth Forest. Thus, the effects of other natural and manmade factors could be exacerbated (as there would only be one population to sustain the effects).

Stressor: Climate change (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: As previously mentioned, the elfinwoods warbler is currently known only from specific habitat types at EYNF and MCF, which makes the species susceptible to the effects of climate change. It has been stated that higher temperatures, changes in precipitation patterns, and any alteration in cloud cover will affect plant communities and ecosystem processes in EYNF (Lasso

and Ackerman 2003, pp. 101–102). In fact, the distribution of tropical forest life zones in the Caribbean is expected to be altered due to both intensified extreme weather events and progressively drier summer months (Wunderle and Arendt 2011, p. 44). At EYNF, such alteration may allow lowelevation Tabonuco forest species to colonize areas currently occupied by Palo Colorado forest (Scatena and Lugo1998, p. 196). Dwarf forests at EYNF also are very sensitive to the effects of climate change because of their occurrence in narrowly defined environmental conditions (Lasso and Ackerman 2003, p. 95). Dwarf forest epiphytes may experience moisture stress due to higher temperatures and less cloud cover with a rising cloud base, affecting epiphyte growth and flowering (Nadkarni and Solano 2002, p. 584). As previously mentioned, both the Palo Colorado and Dwarf forests have been reported to have the highest elfinwoods warbler mean abundance (Anado´n-Irizarry 2006, p. 24). Although the available information predicting changes in habitat due to the effects of climate change pertains to EYNF, similar changes would be expected for the MCF and CCF, which lies within two of the same life zones as EYNF (USFWS, 2016).

Stressor: Fire (USFWS, 2016)
Exposure:
Response:
Consequence:
Narrative: Fires are not part of the natural processes for subtropical and moist forests in Puerto Rico (Santiago-Garcia et al. 2008, p. 604). In fact, Me´ndezTejeda et al. (2015, p. 363) concluded that the majority of forests fires in Puerto Rico are produced by human actions. However, as annual rainfall decreases over time in the Caribbean region, longer periods of drought are expected in the future (Breshears et al. 2005, pp. 146–147; Larsen 2000, pp. 510–512). In 2000, Flannigan et al. (2000, pp. 225–226) projected an increase of the global fire occurrence over the next century due to the effects of climate change. In Puerto Rico, historical evidence suggests fire frequency is increasing (Burney et al. 1994, p. 277; Robbins et al. 2008, pp. 530–531). Moreover, the interactions between climate warming and drying, and increased human development, are considered to have the potential to increase the effects of fires (Robbins et al. 2008, pp. 530–531) (USFWS, 2016).

Recovery

Reclassification Criteria:
Not addressed.

Delisting Criteria:
Not addressed.

Recovery Actions:
- Conserve the Podocarpus forest type within the Maricao Commonwealth Forest as it is critical and essential for the survival of the species (Delannoy 2007, pp. 24-25).
- Restore degraded lands with species such as Maria (Calophyllum calaba) Delannoy 2007, pp. 24-25.
- Restore additional habitat to provide effective corridors for elfin-woods warbler dispersal throughout the central mountains of Puerto Rico.

- Work jointly with DNER and Forest Service to develop and implement policies that do not allow elfin-wood warbler habitat destruction from construction of new telecommunication towers or expansion of the existing ones.
- Develop an elfin-wood warbler habitat suitability map for the entire range of the species in Puerto Rico.
- Develop a distribution map of the elfin-wood warbler population within the El Yunque National Forest and the Maricao Commonwealth Forest.
- Determine if the species is found outside of El Yunque National Forest boundaries.
- Where the species is found outside the El Yunque National Forest boundaries, develop and implement a Candidate Conservation Program with private landowners adjacent to El Yunque National Forest for the restoration of suitable habitat for the elfin-wood warbler.
- Develop a habitat restoration effort for elfin-wood warbler areas that have been affected by hurricanes.
- Determine current density of the elfin-wood warbler within the El Yunque National Forest and the Maricao Commonwealth Forest.
- Establish a long-term elfin-wood warbler population monitoring effort. An annual EWWA survey count should be established within El Yunque National Forest and the Maricao Commonwealth Forest to determine the status and trend of the species.
- Search for the species in new areas within El Yunque National Forest using different technologies such as the playback technique.
- Conduct scientific studies to understand the biology and ecology of the elfin-wood warbler (e.g., breeding success, clutch size, territorial behavior, seasonal movements, habitat selection, and mortality).
- Determine what factors are limiting the distribution of the species.
- Intensify outreach and education efforts for the elfin-woods warbler to increase awareness of the species and its conservation, particularly in municipalities located adjacent to its known habitats.
- Determine if the population in El Yunque National Forest is still declining.

Conservation Measures and Best Management Practices:

- Conserve the Podocarpus forest type within the Maricao Commonwealth Forest as it is critical and essential for the survival of the species (Delannoy 2007, pp. 24-25).
- Restore degraded lands with species such as Maria (Calophyllum calaba) Delannoy 2007, pp. 24-25.
- Restore additional habitat to provide effective corridors for elfin-woods warbler dispersal throughout the central mountains of Puerto Rico.
- Work jointly with DNER and Forest Service to develop and implement policies that do not allow elfin-wood warbler habitat destruction from construction of new telecommunication towers or expansion of the existing ones.
- Develop a distribution map of the elfin-wood warbler population within the El Yunque National Forest and the Maricao Commonwealth Forest.
- Develop an elfin-wood warbler habitat suitability map for the entire range of the species in Puerto Rico.
- In 2014, the Service developed a candidate conservation agreement (CCA) with USFS and PRDNER to promote the conservation of the elfinwoods warbler. The purpose of the CCA is to implement measures to conserve, restore, and improve the elfin-woods warbler’s habitat and populations within EYNF and MCF (Service 2014, p. 6). The CCA provides that PRDNER and USFS will promote, develop, and implement the best management practices to avoid any potential threat to suitable

and occupied elfin-wood warbler habitat and populations. It also provides that both agencies will implement restoration and habitat enhancement efforts within degraded areas of EYNF and MCF. The agencies will also (1) determine the habitat use, movement, and activity patterns of the species; (2) design and establish longterm population monitoring programs; and (3) develop outreach and education programs to improve mechanisms to promote habitat conservation and restoration within private lands adjacent to both forests (USFWS, 2016).

- Although the elfin-woods warbler also occurs on privately owned lands adjacent to MCF that are not covered by the CCA, these areas are part of a habitat restoration initiative in southwestern Puerto Rico implemented by the Service since 2010, through the Partners for Fish and Wildlife (PFW) and Coastal (CP) Programs. The PFW and CP are voluntary programs that provide technical and financial assistance to landowners to implement restoration and conservation practices on their lands for a particular amount of time. These programs promote the restoration of degraded habitat that was likely occupied by the species before the conversion to agricultural lands and that may be restored as suitable elfin-woods warbler habitat in the future. In some cases, occupied suitable habitat for the species is enhanced and protected through cooperative agreements with the private landowners (USFWS, 2016).
- Between 2010 and 2014, a total of 522 ha (1,290 acres) of degraded tropical upland forest and 21 km (13 miles) of riparian buffers have been restored and conserved through these programs in collaboration with the Natural Resources Conservation Service (NRCS), Farm Service Agency (FSA), PRDNER, Envirosurvey Inc. (a local nongovernmental organization), and other partners. Although this initiative promotes the restoration and enhancement of degraded habitat adjacent to the MCF and may potentially provide suitable habitat for the elfin-woods warbler, challenges such as limited resources and uncertainty about landowner participation may affect the implementation of management practices that mitigate impacts of agricultural practices (USFWS, 2016).

References

USFWS 2013. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Dendroica angelae (Elfin-woods Warbler)

2013

Southeast Region

13 p.

USFWS. 2017. Environmental Conservation Online System (ECOS) – Species Profile. http://ecos.fws.gov/ecp0/. Accessed February 2017

USFWS. 2016. Endangered and Threatened Wildlife and Plants

Threatened Species Status for the Elfin-Woods Warbler With 4(d) Rule

Final rule. 81 Federal Register 120. June 22, 2016. Pages 40534 - 40547.

USFWS 2015. Threatened Species Status for the Elfin-woods Warbler

Proposed Rule. 80 FR 58674-58688, 09/30/2015. USFWS 2013. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Dendroica angelae (Elfin-woods Warbler)

SPECIES ACCOUNT: *Somateria fischeri* (Spectacled eider)

Species Taxonomic and Listing Information

Listing Status: Threatened; 05/10/1993; Alaska Region (R7) (USFWS, 2016)

Physical Description

A sea duck. LENGTH:53 WEIGHT: 1432 (NatureServe, 2015). Common eider female body mass increased 20% during the 4-6 weeks prior to egg laying (Gorman and Milne 1971, Milne 1976, Korschgen 1977, Parker and Holm 1990). For spectacled eiders, average female body weight in late March in the Bering Sea was 1,550 ± 35 g (n = 12), and slightly (but not significantly) more upon arrival at breeding sites (1,623 ± 46 g, n = 11; Lovvorn et al. 2003).

Current Range

There are three primary spectacled eider populations, corresponding to breeding grounds on Alaska's North Slope, the Yukon–Kuskokwim Delta (YK-delta), and northern Russia. The YK-delta population declined 96% between the early 1970s and 1992 (Stehn et al. 1994). Data from the Prudhoe Bay oil fields (Warnock and Troy 1992) and information from Native elders at Wainwright, Alaska (R. Suydam, pers. comm. in USFWS 1996) suggested concurrent localized declines on the North Slope, although data for the entire North Slope breeding population were not available. Spectacled eiders molt in several discrete areas (Figure 3.1B) during late summer and fall, with birds from different populations and genders apparently favoring different molting areas (Petersen et al. 1999). All three spectacled eider populations overwinter in openings in pack ice of the central Bering Sea, south of St. Lawrence Island (Petersen et al. 1999; Figure 3.1B), where they remain until March–April (Lovvorn et al. 2003).

Critical Habitat Designated

Yes; 2/6/2001.

Legal Description

On February 6, 2001, the U.S. Fish and Wildlife Service (Service) designated critical habitat for the spectacled eider (Somateria fischeri), a threatened species listed pursuant to the Endangered Species Act of 1973, as amended (Act). These designated areas total approximately 10,098,827 hectares (100,988.3 square kilometers; 38,991.6 square miles; 24,954,638 acres). Section 7 of the Act prohibits destruction or adverse modification of critical habitat by any activity funded, authorized, or carried out by any Federal agency.

Critical Habitat Designation

Critical habitat for the spectacled eider includes areas on the Yukon-Kuskokwim Delta (Y–K Delta), in Norton Sound, Ledyard Bay, and the Bering Sea between St. Lawrence and St. Matthew Islands.

Unit 1: Central Yukon-Kuskokwim Delta (Proposed Unit 3). Unit 1 is comprised of 15 entire townships and 564 sections within 27 additional townships. Our final designation encompasses 2,560.4 km2 (256,041 ha) (988.6 mi2) (Table 2), a 16 percent reduction of what we proposed for this unit (3,037.6 km2 or 1,172.8 mi2). Unit 1 is comprised of the vegetated intertidal zone between the Askinuk Mountains and Nelson Island. The primary constituent elements of spectacled eider critical habitat in this unit include all land within the vegetated intertidal zone, along with all open-water inclusions within that zone. The vegetated intertidal zone includes all lands inundated by tidally influenced water often enough to affect plant growth, habit, or community composition. Waters within this zone are usually brackish. Vegetative communities within this zone include, but are not limited to, low wet sedge tundra, grass marsh, dwarf shrub/ graminoid (consisting of grasses and sedges) meadow, high and intermediate graminoid meadow, mixed high graminoid meadow/dwarf shrub uplands, and areas adjacent to open water, low wet sedge and grass marsh habitats. Areas within our indicated border that are not within the vegetated intertidal zone (e.g., barren mudflats and lands that are above the highest high tide line) are not considered critical habitat. In addition, areas of existing human development within our indicated border are not considered critical habitat.

Unit 2: Southern Yukon-Kuskokwim Delta (Proposed Unit 4). Unit 2 is comprised of 103 sections within 8 townships. Our final designation encompasses 232.4 km2 (23,243 ha) (89.7 mi2) (Table 2), a 65 percent reduction of what we proposed for this unit (665.3 km2 or 256.9 mi2). This unit is comprised of the vegetated intertidal zone along the coast from Nelson Island south to Chefornak, Alaska. The primary constituent elements of spectacled eider critical habitat in this unit include all land within the vegetated intertidal zone, along with all open-water inclusions within that zone. This vegetated intertidal zone includes all lands inundated by tidally influenced water often enough to affect plant growth, habit, or community composition. Waters within this zone are usually brackish. Vegetative communities within this zone include, but are not limited to, low wet sedge tundra, grass marsh, dwarf shrub/graminoid (consisting of grasses and sedges) meadow, high and intermediate graminoid meadow, mixed high graminoid meadow/dwarf shrub uplands, and areas adjacent to open water, low wet sedge and grass marsh habitats. Areas within our indicated border that are not within the vegetated intertidal zone (e.g., barren mudflats and lands that are above the highest high tide line) are not considered critical habitat. In addition, areas of existing human development within our indicated border are not considered critical habitat.

Unit 3: Norton Sound (Proposed Unit 6). Unit 3 includes the waters of Norton Sound east of 162° 47', excluding the indicated waters within Norton Bay. Our final designation encompasses 10,586 km2 (4087.3 mi2) (Table 2), a 40 percent reduction of what we proposed (17,502 km2 (6,757.5 mi2)). The primary constituent elements of spectacled eider critical habitat in this unit include the marine waters greater than 5 m (16.4 ft) and less than or equal to 25 m (82.0 ft) in depth at MLLW, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

Unit 4: Ledyard Bay (Proposed Unit 7). Unit 4 includes the waters of Ledyard Bay within about 74 km (40 nm) of shore, excluding waters less than 1.85 km (1 nm) from shore. Our final designation encompasses 13,960 km2 (5,390.0 mi2), a 35 percent reduction of what we proposed (21,688 km2 (8,373.7 mi2)) (Table 2). The primary constituent elements of spectacled eider critical habitat in this unit include marine waters greater than 5 m (16.4 ft) and less than or equal to 25 m (82.0 ft) in depth, along with the associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

Unit 5: Wintering Area (Proposed Unit 8). Unit 5 includes the U.S. waters south of St. Lawrence Island between the latitudes 61° N and 63° 30' N, and between the longitudes 169° W and 174° 30' W. No portion of St. Lawrence Island or Russia is included in Unit 5. Our final designation encompasses 73,650 km2 (28,436.3 mi2), the same as what we proposed. The primary constituent elements of spectacled eider critical habitat in this unit include marine waters less than or equal to 75 m (246.1 ft) in depth, along with the associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Unit 1 (Central Yukon-Kuskokwim Delta), Unit 2 (South Y–K Delta Unit), Unit 3 (Norton Sound), Unit 4 (Ledyard Bay), and Unit 5 (the Wintering Unit in the Bering Sea between St. Lawrence and St. Matthew Islands). Within these areas, the primary constituent elements are those habitat components that are essential for the primary biological needs of feeding, nesting, brood rearing, roosting, molting, migrating and wintering.

The primary constituent elements for Units 1 and 2 (the Y–K Delta units) include the vegetated intertidal zone and all open water inclusions within this zone.

Primary constituent elements for the Norton Sound Unit (Unit 3) and the Ledyard Bay Unit (Unit 4) include all marine waters greater than 5 m (16.4 ft) in depth and less than or equal to 25 m (82.0 ft) in depth, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

Primary constituent elements for the Wintering Unit (Unit 5) include all marine waters less than or equal to 75 m (246.1 ft) in depth, along with associated marine aquatic flora and fauna in the water column, and the underlying marine benthic community.

Special Management Considerations or Protections

Critical habitat does not include those areas within the boundary of any unit that do not fit the description of primary constituent elements for that unit. Critical habitat does not include existing features and structures, such as buildings, roads, pipelines, utility corridors, airports, other paved areas, and other developed areas.

Within the geographic area occupied by the species, only areas currently known to be essential and that may require special management consideration or protection are designated. Essential areas should already have the features and habitat characteristics that are necessary to sustain the species. It should be noted, however, that not all areas within the occupied geographic range of the species that contain the features and habitats that supports the species are essential and they may or may not require special management or protection.

Life History

Feeding Narrative

Adult: On the breeding grounds, spectacled eiders feed on mollusks, insect larvae (craneflies, caddisflies, and midges), small freshwater crustaceans, and plants and seeds (Kondratev and Zadorina 1992) in shallow freshwater or brackish ponds, or on flooded tundra. Migrating offshore in the Chukchi and Bering seas to a single wintering area in pack-ice lead complexes south/southwest of St. Lawrence Island (Figure 3.1B). In this relatively shallow area, > 300,000 spectacled eiders (Petersen et al. 1999) rest and feed, diving up to 230 ft (70 m) to eat bivalves, other mollusks, and crustaceans (Cottam 1939, Petersen et al. 1998, Lovvorn et al. 2003, Petersen and Douglas 2004).

Reproduction Narrative

Adult: Breeding – In Alaska, spectacled eiders breed primarily on the Arctic Coastal Plain (ACP) of the North Slope and the YK-delta. On the ACP, spectacled eiders breed north of a line connecting the mouth of the Utukok River to a point on the Shaviovik River about 24 km (15 mi) inland from its mouth, with breeding density varying across the ACP (Figure 3.2). Although spectacled eiders historically occurred throughout the coastal zone of the YK-delta, they currently breed primarily in the central coast zone within about 15 km (9 mi) of the coast from Kigigak Island north to Kokechik Bay (USFWS 1996). However, sightings on the YK-delta have also occurred both north and south of this area during the breeding season (R. Platte, USFWS, pers. comm. 1997). Spectacled eiders arrive on the ACP breeding grounds in late May to early June. Numbers of breeding pairs peak in mid-June and decline 4–5 days later when males begin to depart from the breeding grounds (Smith et al. 1994, Anderson and Cooper 1994, Anderson et al. 1995, Bart and Earnst 2005). Mean clutch size reported from studies on the Colville River Delta was 4.3 (Bart and Earnst 2005). Spectacled eider clutch size near Barrow has averaged 3.2–4.1, with clutches of up to eight eggs reported (Quakenbush et al. 1995, Safine 2011). Incubation lasts 20–25 days (Kondratev and Zadorina 1992, Harwood and Moran 1993, Moran and Harwood 1994, Moran 1995), and hatching occurs from mid- to late July (Warnock and Troy 1992). Nest initiation on Kigigak Island on the YK-delta occurs from mid-May to mid-June (Lake 2007). Incubation lasts approximately 24 days (Dau 1974). Mean spectacled eider clutch size is higher on the YK-delta compared to the ACP. Mean annual clutch size ranged from 3.8–5.4 in coastal areas of the YK-delta (1985–2011; Fischer at al. 2011), and 4.0–5.5 on Kigigak Island (1992–2011; Gabrielson and Graff 2011), with clutches of up to eight eggs reported (Lake 2007). On the breeding grounds, spectacled eiders feed on mollusks, insect larvae (craneflies, caddisflies, and midges), small freshwater crustaceans, and plants and seeds (Kondratev and Zadorina 1992) in shallow freshwater or brackish ponds, or on flooded tundra. Ducklings fledge approximately 50 days after hatch, when females with broods move from freshwater to marine habitat prior to fall migration. Survivorship – Nest success is highly variable and thought to be primarily influenced by predators, including gulls (Larus spp.), jaegers (Stercorarius spp.), and red (Vulpes vulpes) and arctic foxes (Alopex lagopus). In arctic Russia, apparent nest success was estimated to be < 2% in 1994 and 27% in 1995; low nest success was attributed to predation (Pearce et al. 1998). Apparent nest success in 1991 and 1993–1995 in the Kuparuk and Prudhoe Bay oil fields on the ACP was also low, varying from 25–40% (Warnock and Troy 1992, Anderson et al. 1998). On Kigigak Island in the YK-delta, nest survival probability ranged from 6–92% from 1992–2007 (Lake 2007); nest success tended to be higher in years with low fox numbers or activity (i.e., no denning) or when foxes were eliminated from the island prior to the nesting season. Bowman et al. (2002) also reported high variation in nest success (20–95%) of spectacled eiders on the YK-delta, depending on year and location. Available data indicate egg hatchability is high for spectacled eiders nesting on the ACP, in arctic Russia, and at inland sites on the YK-delta, but considerably lower in the coastal region of the YK-delta. Spectacled eider eggs that are addled or that do not hatch are very rare in the Prudhoe Bay area (Declan Troy, TERA, pers. comm. 1997), and Esler et al. (1995) found very few addled eggs on the Indigirka River Delta in Arctic Russia. Additionally, from 1969 to 1973 at an inland site on the Yukon Delta National Wildlife Refuge, only 0.8% of spectacled eider eggs were addled or infertile (Dau 1974). In contrast, 24% of all nests monitored in a coastal region of the YK-delta during the early to mid-1990s contained inviable eggs and ~10% of eggs in successful nests did not hatch due to either embryonic mortality or infertility (Grand and Flint 1997). This relatively high occurrence of inviable eggs near the coast of the YK-delta may have been related to exposure to contaminants (Grand and Flint 1997). It is unknown whether hatchability of eggs in this region has improved with decreased use of lead shot in the region and gradual settling of existing lead pellets (Flint and Schamber 2010) in coastal YK-delta wetlands. Recruitment rate (the percentage of young eiders that hatch, fledge, and survive to sexual maturity) of spectacled eiders is poorly known (USFWS 1999) because there is limited data on juvenile survival. In a coastal region of the YK-delta, duckling survival to 30 days averaged 34%, with 74% of this mortality occurring in the first 10 days, while survival of adult females during the first 30 days post hatch was 93% (Flint and Grand 1997).

Habitat Narrative

Adult: Nesting occurs primarily in lowland wetlands on coastal tundra; these are usually large (> 1 kilometer diameter), shallow bodies of water that flood after snowmelt and have well-developed emergent and shoreline vegetation. These are termed 'laydas' in Russia. On Alaska's North Slope, dominant plants in the nesting wetlands include the aquatic grass Arctophila fulva and/or the sedge Carex aquatilis; Mare's-tail, Hippurus sp., is often a submergent component (Balogh 1997).Away from breeding areas, this species is pelagic or occupies coastal marine waters; in winter it inhabits small openings in pack ice (Petersen et al. 1999). Presumably, nonbreeding birds remain at sea year-round until they attempt tobreed at age two or three (USFWS 2001).Near shore; PelagicBay/sound; Lagoon; River mouth/tidal riverLow gradientShallow waterHERBACEOUS WETLAND; RiparianTundraBenthic (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory

Dispersal/Migration Narrative

Adult: Spring migration – Recent information indicates spectacled eiders likely make extensive use of the eastern Chukchi Sea spring lead system between departure from the wintering area in March and April and arrival on the North Slope in mid-May or early June. Limited spring observations in the eastern Chukchi Sea have documented tens to several hundred common eiders (Somateria mollissima) and spectacled eiders in spring leads and several miles offshore in relatively small openings in rotting sea ice (W. Larned, USFWS; J. Lovvorn, University of Wyoming, pers. comm.). Woodby and Divoky (1982) documented large numbers of king (Somateria spectabilis) and common eiders using the eastern Chukchi lead system, advancing in pulses during days of favorable following winds, and concluded that an open lead is probably requisite for spring eider passage in this region. Satellite telemetry data collected by the USGS Alaska Science Center (Figure 3.3; Sexson et al. 2014) suggests that spectacled eiders also use the spring lead system during spring migration. Adequate foraging opportunities and nutrition during spring migration are critical to spectacled eider productivity. Like most sea ducks, female spectacled eiders do not feed substantially on the breeding grounds, but produce and incubate eggs while living primarily off body reserves (Korschgen 1977, Drent and Daan 1980, Parker and Holm 1990). Clutch size, a measure of reproductive potential, was positively correlated with body condition and reserves obtained prior to arrival at breeding areas (Coulson 1984, Raveling 1979, Parker and Holm 1990). Body reserves must be maintained from winter or acquired during the 4-8 weeks (Lovvorn et al. 2003) of spring staging, and Petersen and Flint (2002) suggest common eider productivity on the western Beaufort Sea coast is influenced by conditions encountered in May to early June during migration through the Chukchi Sea (including Ledyard Bay). Common eider female body mass increased 20% during the 4-6 weeks prior to egg laying (Gorman and Milne 1971, Milne 1976, Korschgen 1977, Parker and Holm 1990). For spectacled eiders, average female body weight in late March in the Bering Sea was 1,550 ± 35 g (n = 12), and slightly (but not significantly) more upon arrival at breeding sites (1,623 ± 46 g, n = 11; Lovvorn et al. 2003), suggesting that spectacled eiders maintain or enhance their physiological condition during spring staging. Fall migration and molting – As with many other sea ducks, spectacled eiders spend the 8–10 month non-breeding season at sea. Satellite telemetry and aerial surveys led to the identification of spectacled eider migrating, molting, and wintering areas. These studies are summarized in Petersen et al. (1995 and 1999) and Larned et al. (1995). Results of more recent satellite telemetry research (2008–2011) are consistent with earlier studies (Sexson et al. 2014). Phenology, spring migration and breeding, including arrival, nest initiation, hatch, and fledging, is 3–4 weeks earlier in western Alaska (YK-delta) than northern Alaska (ACP); however, phenology of fall migration is similar between areas. Individuals depart breeding areas July–September, depending on breeding status and success, and molt in September–October (Matt Sexson, USGS, pers. comm.). Males generally depart breeding areas on the ACP when females begin incubation in late June (Anderson and Cooper 1994, Bart and Earnst 2005). Use of the Beaufort Sea by departing males is variable. Some appear to move directly to the Chukchi Sea over land, while the majority move rapidly (average travel of 1.75 days), over nearshore waters from breeding grounds to the Chukchi Sea (TERA 2002). Of 14 males implanted with satellite transmitters, only four spent an extended period of time (11–30 days) in the Beaufort Sea (TERA 2002). Males appeared to prefer areas near large river deltas such as the Colville River where open water is more prevalent in early summer when much of the Beaufort Sea is still frozen. Most adult males marked with satellite transmitters in northern and western Alaska in a recent satellite telemetry study migrated to northern Russia to molt (USGS, unpublished data). Results from this study also suggest that male eiders likely follow coast lines but also migrate straight across the northern Bering and Chukchi seas en route to northern Russia (Matt Sexson, USGS, pers. comm.). Females generally depart the breeding grounds later, when more of the Beaufort Sea is ice-free, allowing more extensive use of the area. Females spent an average of two weeks in the Beaufort Sea (range 6-30 days) with the western Beaufort Sea the most heavily used (TERA 2002). Females also appeared to migrate through the Beaufort Sea an average of 10 km further offshore than males (Petersen et al. 1999). The greater use of the Beaufort Sea and offshore areas by females was attributed to the greater availability of open water when females depart the area (Petersen et al. 1999, TERA 2002). Recent telemetry data indicate that molt migration of failed/non-breeding females from the Colville River Delta through the Beaufort Sea is relatively rapid, 2 weeks, compared to 2–3 months spent in the Chukchi Sea (Matt Sexson, USGS, pers. comm.). Spectacled eiders use specific molting areas from July to late October/early November. Larned et al. (1995) and Petersen et al. (1999) found spectacled eiders show strong preference for specific molting locations, and concluded that spectacled eiders molt in four discrete areas (Table 3.1). Females generally used molting areas nearest their breeding grounds. All marked females from the YK-delta molted in nearby Norton Sound, while females from the North Slope molted in Ledyard Bay, along the Russian coast, and near St. Lawrence Island. Males did not show strong molting site fidelity; males from all three breeding areas molted in Ledyard Bay, Mechigmenskiy Bay, and the Indigirka/Kolyma River Delta. Males reached molting areas first, beginning in late June, and remained through mid-October. Non-breeding females, and those that nested but failed, arrived at molting areas in late July, while successfully-breeding females and young of the year reached molting areas in late August through late September and remained through October. Fledged juveniles marked on the Colville River Delta usually staged in the Beaufort Sea near the delta for 2–3 weeks before migrating to the Chukchi Sea.

Population Information and Trends

Population Trends:
Decreasing

Number of Populations:
Three

Population Size:
369,122 (364,190–374,054 90% CI)

Population Narrative:
Abundance and trends: The most recent rangewide estimate of abundance of spectacled eiders was 369,122 (364,190–374,054 90% CI), obtained by aerial surveys of the known wintering area in the Bering Sea in late winter 2010 (Larned et al. 2012). Comparison of point estimates between 1997 and 2010 indicate an average of 353,051 spectacled eiders (344,147-361956 90% CI) in the global population over that 14-year period (Larned et al. 2012). Population indices for North Slope-breeding spectacled eiders prior to 1992 are unavailable. However, Warnock and Troy (1992) documented an 80% decline in spectacled eider abundance from 1981 to 1991 in the Prudhoe Bay area. Since 1992, the Service has conducted annual aerial surveys for breeding spectacled eiders on the ACP. The 2010 population index based on these aerial surveys was 6,286 birds (95% CI, 4,877–7,695; unadjusted for detection probability), which is 4% lower than the 18-year mean (Larned et al. 2011). In 2010, the index growth rate was significantly negative for both the long-term (0.987; 95% CI, 0.974–0.999) and most recent 10 years (0.974; 95% CI, 0.950–0.999; Larned et al. 2011). Stehn et al. (2006) developed a North Slope-breeding population estimate of 12,916 (95% CI, 10,942–14,890) based on the 2002–2006 ACP aerial index for spectacled eiders and relationships between ground and aerial surveys on the YK-delta. If the same methods are applied to the 2007–2010 ACP aerial index reported in Larned et al. (2011), the resulting adjusted population estimate for North Slope-breeding spectacled eiders is 11,254 (8,338–14,167, 95% CI). The YK-delta spectacled eider population is thought to have declined by about 96% from the 1970s to 1992 (Stehn et al. 1993). Evidence of the dramatic decline in spectacled eider nesting on the YK-delta was corroborated by Ely et al. (1994), who found a 79% decline in eider nesting near the Kashunuk River between 1969 and 1992. Aerial and ground survey data indicated that spectacled eiders declined 9–14% per year from 1985–1992 (Stehn et al. 1993). Further, from the early 1970s to the early 1990s, the number of pairs on the YK-delta declined from 48,000 to 2,000, apparently stabilizing at that low level (Stehn et al. 1993). Before 1972, an estimated 47,700–70,000 pairs of spectacled eiders nested on the YK-delta in average to good years (Dau and Kistchinski 1977). Fischer and Stehn (2013) used combined annual ground-based and aerial survey data to estimate the number of nests and eggs of spectacled eiders on the coastal area of the YK-delta in 2012 and evaluate long-term trends in the YK-delta breeding population from 1985 to 2012. In a given year, the estimated number of nests reflects the minimum number of breeding pairs in the population and does not include non-nesting individuals or nests that were destroyed or abandoned (Fischer and Stehn 2013). The total number of spectacled eider nests on the YK-delta in 2012

was estimated at 8,062 (SE 1110). The average population growth rate based on these surveys was 1.058 (90% CI = 1.005-1.113) in 2003–2012 and 0.999 (90% CI = 0.986-1.012) in 1985–2012 (Fischer and Stehn 2013). Log-linear regression based solely on the long-term YK-delta aerial survey data indicate positive population growth rates of 1.073 (90% CI = 1.046–1.100) in 2001–2010 and 1.070 (90% CI = 1.058–1.081) in 1988–2010 (Platte and Stehn 2011).

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Causes of the decline are not well understood (USFWS 2001). Lead poisoning, caused by ingestion of spent lead shot, has been documented in this species on the Yukon-Kuskokwim Delta. Lead poisoning from ingestion of lead shot has reduced annual survival of adult females by at least 34% in some locations in western Alaska (Grand et al. 1998). Use of lead shot for waterfowl hunting has been prohibited throughout the United States since 1991; enforcement of the ban (initiated in western Alaska in 1998) should gradually reduce this threat.Predation by foxes, large gulls, and ravens on the breeding grounds may be increasing in areas where populations of these predators are enhanced by the year-round food and shelter provided by human activities and garbage dumps. We will probably never know what role predators played in the decline of eiders on the Y-K Delta, but as Y-K Delta goose populations rebound, any negative affect of predators on eider populations is, hopefully, diminishing (USFWS 2001). There is no reason to suspect that predator pressure on eiders has increased over historical levels on the North Slope, except perhaps locally near human habitations and oil production facilities (USFWS 2001).Subsistence hunting probably did not cause the observed decline of eiders on the Y-K Delta, but it might be hindering or preventing recovery (USFWS 2001).Complex changes in fish and invertebrate populations in the Bering Sea may be affecting food availability for spectacled eiders during the 8-10 month nonbreeding season. Spectacled eiders may also be affected by other shifts in the Bering Sea ecosystem, by commercial fisheries, and by environmental contaminants at sea. Direct interactions with commercial fisheries does not seem to be a problem (USFWS 2001).The habit of this species to concentrate into very few, large, molting and wintering flocks makes it vulnerable to threats such as oil spills, bilge pumping in molting areas, and entanglement in fishing gear (Petersen et al. 1999, Petersen et al. 2000). (NatureServe, 2015)

Recovery

Recovery Actions:

- The Spectacled Eider Recovery Plan (USFWS 1996) presents research and management priorities with the objective of recovery and delisting so that protection under the ESA is no longer required. Although the cause or causes of the spectacled eider population decline is/are not known, factors that affect adult survival are likely to be the most influential on population growth rate. These include lead poisoning from ingested spent shotgun pellets, which may have contributed to the rapid decline observed in the YK-delta (Franson et al. 1995, Grand et al. 1998), and other factors such as habitat loss, increased nest predation, over harvest, and disturbance and collisions caused by human infrastructure. Under the Recovery Plan, the species will be considered recovered when each of the three recognized populations (YK-delta, North Slope of Alaska, and Arctic Russia): 1) is stable or increasing over 10 or more years and the minimum estimated population size is at least 6,000 breeding pairs, or 2) number at least 10,000 breeding pairs over 3 or more years, or 3) number at least 25,000 breeding pairs in one year. Spectacled eiders do not currently meet these recovery criteria.

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SPECIES ACCOUNT: *Sterna antillarum browni* (California least tern)

Species Taxonomic and Listing Information

Listing Status: Endangered; June 2, 1970 (35 FR 8491).

Physical Description

The California least tern (Sterna antillarum browni) is the smallest member of the subfamily Sterninae. California least terns are 21 to 23 centimeters (cm) (about 8 to 9 inches [in.]) long and measure 48 to 53 cm (about 19 to 21 in.) wide, including wingspan. Males and females look alike; they have black caps, and are mainly gray on top with gray wings, black wingtips, and a white underside. California least terns have yellow-orange legs and bills and a short, forked tail. Juveniles have darker plumage and a dark bill (NatureServe 2015; USFWS 1985; USFWS 2015).

Taxonomy

California least terns were listed as Sterna antillarum browni; however, the 47th supplement to the American Ornithologist Union checklist recognizes least terns under the previously published name Sternula antillarum, based on mitochondrial DNA molecular phylogeny. Within this species, classification of the various subspecies continues to be debated. Most genetic studies have found little or no evidence of differentiation among least tern subspecies (USFWS 2006).

Historical Range

The historical breeding range of the California least tern extended along the Pacific Coast from Moss Landing in Monterey County, California, to San Jose del Cabo in Baja California Sur, Mexico. California least terns migrate south along the California coast in fall to Baja California, west over mainland Mexico, or as far south as Costa Rica (USFWS 2006).

Current Range

Since 1970, the range of least tern nesting sites has grown as California least terns have been documented from the San Francisco Bay Area to the Tijuana River at the Mexican border; in Mexico in the Gulf of California; and on the western coast of Baja California as far south as San Jose del Cabo. The migration range is the same as it was historically, with the exception of birds traveling from the San Francisco Bay and traveling further distances. California least terns have been found in all nesting areas; however, development in California has fragmented nesting habitats along beaches, primarily in Los Angeles and San Diego counties (USFWS 2006).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: California least terns primarily eat fish but will occasionally eat shrimp and small invertebrates. The food source is widely distributed along the Pacific coast. The California least tern forage within a few hundred meters (thousand feet) of their breeding colony, in waters less than 18.3 m (60 ft.), obtaining most of their food from shallow estuaries and lagoons, and from nearshore ocean waters. Competition from other marine life is not a limiting factor unless fish populations are low due to reasons such as environmental conditions or human disturbances. Food shortages have resulted in high mortality among hatchlings and fledglings. When breeding, California least terns reach adult size and plumage at 2 to 3 years. (NatureServe 2015; USFWS 1985; USFWS 2006; USFWS 2015)

Reproduction Narrative

Adult: California least terns are typically sexually mature at 3 years of age. They breed from mid-April to early May and are finished by June. Re-nesting occurs from June to August. California least terns nest primarily on open beaches kept free of vegetation by natural scouring from tidal action, or on open expanses of sand, dirt, or dried mud close to a lagoon or estuary with a dependable food supply. If habitat is limited, they will nest in airports or landfills. Courtship displays include males performing elaborate aerial displays and offering a fish to the female. Nesting starts shortly after bonds form, in colonies typically consisting of 25 nesting pairs. Nests are either scooped out by California least terns of made in existing depressions in the sand; the minimum distances between nests is 3.0 to 4.6 m (10 to 15 ft.), with averages usually much greater (USFWS 2015). Two to three eggs are typically laid, and incubation is 20 to 25 days. Egg success rate is about 80 percent (NatureServe 2015; USFWS 1985; USFWS 2006; USFWS 2015).

Geographic or Habitat Restraints or Barriers

Adult: Human activity and development has fragmented beaches, causing California least terns to nest in airports or landfills (USFWS 1985).

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Broad/generalist, or community with all key requirements common.

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: Moderate to high.

Habitat Narrative

Adult: California least terns are aquatic birds that are found along the Pacific Coast on beaches, lagoons, rivers, bays, mudflats, and estuaries. California least terns have a broad environmental specificity but do need open beaches for nesting. When no open beaches are available, mostly due to human activity and habitat fragmentation from urban development, California least terns will nest on man-made open habitat such as airports and landfill. California least terns have moderate to high site fidelity (NatureServe 2015; USFWS 1985; USFWS 2006; USFWS 2015).

Dispersal/Migration

Motility/Mobility

Adult: Mobile

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory

Dispersal

Adult: High

Immigration/Emigration

Adult: No

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: California least terns are very mobile and have a high dispersal rate. California least terns migrate north for breeding and south for overwintering. California least terns arrive in northern breeding areas on the West Coast in April or early May, where they nest from Moss Landing in Monterey County, California, to San Jose del Cabo in Baja California Sur, Mexico. Most California least terns depart south by November (as early as August), and winter in western Mexico or as far south as Costa Rica (NatureServe 2015; USFWS 1985).

Additional Life History Information

Adult: California least terns arrive in northern breeding areas on the west coast in April or early May. Most California least terns depart south by November (as early as August), and winter in western Mexico (NatureServe 2015; USFWS 1985).

Population Information and Trends

Population Trends:

Relatively stable (less than 10 percent change) (NatureServe 2015).

Species Trends:

Declining

Resiliency:

High

Representation:

High

Redundancy:

Moderate

Population Growth Rate:

Stable

Number of Populations:

One

Population Size:
2,500 to 14,200 individuals (NatureServe 2015; USFWS 2006).

Minimum Viable Population Size:
1,200 breeding pairs in 15 different breeding locations (USFWS 1985).

Resistance to Disease:
Disease has not been known to have a dramatic effect on California least tern populations (USFWS 2006).

Adaptability:
High

Population Narrative:
California least terns currently have a stable population of 2,500 to 14,200 individuals. According to the recovery plan specific to this species, the minimum viable population size is 1,200 breeding pairs in 15 different breeding locations (NatureServe 2015; USFWS 1985; USFWS 2006).

Threats and Stressors

Stressor: Predation
Exposure: Direct; mortality.
Response: Mortality
Consequence: Mortality
Narrative: Predators include birds such as raptors and the American crow; and mammals such as raccoons, opossums, foxes, and domestic dogs and cats. California least terns are predated upon at all life stages, but are especially susceptible to predation during the nesting season, when chicks are too young to leave nests to escape or when fledglings are still clumsy to make a successful getaway. Predations can have a significant effect on reproductive success and can cause nest failure, re-nesting, and site abandonment in addition to direct and indirect mortality (USFWS 2006; USFWS 2015).

Stressor: Environmental contaminants
Exposure: Direct; ingestion of toxic contaminants. Indirect; contaminants on feather or body of California least tern, causing inability to regulate body temperature.
Response: Illness, mortality, nesting failure.
Consequence: Decreased reproductive success.
Narrative: Oil spills in the ocean can negatively affect California least terns; when exposed to oil, birds lose their ability to regulate their body temperature and can die of hypothermia or from toxic hydrocarbons ingested while preening. In addition, oil on eggs can limit their ability to breathe and can introduce toxic hydrocarbons into the eggs (USFWS 2006).

Stressor: Hunting
Exposure: Direct; mortality.
Response: Mortality

Consequence: Mortality
Narrative: Historically, California least terns suffered local losses due to shooting, but it is doubtful that these activities affected the population as a whole (USFWS 1985).

Stressor: Habitat destruction
Exposure: Direct; loss of nesting habitat.
Response: Reduction in population growth.
Consequence: Reduction in population growth.
Narrative: The chief limiting factor influencing the number of least tern breeding pairs is the availability of undisturbed suitable habitat, and few of the current nesting sites for California least terns are close to the historical high and moderate quality of natural habitats. Currently, there are no beaches devoid of human recreation, development, or military pressure, and airports and landfills are often new sites for nesting California least terns. By the 1940s, most terns were gone from the beaches of Orange and Los Angeles counties, and they were considered sparse everywhere. Continuing loss of both nesting and feeding habitat, and high levels of human disturbance at remaining colonies, have been responsible for the continued decline to the present time. Although habitat destruction has occurred historically, it is happening at an accelerated rate, and almost all the coastal habitats have been fragmented or degraded (USFWS 1985; USFWS 2006).

Recovery

Reclassification Criteria:
There are 1,200 breeding pairs with an overall mean productive rate in 15 secure coastal management areas, for a consecutive 3-year period.

Interim reclassification to threatened status can be considered when:

The 1,200 pair population level is achieved;

15 coastal management areas (including San Francisco Bay, Mission Bay, and San Diego Bay, which should have three, five, and four secure colonies, respectively) support viable colonies and are managed to conserve California least terns; and

A 3-year mean reproductive rate of at least 1.0 young/breeding pair is achieved. Once additional information on the Baja California colonies is available, possibly one or two secure sites of the above 15 may be located in Baja. Because of possible nonsecurity of Baja California habitats, it appears unlikely that the Mexican populations will contribute significantly to tern recovery. However, this must be more thoroughly investigated. As additional data become available, the prime objective may be modified to reflect current information.

Delisting Criteria:
If 1,200 pairs of California least tern are distributed among secure colonies in at least 20 secure coastal management areas throughout their breeding range, delisting of the species can be considered, with these provisions:

Sufficient habitat to support at least one viable tern colony (defined as consisting of a minimum of 20 breeding pairs with a 5-year mean reproductive rate of at least 1.0 young fledged per year per breeding pair) at each of the 20 coastal management areas (including San Francisco Bay, Mission Bay, and San Diego Bay, which should have four, six, and six secure colonies, respectively), that are managed to conserve least terns;

Land ownership and management objectives are such that future habitat management for the benefit of California least terns at those locations can be assured. The security and status of Baja California colonies must be assessed; if any such colonies are estimated to be secure and will be managed in perpetuity to benefit least terns, such colonies will also be incorporated into the quantified prime objective;

Each of the 20 “secure" coastal management areas must have at least 20 breeding pairs;

Each of the 20 “secure" coastal management areas must have a 5-year mean reproductive rate of at least 1.0 young fledge per breeding pair; and

San Francisco Bay, Mission Bay, and San Diego Bay must be included in the 20 secure management areas, with four, six, and six secure colonies, respectively.

Recovery Actions:

- Preserve and manage nesting habitat.
- Protect and manage nonnesting habitat.
- Monitor least tern population to determine status, distribution, and progress of management during the breeding season.
- Conduct research on California least tern to provide additional necessary information for tern management.
- Encourage the protection of population outside the United States.
- Use existing laws and regulations protecting least tern and their habitat.
- Develop and implement a conservation education program regarding recovery of California least tern.

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Date accessed: September 14, 2015.

SPECIES ACCOUNT: *Sterna dougallii dougallii* (Roseate tern (Caribbean DPS))

Species Taxonomic and Listing Information

Listing Status: Endangered, Threatened; 11/02/1987; Northeast Region (R5), Southeast Region (R4) (USFWS, 2016)

Physical Description

From USFWS (2010): The Caribbean roseate tern is a primarily white, slender-winged, long-tailed, typical capped tern (family Laridae, subfamily Sterninae). Its overall length is about 40 centimeters [cm (16 inches (in))], including tail streamers 15 to 25 cm (6 to 10 in) in length (USFWS 1993). It has a black crown, pale-grey upper surface, and immaculate white underparts. Both the upper and under surfaces are paler than in the very similar common tern. In non-breeding plumage, both common and roseate terns have a dark carpal bar over the bend of the wing, although it is slightly lighter in roseate terns (USFWS 1993). The three or four outer primaries (wing feathers) of roseate terns are frosted with silver-grey and edged with black (USFWS 1993). The long tail streamers are pure white, whereas those of common terns (Sterna hirundo) are grayish and have a black outer margin (Harrison 1983). Early in the breeding season, there is an evanescent pink or peach bloom on the underparts, visible in some lights (Harrison 1983). The basal three-quarters of the bill in Caribbean roseate terns gradually becomes reddish orange during the breeding season (Shealer and Saliva 1992).

Taxonomy

From USFWS (2010): The Caribbean population is the only tropical population of roseate terns in the North or South Atlantic Oceans and, hence, the only tropical population of the subspecies S. d. dougallii (Lashko 2004).

Historical Range

Unknown - Failure to distinguish Caribbean roseate terns from common terns (S. hirundo) makes it difficult to reconstruct the history of roseate terns in the Caribbean (USFWS 2010).

Current Range

From USFWS (2010): The Caribbean roseate tern population appears to constitute cells of a metapopulation (Bradley and Norton 2009) that include Bermuda (formerly); Bahamas Islands; the Florida Keys; Turks and Caicos Islands; Greater Antilles (Cuba, Hispaniola [Dominican Republic and Haiti], Jamaica, and Puerto Rico); United States and British Virgin Islands; Lesser Antilles (Anguilla, Antigua, Barbuda, Guadeloupe Archipelago, Martinique, St. Martin, St. Bartholomew, St. Kitts and Nevis, St. Lucia, St. Vincent, Grenadines and Grenada); Trinidad and Tobago; and islands in the southern Caribbean (Aruba, Bonaire, Curaçao, and formerly islands off Venezuela) (Bradley and Norton 2009).

Distinct Population Segments Defined

Yes; Caribbean population (USFWS 2010)

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: For nestling/juvenile feeding see adult reproduction narrative.

Adult: From USFWS (2010): In the Caribbean, roseate terns feed on a variety of fish species. Local abundance of small schooling marine fish may vary from year to year, and roseate terns seem to be attracted to areas of peak prey abundance (Pierce 2001). Adults feeding chicks do not regurgitate, but return to the colony carrying a single fish in their beaks. Shealer and Burger (1995) and Shealer (1996) found evidence that roseate terns specialized on a biotic factor, namely the presence of predatory fish, to make prey available to them.

Reproduction Narrative

Egg: In the Puerto Rican colonies, incubation lasts 23 to 25 days (Saliva and Shealer, unpub. Data) (USFWS 1993).

Adult: From USFWS (2010): Caribbean birds usually nest on smaller islands, often with little or no vegetation, and their nests are usually in the open (Gochfeld et al. 1998). There is no direct evidence on the sex-ratio of Caribbean roseate terns. In the Caribbean, where they rarely breed on large islands, roseate terns nest primarily on small offshore islands, rocks, cays, and islets (Burger and Gochfeld 1988; Hoffman et al. 1993; USFWS, 1993; Saliva 2000). They have been reported nesting near vegetation or jagged rock, on open sandy beaches, close to the water line on narrow ledges of emerging rocks, or among coral rubble (Saliva 2000). In Puerto Rico and the Virgin Islands, roseate terns may choose a suitable nesting location 1 year and ignore it in other years; and the same islands may be used in successive years (Pierce 1996; Douglas 2000). Adult roseate terns continued to feed and care for juveniles after they departed the breeding colony, and at least up until the date when they departed southwestern Puerto Rico in early August (Douglas 2000). From USFWS (1993): In general, roseate terns in the Caribbean begin egg laying in May, and have downy chicks in June. Sometimes laying may be reinitiated as late as mid-July, after the terns have attempted to nest on several islands (Saliva, pers. obs.). Roseate terns usually lay one or two eggs, and chicks fledge after 22 to 29 days of age.

Habitat Narrative

Adult: See reproduction narrative for habitat.

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Juvenile: Non-migratory

Adult: Migratory

Dispersal

Juvenile: Low (inferred from USFWS 1993)

Immigration/Emigration

Adult: Immigrates/emigrates (USFWS 2010)

Dispersal/Migration Narrative

Juvenile: From USFWS (1993): Immature birds and most yearlings generally do not migrate northward, but remain on wintering areas (Nisbet 1984).

Adult: From USFWS (2010): They are known to winter at sites in eastern Brazil (Hays et al. 1999) (USFWS 2010). Shealer et al. (2005) estimated dispersal rates among three groups of colonies: Parguera (southwestern Puerto Rico), Culebra (northeastern Puerto Rico) and the U.S. Virgin Islands farther to the east. Emigration from Culebra Island was high (7 of 10 birds over the course of the study), and immigration to Culebra Island was limited to 2 of 31 birds from the U.S. Virgin Islands.

Population Information and Trends

Population Trends:

Not available

Species Trends:

Non-U.S. - Declining; U.S. - Increasing (USFWS 2010)

Representation:

Unknown

Population Size:

3,571 - 7,095 pairs

Population Narrative:

From USFWS (2010): No genetic studies of the Caribbean population have been carried out. The USFWS considers the Caribbean roseate tern population in U.S. territories to be improving, because the Florida population and the second largest population in southwestern Puerto Rico have been slowly increasing since 1960 and 1990, respectively, and the largest population in the U.S. Virgin Islands appears to be stable. In contrast, the available data on roseate tern populations throughout the Caribbean (excluding Florida, Puerto Rico, and the Virgin Islands) indicate that most colonies are relatively small, decreasing in size, or abandoning historic sites. Combining several sets of estimates, Bradley and Norton (2009) estimated that the total number of nesting roseate terns for the Caribbean region in 2007 was in the range 3,571 to 7,095 pairs, with a central estimate of 5,412 pairs.

Threats and Stressors

Stressor: Predation (USFWS 2010)
Exposure:
Response:
Consequence:

Narrative: From USFWS (2010): Predation is known to be a major factor affecting reproductive success in many Caribbean colonies (see CA section 2.3.1.7.1). Important predators include laughing gulls, peregrine falcons, red-tailed hawks, ruddy turnstones, rats, and land crabs. These predators commonly prey on roseate tern eggs and chicks, and the observations summarized in CA section 2.3.1.7.1 suggest that together they reduce the average reproductive success of Caribbean roseate terns to well below the level that could be achieved in the absence of predation. Predation also appears to be responsible for many of the shifts among sites that are characteristic of Caribbean roseate terns. Although there is little evidence that the frequency or intensity of predation are increasing or have been exacerbated by human activity (except as noted for laughing gulls in the U.S. Virgin Islands), there is a clear opportunity for more intensive predator management to effect a considerable increase in average reproductive success.

Stressor: Ectoparasitism (USFWS 2010)
Exposure:
Response:
Consequence:
Narrative: There is evidence that ectoparasite infestations may result in significant mortality of young roseate terns (USFWS 2010).

Stressor: Human disturbance and harvest (USFWS 2010)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2010): Many tern species breed along coasts and inland waterways, and they have thus had a long history of interactions with man (Del Hoyo et al. 1996). Over much of this mutual history, tern eggs, chicks, and adults have been exploited for food, fashion, and information. Throughout history, bird eggs have provided an easily accessible, high-protein, low-cost food source; and exploitation of tern eggs has been recorded for most species, and for most areas of the world (Del Hoyo et al. 1996). Even today, and despite legal restrictions, egging is a problem for many tern species, because colonies are often in places that are hard to monitor and eggs are often highly prized. Human residential, commercial, and recreational activities in proximity to roseate tern colonies are a significant source of disturbance to breeding terns (Saliva 2000). Although terns can habituate to some human disturbance, it does nonetheless cause chicks to run from nesting ledges or may keep adults off their nests, allowing predators to steal eggs or exposing eggs to lethal temperatures (Saliva 2000).

Stressor: Climate change/stochastic events (USFWS 2010)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2010): Climatic factors determining the availability of food sources affect the fledging success and survival of roseate terns. Underwater sea currents and sea temperatures influence the production and timing of arrival of juvenile fish, the main source of food for young terns near breeding areas. Storm surge and abrupt tidal changes dramatically affect the habitat within low-lying islands where some roseate tern colonies are located, resulting in nest abandonment or failure to nest. Given the paucity of islands with suitable nesting substrate and minimal human disturbance, the sole population of the Caribbean roseate

tern in the continental United States appears dangerously vulnerable to any one of a number of human-induced or natural stochastic events (Zambrano 2001).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. Conservation programs to maintain, protect, and enhance populations of this species have been implemented in coordination with countries in the Caribbean where roseate tern populations occur (USFWS 2010).

2. Populations of roseate terns in the Caribbean remain stable (i.e., without significant decrease in number of breeding birds) or increasing for at least 5 consecutive years (USFWS 2010).

Recovery Actions:
- 1. Protect and manage roseate tern populations and their habitat to prevent further population decline and increase productivity (USFWS 1993).
- 2. Continue to gather information on the distribution and abundance of roseate terns in the Caribbean (USFWS 1993).
- 3. Conduct studies of the breeding biology and reproductive success of roseate terns in the Caribbean (USFWS 1993).
- 4. Determine post-breeding dispersal and wintering grounds (USFWS 1993).
- 5. Refine recovery goals (USFWS 1993).

Conservation Measures and Best Management Practices:
- 1. Fire ant control would be an inexpensive, effective way to improve nesting success. Fire ant poison should be broadcast in the nesting areas on these islands prior to arrival of the terns. It would be advisable to formulate plans for this work in consultation with a fire ant specialist and an avian toxicologist to develop a protocol that results in maximum kill of fire ants with a minimum risk of toxicity to the birds. Ideally, this method could be executed up to a month prior to breeding and would effectively depress fire ant parasitism through the end of June (USFWS 2010).
- 2. Crab removal and relocation should be considered at colonies with abundant crab populations (USFWS 2010).
- 3. Rats should be eradicated from islands used by roseate terns (USFWS 2010).
- 4. Laughing gull control should be considered in areas where gulls specialized in egg robbing are detected, through aversive conditioning or gull colony-level control (USFWS 2010).
- 5. Enhance nesting habitat. Roseate terns in the U.S. Virgin Islands seem to prefer open sites with some type of shelter near the nest. Vegetation encroachment in nesting areas should be controlled by removing excessive vegetation cover. Artificial nest shelters can be provided in those areas where natural shelter is not available. The number of shelters provided would depend on the number of nesting terns, the location of nests, and availability of natural shelter (USFWS 2010).
- 6. A regional approach to conduct annual surveys should be implemented. Because of the yearly shifting of colonies, monitoring roseate terns requires a regional approach. Simultaneous annual nest counts in the U.S. Virgin Islands, British Virgin Islands, and Puerto Rico should be conducted to accurately establish the population status of this species for the Puerto Rico Bank. Communication

and cooperation between researchers in this region is essential to detect the population trends for this species USFWS 2010).

- 7. Continued banding increases the likelihood of recoveries of banded birds. Banding provides information about migration, longevity, and factors affecting the species on the wintering grounds. Banding of adults is also necessary to determine the extent, if any, of dispersal and inter-colony movement. Linkages between breeding and wintering sites should promote the establishment of more holistic and efficient management plans (USFWS 2010).
- 8. Prevent human disturbance. The posting of breeding areas will alert the public that the area is an endangered species nesting area and that foot traffic is prohibited. The preparation and placing of warning signs to prevent humans from entering the nesting areas or poaching eggs, for instance, is not a law enforcement issue (USFWS 2010).
- 9. Recreational use of cays and islands used by roseate terns, particularly in Florida, should be restricted. Islands where potential conflict between human use and tern nesting is expected should be monitored early in the roseate tern-breeding season for potential nesting activity. If nesting activity is strongly suspected or imminent, these islands should be temporarily closed to the public during the incubation period. After chick hatching, the islands may be opened to the public with warning signs posted to prevent human incursion into the colony area (USFWS 2010).
- 10. Protect nesting colonies from poaching. The illegal take of eggs by humans is by far the primary limiting factor for roseate terns in the Virgin Islands. Federal and local law enforcement officer patrolling of nesting areas is crucial during the 3-week window when colonies are most vulnerable (USFWS 2010).
- 11. Additional research is needed on the genetics of the Caribbean metapopulation, as well as colony-site fidelity, to determine the degree of intermixing between colonies. Population models using estimates of annual productivity and annual adult survival rates, to determine the long-term status of the population, should be considered (USFWS 2010).
- 12. Long-term data on annual reproductive success and chick growth rates are needed to properly assess the importance of Florida colonies to the total Caribbean population (USFWS 2010).
- 13. Roseate terns in the Seychelles are seriously affected by tick parasitism (see section 2.3.1.7.2, above). Ectoparasites could be a significant threat in other tropical areas, including the Caribbean, and deserves further study (USFWS 2010).
- 14. The extent of roseate tern mortality due to trapping for food in northern South America during wintering and migration is currently not known, and merits further evaluation (USFWS 2010).
- 15. Monitor prey and predatory fish populations in waters off southwestern Puerto Rico between April and August for a period of 10 years. Schools of juvenile fish, followed by predatory fish, appear in southwestern waters each spring. Even if prey fish species are abundant, they are only accessible to roseate terns when predatory fish species drive the smaller fish to the surface and within reach of roseate terns. Therefore, both healthy prey and predatory fish populations are necessary for roseate terns to breed successfully. Fish populations may be affected by overfishing and climatic changes that regulate their population size and distribution. Monitoring these fish populations provide early warning that climatic changes may imminently affect roseate tern recovery (USFWS 2010).

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SPECIES ACCOUNT: *Sterna dougallii dougallii* (Roseate tern (North Atlantic DPS))

Species Taxonomic and Listing Information

Listing Status: Endangered; 11/02/1987; Northeast Region (R5) (USFWS, 2015)

Physical Description

A gray, white, and black seabird with a mostly black bill. Breeding adult has pale gray upperparts, a black cap and nape, and white underparts (slight pinkish cast visible in good light); bill is mostly black, with a variable amount of red at the base; tail is white, deeply forked, and extends well beyond the wings when the bird stands with the wings folded; legs and feet are bright red-orange. Juvenile has a brownish cap that extends over the forehead; mantle looks coarsely scaled; lower back is barred with black. First-summer bird has a white forehead. Attains full adult plumage by the second winter (NGS 1983) (NatureServe, 2015).

Taxonomy

Both the Northeast and Caribbean populations remain classified in the subspecies Sterna d. dougallii. Within the genus, the roseate tern appears most closely related to the white-fronted tern (S. striata) of Australia and the black-naped Tern (S. sumatrana) of the Indo-Pacific region, then to the Arctic (S. paradisaea), common (S. hirundo), South American (S. hirundinacea), and Antarctic (S. vittata) terns (USFWS, 2010).

Historical Range

Historically, the breeding range extended south to Virginia and North Carolina (USFWS, 1998).

Current Range

About 120 to 150 pairs of roseate terns breed in Canada, where the species is similarly listed as endangered. The entire range of the Northeast roseate tern population has been surveyed since 1988, either every year (Massachusetts, New Hampshire, Maine and the largest colony sites in New York, Connecticut, and Nova Scotia [NS]), in alternate years (remainder of New York), or sporadically (remainder of Connecticut and Nova Scotia). Except for some islands in Gardiner's Bay (east Long Island, New York) that have been occupied sporadically and may have been missed in some years, it is believed that almost the entire population is located and counted at least biennially. This DPS includes three large central colonies at Bird, Ram, and Great Gull Islands and about 75 peripheral sites, of which only 10 to 25 have been occupied at any one time (USFWS, 2010).

Distinct Population Segments Defined

Yes; Northeast population (USFWS 2010)

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Among prey delivered to roseate tern chicks in June to July, 86.9 percent were American sand lance, 7.8 percent Atlantic herring, and 2.4 percent anchovies (Anchoa spp.). The mean provisioning rate was about 0.8 fish/brood/hour (USFWS, 2010). Chicks grow rapidly and reach their asymptotic weight in about 15 days (Nisbet et al. 1995). They usually fledge between 25 and 29 days. Juvenile roseate terns are dependent on their parents for food for at least six weeks after fledging (USFWS, 1998).

Reproduction Narrative

Egg: See adult reproduction narrative for egg habitat and development.

Site Fidelity

Adult: Moderate to high (USFWS, 2010)

Habitat Narrative

Adult: The natal fidelity rate at the small colony at Falkner Island (about 0.58) was much smaller than those at the large colonies at Bird and Great Gull Islands (about 0.90) (USFWS, 2010). See adult habitat narrative for juvenile habitat.

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 2010)

Dispersal

Adult: High (USFWS, 2010)

Dispersal/Migration Narrative

Adult: Juvenile dispersal is sufficiently high to lead to complete population mixing within one generation (USFWS, 2010).

Population Information and Trends

Population Trends:

Breeding range has been decreasing since pre-1989 (USFWS, 2010)

Species Trends:

25% decline in nesting population from 2000 - 2009 (USFWS, 2010)

Resiliency:

High (inferred from USFWS, 2010; see current range/distribution)

Representation:

Moderate (inferred from USFWS, 2010)

Redundancy:

High (inferred from USFWS, 2010; see current range/distribution)

Number of Populations:

~78 (USFWS, 2010; see current range/distribution)

Population Size:
4,000 - 4,100 pairs (USFWS, 2010)

Population Narrative:
The highest total of 4,308 pairs in 2000 was 5 to 10 percent above both trend lines and may have resulted from overestimates at one of more colony sites: a total number of 4000 to 4100 pairs would better fit the trend line and would be within the range of uncertainty in the individual counts. Based on the demographic information summarized in previous sections, the Northeast population of the roseate tern appears to conform to a classic “source-sink” metapopulation (Pulliam 1988, Hanski 1999). Szczys et al. (2005a) used some of the same microsatellite markers to compare roseate terns from Bird and Falkner Islands in the United States to those in Western Australia. They reported that the U.S. birds had much lower genetic diversity than the Australian birds, perhaps reflecting recent historical population fluctuations and bottlenecks; however, they found little evidence of inbreeding. The breeding range of the Northeast population of roseate terns had been shrinking before 1998, and this trend continued in 1998 to 2009. Nearly 1000 fewer adult breeding pairs were recorded nesting among colonies in the Northeast in 2009, a 25 percent decline since the year 2000 (USFWS, 2010).

Threats and Stressors

Stressor: Predation (USFWS 2010)
Exposure:
Response:
Consequence:
Narrative: Although many different predators have been recorded preying on roseate terns in the region, the most important population effects have been the killing of adult terns by great horned owls, mink, and raccoons. Together, these predators are known to have killed 102 adult roseates in the warm water subregion and 29 in the cold water subregion in the period 1998 to 2009. It is not clear that all kills were reported, and many more are likely to have been missed, especially at Great Gull Island. In the United States, these kills amounted to less than 1 percent of the adult population annually in both the cold water and warm water subregions. By itself, this would not be a major drain on the population, but predation by these three species also causes major disruption of nesting and has led to repeated shifts away from affected sites, sometimes to sites that are less suitable (USFWS, 2010).

Stressor: Loss and degradation of nesting habitat (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: The 1987 final listing rule (52 FR 42065) and the 1998 recovery plan (USFWS 1998b) address the primary cause for the loss of nesting habitat-the expansion of breeding herring gulls and great black-backed gulls onto islands used for nesting by terns. As populations of these large and aggressive gulls expanded in the Northeast during the mid-20th century, terns were displaced from their favored nesting sites. While recent evidence suggests that populations of these large gulls have now stabilized or are declining (e.g., Welch et al. 2010, Nisbet et al. in press) populations of laughing gulls have expanded on Petit Manan Island, Maine, to the

detriment of the roseate tern population there (RTRT 2008). The coastal islands used for nesting by roseate terns in the Northeast are subject to dynamic changes both in conformation and vegetative cover. The most pervasive and important changes that have been reported since 1998 are erosion and the spread of invasive plants. The loss and degradation of nesting habitat due to erosion is among the most significant threats facing the species. Like invasive species elsewhere, exotic and invasive plants in the coastal environment may reproduce and spread quickly, often out-competing native plant species. Invasive plants have the potential to alter the structure, microhabitat and accessibility of island habitats used by nesting roseate terns. If left uncontrolled, invasive plants may create dense, impenetrable clumps or otherwise convert sparsely vegetated sand to dense vegetation, resulting in the loss or degradation of roseate nesting habitat. Invasive plants are seriously affecting habitat quality at several important roseate tern colony sites (e.g., Great Gull Island, New York, Seavey Island, New Hampshire, Bird and Penikese Islands, Massachusetts, and Outer Green Island and Eastern Egg Rock, Maine) (USFWS, 2010).

Stressor: Sea level rise and climate change (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: In the last century, for example, sea level rise along the U.S. Gulf Coast exceeded the global average by 13 to 15 cm, because coastal lands there are subsiding (EPA 2009). Sediment compaction and oil and gas extraction compound tectonic subsidence (Penland and Ramsey 1990, Morton et al. 2003, Hopkinson et al. 2008). Low elevations and proximity to the coast make all non-breeding foraging and roosting habitats used by roseate terns vulnerable to the effects. Rising sea levels are expected to inundate many habitats used by roseate terns during their annual cycle, such as sandy beaches, barrier islands, and sand flats (NABCI 2010). Several important roseate tern breeding sites are low profile islands with significant area less than 10 feet above sea level (e.g., Ram and Bird Islands, MA, North Brothers Island, Nova Scotia, and Gardner’s Island/Cartwright Point, NY). Climate change may affect roseate terns in another manner if coastal storms increase in either frequency or intensity. The survival rate for roseate terns in 1991 to 1992 was lower than that measured for all other years (Spendelow et. al. 2008). This has been attributed to Hurricane Bob, which passed through the main staging area for the Northeast population (coastal southeastern Massachusetts) on August 21, 1991. Hurricane Bob appears to have significantly lowered the survival rate of most juveniles and many adults (Nisbet and Spendelow 1999, Spendelow et al. 2002, 2008, Lebreton et al. 2003) (USFWS, 2010).

Stressor: Sand mining (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Roseate terns forage over sand bars and shoals, where tidal forces and shallow water depths make small prey fish more available to plunge-diving birds like terns. If exposed during lower tides, roseate terns also favor these habitats for resting and roosting, as they often have less human recreational disturbance than beaches nearby. Sand mining, the practice of extracting (dredging) sand from sand bars, shoals, and inlets in the near shore zone, is a potential threat to these habitats because removing these sand sources can alter depth contours (Hayes and Michel 2008), and may make them unsuitable for use by foraging and resting roseate terns (USFWS, 2010).

Stressor: Human disturbance (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Trull et al. (1999) reported that of the 20 sites most used by staging roseate terns, human disturbance that caused flocks to disperse or flush and then resettle was documented at many locations. Disturbance took many forms, for example, by pedestrians, beach vehicles, aircraft, boats and dogs. Recently, the Coastal Waterbird Program of Massachusetts Audubon Society, the U.S. Geological Survey and other partners confirmed (through observations of color-banded birds), the importance of southeastern Massachusetts beaches to roseate terns from throughout the breeding range (Jedrey et al. 2010). Their studies also concurred with the observations of Trull et al. (1999) that human disturbance may be influencing what sites are used and how long terns use them. Roseate terns are thought to roost on remote sand flats at the end of barrier beaches while in their winter quarters (Hays et al. 1999). These sites are similar to those used for staging around Cape Cod, and may be similarly subject to human disturbance

Stressor: Contaminants (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Two significant contaminant related events have occurred in Buzzards Bay, Massachusetts, the release of polychlorinated biphenyls (PCBs) into New Bedford Harbor and the Bouchard-120 oil spill. Roseate (and common) terns nesting in Buzzards Bay, Massachusetts, are known to have been exposed to dangerously high levels of PCBs that had accumulated in marine fish preyed on by the birds (Aquatec 1990; Nisbet et al. 1996; I. Nisbet, unpubl. data). Ram Island, Mattapoisett, one of the three largest nesting colonies of roseate terns, was moderately oiled and small quantities of oil also appeared at Bird Island and Penikese Islands (USFWS, 2010).

Stressor: Wind turbines (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: Several wind turbines within the breeding range of the roseate tern in the western North Atlantic have been constructed, and several more are either proposed or planned (USFWS, unpubl. data). Risk from wind turbine generators sited between nesting islands and feeding shoals or in the vicinity of beaches used during the fall staging period pose the greatest risk and require further assessment. Wind turbine generators pose a threat to roseate tens in the foreseeable future, but the magnitude of this threat cannot be assessed without better information about annual and within the breeding season movements (USFWS, 2010).

Recovery

Reclassification Criteria:
1. The Northeast nesting population is increased to 5,000 "peak period" nesting pairs (USFWS, 1998).

2. A minimum of six large colonies (at least 200 pairs) with high productivity (at least 1.0 fledged young/pair for five consecutive years) exist within the current geographic distribution (USFWS, 1998).

3. Long-term agreements to assure protection and management sufficient to maintain the population targets and average productivity in each breeding colony are in place (USFWS, 1998).

Delisting Criteria:
The "peak period" nesting population reaches the historic high level of 8,500 pairs of the 1930's (USFWS, 1998).

Recovery Actions:
- Oversee breeding roseate terns and their habitat to help increase survival and productivity. This includes the physical maintenance, expansion and enhancement of nesting habitat (USFWS, 1998).
- Develop a management plan for monitoring wintering and migration areas (USFWS, 1998).
- Secure unprotected sites through acquisition and easements (USFWS, 1998).
- Develop outreach materials and implement education programs (USFWS, 1998).
- Conduct scientific investigations that will facilitate recovery efforts (USFWS, 1998).
- Review progress of recovery annually and revise recovery efforts as needed (USFWS, 1998).

Conservation Measures and Best Management Practices:
- The many conservation activities on-going for the roseate tern in the Northeast should continue. a. These include the monitoring of all breeding colonies to assess the number of nesting pairs, their hatching success and nesting productivity; the management of competitors and predators that compete with roseate terns for limited nesting space or cause loss of eggs, chicks or adults; enhancing nesting habitat through the placement of artificial nest boxes or other structures; and taking measures to avoid habitat degradation from the incursion of invasive exotic and native plant species that can cover sparsely vegetated nesting areas with rank or dense vegetation that is unsuitable for tern nesting. b. Banding and color-banding studies that add meaningfully to our understanding of metapopulation dynamics, individual longevity, nest site fidelity, identification of migration and wintering areas, age at first breeding, juvenile and adult survival rates and other demographic parameters should continue. These studies may provide data essential to our understanding of roseate tern population dynamics (USFWS, 2010).
- Immediate measures to ensure the viability of nesting habitats at key island colony sites in the Northeast should be taken before erosion and rising sea levels cause further reduction in habitat suitability, carrying capacity and productivity of nesting pairs. A detailed project report and environmental assessment has been prepared for the restoration of Bird Island (USACOE 2005), and alternatives to protect the shoreline of Ram Island have been identified (ACRE 2009), but substantive actions to implement projects are needed (USFWS, 2010).
- New studies and technologies are needed to identify why the adult breeding population of the roseate tern in the Northeast has declined (2000 to 2009), despite generally good nesting productivity and the absence of significant mortality of adults during most breeding seasons (USFWS, 2010).
- For all nesting sites in the Northeast and particularly for colonies in the warm water sub region, the vulnerability to sea level rise and over washing by coastal storms should be assessed, and where feasible, plans developed to mitigate further loss of habitat. At other sites, where there are either

natural or man influenced changes to the coastal geomorphology of nesting islands, shoreline protection opportunities may not be feasible or desirable. At these locations, alternative nesting sites nearby should be evaluated and their suitability to support nesting roseate terns through the removal of competing species, habitat improvement or other means should be investigated (USFWS, 2010).

- Measures to address the features of the revetment at Falkner Island that are inimical to successful nesting and chick rearing by roseate terns should be mitigated. Specifically, the interstitial spaces within the revetment that are in proximity to nesting sites of roseate terns, wherein chicks, adults and fledglings may become trapped, should be filled with crushed stone or other material. Secondly, source material suitable to sustain the spit at the north end of the island should be provided or an alternative means should be identified to avoid the further loss of the tern nesting habitat there (USFWS, 2010).
- Geolocators have made possible the first technology-based means to track the phenology and general migratory path followed by roseate terns during their annual cycle. Results to date should be evaluated and a determination made whether continuation of this study would provide additional information to benefit the recovery program (USFWS, 2010).
- A better understanding of the habitats used by roseate terns during the post-breeding staging period should be developed and the factors that are limiting the use of preferred sites should be addressed (USFWS, 2010).
- Very little is known about the distribution and ecology of roseate terns during migration and wintering, and there is no information of any kind about causes of death. Much more information is needed about factors limiting survival in the winter quarters to allow formulation of effective conservation measures (USFWS, 2010).

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USFWS 2010. Caribbean Roseate Tern and North Atlantic Roseate Tern (Sterna dougallii dougallii) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service. Southeast Region Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. Northeast Region New England Field Office Concord, New Hampshire. September 2010.

SPECIES ACCOUNT: *Strix occidentalis caurina* (Northern spotted owl)

Species Taxonomic and Listing Information

Commonly-used Acronym: NSOW

Listing Status: Threatened; June 26, 1990 (55 FR 26114).

Physical Description

Northern spotted owls (Strix occidentalis caurina) are medium-sized, stocky owls with dark to chestnut-brown plumage, and dark brown eyes surrounded by prominent facial disks. They have white spotting on the head and breast, and barred tails. The northern spotted owl has a pale face, no ear tuffs, and dense, dark mottling/spotting on the breast and flanks. They exhibit an average body length 46 to 48 centimeters (cm) (18 to 19 inches [in.]) full grown, with a wingspan of approximately 101 cm (40 in.). An adult northern spotted owl averages between 500 to 700 grams (1.1 to 1.5 pounds) in weight; the sexes are dimorphic, with males weighing about 13 percent less on average than females (USFWS 2011; USFWS 2015).

Taxonomy

Northern spotted owls are endemic to northwestern North America, and are placed in the Family Strigidae in Order Strigiformes. The species Strix occidentalis contains three extant subspecies: northern spotted owl (S. o. caurina), California spotted owl (S. o. occidentalis), and the Mexican spotted owl (S. o. lucida). The northern spotted owl is capable of producing nonviable offspring with the barred owl; this hybridized species, Strix varia varia, possesses audible and morphological similarities to both species. 1) The northern spotted owl has the darkest plumage with the smallest white spots (giving it a mottled appearance), and is the largest in size compared to the California and Mexican spotted owl subspecies. 2) Northern spotted owls have a call that sounds very similar to the mnemonic device "Who cooks for you, who cooks for you." 3) Northern spotted owls have spots on the head and back; unlike the barred owl, which has elongated streaks across head and back (55 FR 26114; USFWS 2015).

Historical Range

The northern spotted owl is believed to have historically inhabited most forests throughout southwestern British Columbia, western Washington and Oregon, and northwestern California as far south as San Francisco Bay (USFWS 2015).

Current Range

The current range of the spotted owl extends from southwest British Columbia through the Cascade Mountains, coastal ranges, and intervening forested lands in Washington, Oregon, and California; extending east to just northwest of the Pit River (in northeastern Shasta County), and as far south as Marin County (NatureServe 2015; USFWS 2011).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 12/4/2012.

Legal Description
On December 4, 2012, the U.S. Fish and Wildlife Service designated revised critical habitat for the northern spotted owl (Strix occidentalis caurina) under the Endangered Species Act. In total, approximately 9,577,969 acres (ac) (3,876,064 hectares (ha)) in 11 units and 60 subunits in California, Oregon, and Washington fall within the boundaries of the critical habitat designation (77 FR 71875 - 72068).

Critical Habitat Designation
9,577,969 ac (3,876,064ha) in 11 units and 60 subunits are identified as meeting the definition of critical habitat for the northern spotted owl. The 11 units of critical habitat are: (1) North Coast Olympics, (2) Oregon Coast Ranges, (3) Redwood Coast, (4) West Cascades North, (5) West Cascades Central, (6) West Cascades South, (7) East Cascades North, (8) East Cascades South, (9) Klamath West, (10) Klamath East, and (11) Interior California Coast Ranges. All of the critical habitat units and subunits identified were occupied at the time of listing; however, some units may include some smaller areas that were not known to be occupied at the time of listing but have been determined to be essential to the conservation of the species.

Unit 1: North Coast Ranges and Olympic Peninsula (NCO): Unit 1 consists of 824,500 ac (333,623 ha) and contains five subunits. This unit consists of the Oregon and Washington Coast Ranges Section M242A, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994a, Section M242A). This region is characterized by high rainfall, cool to moderate temperatures, and generally low topography (1,470 to 2,460 ft (448 to 750 m)). High elevations and cold temperatures occur in the interior portions of the Olympic Peninsula, but northern spotted owls in this area are limited to the lower elevations (less than 2,950 ft (900 m)). Forests in the NCO are dominated by western hemlock, Sitka spruce, Douglas-fir, and western red cedar (Thuja plicata). Hardwoods are limited in species diversity (consist mostly of bigleaf maple and red alder (Alnus rubra)) and distribution within this region, and typically occur in riparian zones. Root pathogens like laminated root rot (Phellinus weirii) are important gap formers, and vine maple (Acer circinatum), among others, fills these gaps. Because Douglas-fir dwarf mistletoe is unusual in this region, northern spotted owl nesting habitat consists of stands providing very large trees with cavities or deformities. A few nests are associated with western hemlock dwarf mistletoe (Arceuthobium tsugense subsp. tsugense). Northern spotted owl diets are dominated by species associated with mature to latesuccessional forests (flying squirrels, red tree voles), resulting in similar definitions of habitats used for nesting/ roosting and foraging by northern spotted owls. Subunit Descriptions: Unit 1 NCO–1. The NCO–1 subunit consists of approximately 293,539 ac (118,791 ha) in Clallam, Jefferson, Grays Harbor, and Mason Counties, Washington, and comprises lands managed by U.S. Forest Service (USFS) and State of Washington. The USFS manages 230,966 ac (93,309 ha) as Latesuccessional Reserves to maintain functional, interactive, late-successional and old-growth forest ecosystems and 62,966 ac (25,481 ha) under the adaptive management area land use allocation. Threats in this subunit include current and past timber harvest, competition with barred owls, and isolation on a peninsula (along with subunit NCO–2). This subunit is expected to function primarily for demographic support of the overall population. NCO–1 is located primarily in the watersheds of Lyre, Hoko, Soleduck, Hoh, Quinault, Queets, and Clearwater Rivers, and includes the northern part of the Lower Chehalis River watershed. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 94 percent of the area of NCO–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. NCO–2. The NCO–2 subunit consists of approximately 213,633 ac (86,454 ha) in Kitsap, Clallam, Jefferson, Grays Harbor, and Mason Counties, Washington, and comprises lands managed by the USFS. The USFS manages 173,682 ac (70,287 ha) as Latesuccessional Reserves to maintain functional, interactive, late-successional and old-growth forest ecosystems and 39,083 ac (15,816 ha) under the adaptive management area land use allocation. Threats in this subunit include current and past timber harvest, competition with barred owls, and isolation on a peninsula (along with subunit NCO–1). This subunit is expected to function primarily for demographic support of the overall population. NCO–2 is located primarily in the watersheds of the Elwha, Dungeness, Quilcene, Snow, Skokomish, and Dosewallips rivers. Our evaluation of sites known to be occupied at the time of listing indicate that approximately 95 percent of the area of this subunit was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. NCO–3. We exempted subunit NCO– 3 from the final designation of critical habitat under Section 4(a)(3) of the Act (See Exemptions section below). This subunit is comprised approximately 14,313 ac (5,792 ha) of lands managed by the Department of Defense as part of Joint Base Lewis-McChord under their integrated natural resource management plan (INRMP). NCO–4. The NCO–4 subunit consists of approximately 179,745 ac (72,740 ha) in Clatsop, Columbia, Tillamook, and Washington Counties, Oregon, and comprises Federal lands and lands managed by the State of Oregon. Of this subunit, 117,033 ac (47,361 ha) are managed as part of the Tillamook and Clatsop State Forests for multiple uses including timber revenue production, recreation, and wildlife habitat according to the Northwest Oregon State Forest Management Plan (ODF 2010a, entire). Federal lands encompass 62,712 ac (25,379 ha) of this subunit and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population. This subunit is isolated from the nearest subunit to the north but is adjacent to subunit NCO–5 to the south. Our evaluation of sites known to be occupied at the time of listing indicate that approximately 63 percent of the area of NCO–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider a large part of this subunit to have been occupied at the time of listing. There are some areas of younger forest in this subunit that may have been unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat in this subunit is especially important for providing for population growth and additional demographic support in this region. The development of additional suitable habitat in this subunit is needed to support viable northern spotted owl populations over the long term. The recruitment of additional suitable habitat will also contribute to the successful dispersal of northern spotted owls, and serve to buffer northern spotted owls from competition with the barred owl. NCO–5. The NCO–5 subunit consists of approximately 142,937 ac (57,845 ha) in Yamhill, Lincoln, Tillamook, and Polk Counties, Oregon, and comprises lands managed by the State of Oregon, the BLM, and the USFS. Of this subunit 11,067 ac (4,479 ha) are managed by the State of Oregon for multiple uses including timber revenue production, recreation, and wildlife habitat according to the Northwest Oregon State Forest Management Plan (ODF 2010a, entire), and may be considered for exclusion from the final critical habitat designation. Federal lands comprise 131,870 ac (53,666 ha) and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population and north-south connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicate that approximately 63 percent of the area of NCO–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider a large part of this subunit to have been occupied at the time of listing. There are some areas of younger forest in this subunit that may have been unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat in this subunit is especially important for providing for population growth and additional demographic support in this region. The development of additional suitable habitat in this subunit is needed to support viable northern spotted owl populations over the long term. The recruitment of additional suitable habitat will also contribute to the successful dispersal of northern spotted owls, and serve to buffer northern spotted owls from competition with the barred owl.

Unit 2: Oregon Coast Ranges (OCR): Unit 2 consists of 859,864 ac (347,975 ha) and contains six subunits. This unit consists of the southern third of the Oregon and Washington Coast Ranges Section M242A, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994a, Section M242A). We split the section in the vicinity of Otter Rock, OR, based on gradients of increased temperature and decreased moisture that result in different patterns of vegetation to the south. Generally this region is characterized by high rainfall, cool to moderate temperatures, and generally low topography (980 to 2,460 ft (300 to 750 m)). Forests in this region are dominated by western hemlock, Sitka spruce, and Douglas-fir; hardwoods are limited in species diversity (largely bigleaf maple and red alder) and distribution, and are typically limited to riparian zones. Douglas-fir and hardwood species associated with the California Floristic Province (tanoak, Pacific madrone, black oak, giant chinquapin (Castanopsis chrysophylla)) increase toward the southern end of the OCR. On the eastern side of the Coast Ranges crest, habitats tend to be drier and dominated by Douglas-fir. Root pathogens like laminated root rot are important gap formers, and vine maple among others fills these gaps. Because Douglas-fir dwarf mistletoe is unusual in this region, northern spotted owl nesting habitat tends to be limited to stands providing very large trees with cavities or deformities. A few nests are associated with western hemlock dwarf mistletoe. Northern spotted owl diets are dominated by species associated with mature to late-successional forests (flying squirrels, red tree voles), resulting in similar definitions of habitats used for nesting/roosting and foraging by northern spotted owls. One significant difference between OCR and NCO is that woodrats comprise an increasing proportion of the diet in the southern portion of the modeling region. Subunit Descriptions—Unit 2 OCR–1. The OCR–1 subunit consists of approximately 110,657 ac (44,781 ha) in Polk, Benton and Lincoln Counties, Oregon, and comprises lands managed by the State of Oregon, the BLM, and the USFS. Of this subunit 6,612 ac (2,676 ha) are managed by the State of Oregon for multiple uses including timber revenue production, recreation, and wildlife habitat according to the Northwest Oregon State Forest Management Plan (ODF 2010a, entire). Federal lands comprise 104,045 ac (42,105 ha) and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population and north-south connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 55 percent of the area of OCR–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider a large part of this subunit to have been occupied at the time of listing. There are some areas of younger forest in this subunit that may have been unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat in this subunit is especially important for providing for population growth and additional demographic support in this region. The development of additional suitable habitat in this subunit is needed to support viable northern spotted owl populations over the long term. The recruitment of additional suitable habitat will also contribute to the successful dispersal of northern spotted owls, and serve to buffer northern spotted owls from competition with the barred owl. OCR–2. The OCR–2 subunit consists of approximately 261,405 ac (105,787 ha) in Lane, Benton, and Lincoln Counties, Oregon, and comprises lands managed by the State of Oregon, the BLM, and the USFS. Of this subunit 18,504 ac (7,448 ha) are managed by the State of Oregon for multiple uses including timber revenue production, recreation, and wildlife habitat according to the Northwest Oregon State Forest Management Plan (ODF 2010a, entire). Federal lands comprise 242,901 ac (98,298 ha) and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population and north-south connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 77 percent of the area of OCR–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. OCR–3. The OCR–3 subunit consists of approximately 203,681 ac (82,427 ha) in Lane and Douglas Counties, Oregon, and comprises lands managed by the State of Oregon, the BLM, and the USFS. Of this subunit 5,082 ac (2,07 ha) are managed by the State of Oregon for multiple uses including timber revenue production, recreation, and wildlife habitat according to the Northwest Oregon State Forest Management Plan (ODF 2010a, entire). Federal lands comprise 198,599 ac (80,369 ha) and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population and for both north-south and east-west connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 97 percent of the area of OCR–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. OCR–4. The OCR–4 subunit consists of approximately 8,263 ac (3,344 ha) in Lane and Douglas Counties, Oregon, and comprises lands managed by the BLM as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for east-west connectivity between subunits and critical habitat units, and between the Oregon coast and the western Cascades. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 43 percent of the area of OCR–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider a large part of this subunit to have been occupied at the time of listing. There are some areas of younger forest in this subunit that may have been unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat in this subunit is especially important for providing essential connectivity between currently occupied areas to support the successful dispersal of northern spotted owls, and may also help to buffer northern spotted owls from competition with the barred owl. OCR–5. The OCR–5 subunit consists of approximately 176,905 ac (71,591ha) in Coos and Douglas Counties, Oregon, and comprises lands managed by the State of Oregon, the BLM, and the USFS. Of this subunit 40,747 ac (16,490 ha) are managed by the State of Oregon for multiple uses including sustained economic benefit through timber harvest and management, recreation, and wildlife habitat according to the Elliot State Forest Management Plan (ODF 2011, entire). Federal lands comprise 136,158 ac (55,101 ha) and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population and for north-south, and potentially eastwest, connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 94 percent of the area of OCR–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. OCR–6. The OCR–6 subunit consists of approximately 81,900 ac (33,144 ha) in Coos and Douglas Counties, Oregon, and comprises lands managed by the BLM as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population and for north-south connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 97 percent of the area of OCR–6 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. Unit 3: Redwood Coast (RWC) Unit 3 contains 180,855ac (73,189ha) and three subunits. This unit consists of the Northern California Coast Ecological Section 263, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994b, entire). This region is characterized by lowlying terrain (0 to 2,950 ft (0 to 900 m)) with a maritime climate, generally mesic conditions, and moderate temperatures. Climatic conditions are rarely limiting to northern spotted owls at all elevations. Forest communities are dominated by redwood, Douglas-firtanoak forest, coast live oak, and tanoak series. The vast majority of the region is in private ownership, dominated by a few large industrial timberland holdings. The results of numerous studies of northern spotted owl habitat relationships suggest stump-sprouting and rapid growth rates of redwoods, combined with high availability of woodrats in patchy, intensively managed forests, enables northern spotted owls to maintain high densities in a wide range of habitat conditions within the Redwood zone.

Subunit Descriptions—Unit 3: RDC–1. This subunit contains 63,127 ac (25,547 ha) of lands managed by the USFS and BLM in Curry County, Oregon and in Del Norte, Humboldt, and Trinity Counties, California. Special management considerations or protection are required in this subunit to address threats from the barred owl. Suitable habitat within the subunit is relatively contiguous north-to-south, and is capable of supporting a sustainable subpopulation of owls. We expect that this subunit will provide strong connectivity among the adjacent critical habitat units to the north (OCR) and east (KLW, ICC). The subunit is weakly connected to the adjacent subunit to the south (RDC–2). Our evaluation of sites known to be occupied at the time of listing indicates that approximately 78 percent of the area of RDC–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. RDC–2. This subunit contains 65,391 ac (26,463 ha) in Mendocino and southwestern Humboldt Counties, California. There are 16,479 ac (6,669 ha) of Federal lands in the subunit, managed by the Bureau of Land Management. The California Department of Forestry and Fire Protection operates the Jackson Demonstration State Forest (48,912 ac (19,794 ha)) for multiple uses including timber production, water quality, wildlife habitat, and research. Special management considerations or protection are required in this subunit to address threats from the barred owl. Suitable habitat within the subunit is relatively contiguous northto-south, and is capable of supporting a sustainable subpopulation of owls. The subunit is weakly connected to the adjacent CHU to the east (ICC) and to the coastal subunit to the north (RDC– 1); it is relatively well connected to the coastal subunit to the south (RDC–3). Our evaluation of sites known to be occupied at the time of listing indicates that approximately 85 percent of the area of RDC–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. RDC–3. This subunit was comprised entirely of private lands, which have been excluded from the final rule. RDC–4. This subunit was comprised entirely of private lands, which have been excluded from the final rule. RDC–5. This subunit contains 20,684 ac (8,371 ha) in southern Marin County, California and represents the southern range limit of the subspecies. No private lands are contained in this subunit. The Mount Tamalpais Watershed (18,900 ac (7,649 ha)) of the Marin Municipal Water District is included in the final critical habitat designation. Six Open Space Preserves (OSPs) in the Marin County Parks and Open Space System, totaling 3,627 ac (1,468 ha), are included in the final critical habitat designation, including Gary Giacomini, White Hill, Cascade

Canyon, Baltimore Canyon, Camino Alto, and Blithedale Summit OSPs. Special management considerations or protection are required in this subunit to address incipient threats from the barred owl. Suitable habitat within the subunit is continuous from east to west. It is unknown whether this subunit is capable of supporting a self-sustaining subpopulation of owls without support from the subunit to the north (RDC–4). The lands between this subunit and the nearest subunit to the east (ICC–6) are dominated by agricultural and urban land use, and are very weakly connected. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 82 percent of the area of RDC–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. Unit 4: West Cascades North (WCN) This unit contains 542,274 ac (219,450 ha) and two subunits. This unit coincides with the northern Western Cascades Section M242B, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994a, Section M242B), combined with the western portion of M242D (Northern Cascades Section), extending from the U.S.- Canadian border south to Snoqualmie Pass in central Washington. It is similar to the Northern Cascades Province of Franklin and Dyrness (1988, pp. 17–20). This region is characterized by high mountainous terrain with extensive areas of glaciers and snowfields at higher elevation. The marine climate brings high precipitation (both annual and summer) but is modified by high elevations and low temperatures over much of this modeling region. The resulting distribution of forest vegetation is dominated by subalpine species, mountain hemlock and silver fir; the western hemlock and Douglas-fir forests typically used by northern spotted owls are more limited to lower elevations and river valleys (northern spotted owls are rarely found at elevations greater than 4,200 ft (1,280 m) in this region) grading into the mesic Puget lowland to the west.

Subunit Descriptions—Unit 4: WCN–1. The WCN–1 subunit consists of approximately 438,255 ac (177,355 ha) in Whatcom, Skagit, and Snohomish Counties, Washington, and comprises lands managed by the USFS and the State of Washington. The USFS manages 320,146 ac (129,559 ha) as Latesuccessional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems and 6,147 ac (2,487 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, steep topography with high-elevation ridges that separate relatively small, linear strips of suitable habitat in valley bottoms, and location at the northern limit of the subspecies range. This subunit is expected to function primarily for demographic support of the overall population and to maintain the subspecies distribution in the northernmost portion of its range. WCN–1 is located in the watersheds of the Stillaguamish, Skagit, and Nooksack rivers, and is bounded on the north by the international boundary with British Columbia, Canada. In this subunit, we have excluded lands covered under the Washington Department of Natural Resources State Lands HCP. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 92 percent of the area of WCN–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCN–2. The WCN–2 subunit consists of approximately 103,988 ac (42,083 ha) in King and Snohomish Counties, Washington, and comprises lands managed by the USFS, State of Washington, and private landowners. The USFS manages 82,316 ac (33,312 ha) as Late-successional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems and 834 ac (338 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, and steep topography with high-elevation ridges that separate relatively small, linear strips of suitable habitat in valley bottoms. This subunit has a key role in maintaining connectivity between northern spotted owl populations, both north to south in the West Cascades and west to east between the West and East Cascades units. This role is shared with the WCC–1 subunit to the south and the ECN–4 subunit to the east. This subunit is also expected to provide demographic support of the overall population. WCN–2 is located in the watersheds of the Snohomish and Cedar/Sammamish Rivers. In this subunit, we have excluded lands covered under the Washington Department of Natural Resources State Lands HCP in the final designation. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 79 percent of the area of WCN–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Unit 5: West Cascades Central (WCC) This unit contains 909,687 ac (368,136 ha) and three subunits. This region consists of the midsection of the Western Cascades Section M242B, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994a, Section M242B), extending from Snoqualmie Pass in central Washington south to the Columbia River. It is similar to the Southern Washington Cascades Province of Franklin and Dyrness (1988, pp. 21–23). We separated this region from the northern section based on differences in northern spotted owl habitat due to relatively milder temperatures, lower elevations, and greater proportion of western hemlock/ Douglas-fir forest and occurrence of noble fir (A. procera) to the south of Snoqualmie Pass. Because Douglas-fir dwarf mistletoe occurs rarely in this region, northern spotted owl nest sites are largely limited to defects in large trees, and occasionally nests of other raptors. Subunit Descriptions—Unit 5 WCC–1. The WCC–1 subunit consists of approximately 225,847 ac (91,397 ha) in King, Pierce, Thurston, Lewis, Kittitas, and Yakima Counties, Washington, and comprises lands managed by USFS and State of Washington. The USFS manages 183,884 ac (76,843 ha) as Latesuccessional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems and 35,145 ac (14,222 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, and stand conversion. This subunit is expected to provide demographic support of the overall population and to maintain demographic connectivity between the Cascade Range and the Olympic Peninsula in conjunction with subunit NCO–3. WCC–1 is located primarily in the watersheds of the Nisqually, Puyallup, White, Duwamish, and Green Rivers. In this subunit, we have excluded lands from our final critical habitat designation that are covered under the Washington Department of Natural Resources State Lands HCP, the Cedar River Watershed HCP, the Plum Creek Timber Central Cascades HCP, the West Fork Timber HCP, the Tacoma Water Green River Water Supply Operations and Watershed Protection HCP as well as other private lands from the final designation. Our evaluation of sites known to be occupied at the time of listing indicate that approximately 96 percent of the area of WCC–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCC–2. The WCC–2 subunit consists of approximately 279,445 ac (113,087 ha) in Pierce, Lewis, Cowlitz, Skamania, and Yakima Counties, Washington, and comprises lands managed by USFS, State of Washington, and private landowners. The USFS manages 92,835 ac (37,569 ha) as Late-successional Reserves to maintain functional, interactive, late-successional, and oldgrowth forest ecosystems and 88,655 ac (35,878 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest and competition with barred owls. This subunit is expected to provide demographic support of the overall population. WCC–2 is located primarily in the Cowlitz River watersheds west of the Cascade Crest and the headwaters of the Naches River watershed east of the Crest. In this subunit, we have excluded lands covered under the Washington Department of Natural Resources State Lands HCP, the West Fork Timber HCP, and the Port Blakely Tree Farms L.P. (Morton Block) SHA, Landowner Option Plan, and Cooperative Habitat Enhancement Agreement in the final critical habitat designation. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 96 percent of the area of WCC–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCC–3. The WCC–3 subunit consists of approximately 394,501 ac (159,649 ha) in Clark, Skamania, and Yakima Counties, Washington, and comprises lands managed by the USFS, the State of Washington, and private landowners. The USFS manages 242,929 ac (98,310 ha) as Late-successional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems and 122,641 ac (49,631 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, and the Columbia River as an impediment to northern spotted owl dispersal. This subunit is expected to provide demographic support of the overall population and an opportunity for demographic exchange between the WCC Unit and the WCS Unit. WCC–3 is located primarily in the watersheds of the Lewis, Wind, and White Salmon Rivers, and is bounded on the south by the Columbia River. In this subunit, we have excluded lands covered under the Washington Department of Natural Resources State Lands HCP from critical habitat designation. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 96 percent of the area of WCC–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Unit 6: West Cascades South (WCS): Unit 6 contains 1,355,198ac (548,429 ha) and contains six subunits. This unit consists of the southern portion of the Western Cascades Section M242B, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994a, Section M242B), and extends from the Columbia River south to the North Umpqua River. We separated this region from the northern section due to its relatively milder temperatures, reduced summer precipitation due to the influence of the Willamette Valley to the west, lower elevations, and greater proportion of western hemlock/Douglasfir forest. The southern portion of this region exhibits a gradient between Douglas-fir/western hemlock and increasing Klamath-like vegetation (mixed conifer/evergreen hardwoods), which continues across the Umpqua divide area. The southern boundary of this region is novel and reflects a transition to mixed-conifer forest (Franklin and Dyrness 1988, pp. 23–24, 137–143). The importance of Douglas-fir dwarf mistletoe increases to the south in this region, but most northern spotted owl nest sites are found in defective large trees, and occasionally nests of other raptors. Subunit Descriptions—Unit 6 WCS–1. The WCS–1 subunit consists of approximately 92,586 ac (37,468 ha) in Multnomah, Hood River, and Clackamas Counties, Oregon, and comprises only Federal lands managed by the BLM and the USFS under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as north-south and east-west connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 88 percent of the area of WCS–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCS–2. The WCS–2 subunit consists of approximately 150,105 ac (60,745 ha) in Clackamas, Marion, and Wasco Counties, Oregon, and comprises only Federal lands managed by the BLM and the USFS under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as north-south connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 82 percent of the area of WCS–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011 p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCS–3. The WCS–3 subunit consists of approximately 319,736 ac (129,393 ha) in Clackamas, Marion, Linn, and Lane Counties, Oregon, and comprises lands managed by the State of Oregon, the BLM, and the USFS. Of this subunit, 184 ac (75 ha) are managed by the State of Oregon primarily for recreation (Oregon Administrative Rules, Chapter 736, entire). The remaining 319,552 ac (129,318 ha) are Federal lands managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as north-south connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 85 percent of the area of WCS–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCS–4. The WCS–4 subunit consists of approximately 379,130 ac (153,429 ha) in Lane and Douglas Counties, Oregon, and comprises only Federal lands managed by the BLM and the USFS under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as north-south connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 86 percent of the area of WCS–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCS–5. The WCS–5 subunit consists of approximately 356,415 ac (144,236 ha) in Lane and Douglas Counties, Oregon, and comprises only Federal lands managed by the USFS under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as north-south and east-west connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 83 percent of the area of WCS–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. WCS–6. The WCS–6 subunit consists of approximately 99,558 ac (40,290 ha) in Lane, Klamath, and Douglas Counties, Oregon, and is managed by the BLM and the USFS as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest and competition with barred owls. This subunit is expected to function primarily for east-west connectivity between subunits and critical habitat units, and between the Oregon coast and the western Cascades. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 97 percent of the area of WCS–6 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Unit 7: East Cascades North (ECN): Unit 7 contains 1,345,523ac (557,002 ha) and nine subunits. This unit consists of the eastern slopes of the Cascade range, extending from the Canadian border south to the Deschutes National Forest near Bend, OR. Terrain in portions of this region is glaciated and steeply dissected. This region is characterized by a continental climate (cold, snowy winters and dry summers). High-frequency, low-intensity fire regimes occur at lower elevations, mid elevations have mixed-severity regimes, and high elevations have high-severity regimes. Increased precipitation from marine air passing east through Snoqualmie Pass and the Columbia River has resulted in an increase of moist forest conditions in this region (Hessburg et al. 2000b, p. 165). In Washington, ponderosa pine and Douglas-fir forest are dominant at low elevations, Douglas-fir/grand fir mixedconifer forest are characteristic of midelevations, and higher elevations support forests of silver fir, hemlock, and subalpine fir. The terrain is highly dissected and mountainous. The terrain and ecology are different on the southern portion of the unit, where ponderosa pine predominates on flat terrain at low elevations, and owl habitat is restricted to buttes and the slopes of the Cascade Range in forests of Douglas-fir, grand/white fir, and true firs. There is substantially less habitat in the Deschutes area of Oregon compared to the area north of Sisters, Oregon, and into Washington. The bulk of owls in this Unit are in Washington. Forest composition, particularly the presence of grand fir and western larch, distinguishes this modeling region from the southern section of the eastern Cascades. While ponderosa pine forest dominates lower and middle elevations in both this and the southern section, the northern section supports grand fir and Douglas-fir habitat at middle elevations. Dwarf mistletoe provides an important component of nesting habitat, enabling northern spotted owls to nest within stands of relatively younger and smaller trees. Subunit Descriptions—Unit 7 ECN–1. The ECN–1 subunit consists of approximately 101,661 ac (41,141 ha) in Whatcom, Skagit, and Okanogan Counties, Washington, and comprises lands managed by USFS. The USFS manages 60,173 ac (24,351 ha) as Latesuccessional Reserves to maintain functional, interactive, late-successional and old-growth forest ecosystems and 22,802 ac (9,228 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest; competition with barred owls; removal or modification of habitat by forest fires, insects, and diseases; steep topography with high-elevation ridges that separate relatively small, linear strips of suitable habitat in valley bottoms; and location at the northeastern limit of the range of the subspecies. This subunit is expected to provide demographic support of the overall population and maintain the subspecies distribution in the northeastern portion of its range. ECN– 1 is located primarily in the watershed of the Methow River and includes a small portion of the upper Skagit River watershed. It is bounded on the north by the international boundary with British Columbia, Canada. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 41 percent of the area of ECN–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–2. The ECN–2 subunit consists of approximately 60,128 ac (24,333 ha) in Chelan County, Washington, and comprises lands managed by USFS. The USFS manages 35,835 ac (14,502 ha) as Late-successional Reserves to maintain functional, interactive, late-successional and old-growth forest ecosystems and 17,545 ac (7,100 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest; competition with barred owls; steep topography with high-elevation ridges that separate relatively small, linear strips of suitable habitat in valley bottoms; the combination of Lake Chelan and the Sawtooth Mountains acting as a barrier to dispersal; and removal or modification of habitat by forest fires, insects, and diseases. This subunit is expected to provide demographic support of the overall population. ECN– 2 is located primarily in the watersheds of the Chelan and Entiat Rivers. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 34 percent of the area of ECN–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–3. The ECN–3 subunit consists of approximately 301,219 ac (121,899 ha) in Chelan County, Washington, and comprises lands managed by the USFS and private landowners. The USFS manages 187,103 ac (75,718 ha) as Latesuccessional Reserves to maintain functional, interactive, late-successional and old-growth forest ecosystems and 114,117 ac (46,181 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, and removal or modification of habitat by forest fires, insects, and diseases. This subunit is expected to provide demographic support of the overall population. ECN– 3 is located primarily in the watershed of the Wenatchee River. In this subunit, we have excluded private lands and lands covered under the Washington Department of Natural Resources State Lands HCP. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 71 percent of the area of ECN–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–4. The ECN–4 subunit consists of approximately 222,818 ac (90,171 ha) in Kittitas County, Washington, and comprises lands managed by the USFS and the State of Washington. The USFS manages 99,641 ac (40,323 ha) as Latesuccessional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems and 118,676 ac (48,027 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. The Washington Department of Fish and Wildlife manages 4,498 ac (1,820 ha). Threats in this subunit include current and past timber harvest, competition with barred owls, and removal or modification of habitat by forest fires, insects, and diseases. This subunit is expected to provide demographic support of the overall population. This subunit also has a key role in maintaining connectivity between northern spotted owl populations, both north to south in the East Cascades North Unit and west to east between the West and East Cascades units. This role is shared with the WCN–2 subunit and the WCC–1 subunit to the west. ECN–4 is located primarily in the Upper Yakima River watershed. In this subunit, we have excluded private lands and lands covered under the Washington Department of Natural Resources State Lands HCP and the Plum Creek Timber Central Cascades HCP. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 78 percent of the area of ECN–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–5. The ECN–5 subunit consists of approximately 201,108 ac (81,415 ha) in Kittitas and Yakima Counties, Washington, and comprises lands managed by the USFS and the State of Washington. The USFS manages 115,289 ac (46,656 ha) as Latesuccessional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems and 83,849 ac (33,933 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, and removal or modification of habitat by forest fires, insects, and diseases. This subunit is expected to provide demographic support of the overall population. ECN–5 is located primarily in the watershed of the Naches River. In this subunit, we have excluded from final critical habitat designation lands covered under the Washington Department of Natural Resources State Lands HCP, the Plum Creek Timber Central Cascades HCP, and private lands. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 85 percent of the area of ECN–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–6. The ECN–6 subunit consists of approximately 81,852 ac (33,124 ha) in Skamania, Yakima, and Klickitat Counties, Washington, and comprises lands managed by the USFS and the State of Washington. The USFS manages 32,400 ac (13,112 ha) as Latesuccessional Reserves to maintain functional, interactive, latesuccessional, and old-growth forest ecosystems; and 49,452 ac (20,012 ha) under the matrix land use allocation where multiple uses occur, including most timber harvest and other silvicultural activities. Threats in this subunit include current and past timber harvest, competition with barred owls, and the Columbia River as an impediment to northern spotted owl dispersal. This subunit is expected to provide demographic support of the overall population. ECN–6 is located primarily in the watersheds of the Klickitat and White Salmon Rivers, and is bounded on the south by the Columbia River. In this subunit, we have excluded lands covered under the Washington Department of Natural Resources State Lands HCP as well as private lands from the final designation. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 88 percent of the area of ECN–6 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–7. The ECN–7 subunit consists of approximately 139,983 ac (56,649 ha) in Hood River and Wasco Counties, Oregon, and comprises only Federal lands managed by the USFS under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest, removal or modification of habitat by forest fires and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as northsouth and east-west connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that nearly 100 percent of the area of ECN–7 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–8. The ECN–8 subunit consists of approximately 94,622 ac

(38,292 ha) in Jefferson and Deschutes Counties, Oregon, of Federal lands managed by the USFS under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as northsouth connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicate that approximately 61 percent of the area of ECN–8 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECN–9. The ECN–9 subunit consists of approximately 155,434 ac (62,902 ha) in Deschutes and Klamath Counties, Oregon, and comprises only Federal lands managed by the USFS under the NWFP (USDA and USDI 1994). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as north-south connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 45 percent of the area of ECN–9 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Unit 8: East Cascades South (ECS): Unit 8 contains 368,381 ac (149,078 ha) and three subunits. This unit incorporates the Southern Cascades Ecological Section M261D, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994c, Section M261D) and the eastern slopes of the Cascades from the Crescent Ranger District of the Deschutes National Forest south to the Shasta area. Topography is gentler and less dissected than the glaciated northern section of the eastern Cascades. A large expanse of recent volcanic soils (pumice region) (Franklin and Dyrness 1988, pp. 25–26), large areas of lodgepole pine, and increasing presence of red fir (Abies magnifica) and white fir (and decreasing grand fir) along a south-trending gradient further supported separation of this region from the northern portion of the eastern Cascades. This region is characterized by a continental climate (cold, snowy winters and dry summers) and a highfrequency/low-mixed severity fire regime. Ponderosa pine is a dominant forest type at mid-to-lower elevations, with a narrow band of Douglas-fir and white fir at middle elevations providing the majority of northern spotted owl habitat. Dwarf mistletoe provides an important component of nesting habitat, enabling northern spotted owls to nest within stands of relatively younger, smaller trees. Subunit Descriptions—Unit 8 ECS–1. The ECS–1 subunit consists of approximately 127,801 ac (51,719 ha) in Klamath, Jackson, and Douglas Counties, Oregon, and comprises lands managed by the BLM and the USFS. Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as northsouth and east-west connectivity between subunits and critical habitat units. This subunit is adjacent to ECS– 2 to the south. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 78 percent of the area of ECS–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECS–2. The ECS–2 subunit consists of approximately 66,086 ac (26,744 ha) in Klamath and Jackson Counties, Oregon, and Siskiyou County, California, all of which are Federal lands managed by the BLM and USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for north-south connectivity between subunits, but also for demographic support in this area of sparse Federal land and sparse highquality nesting habitat. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 77 percent of the area of ECS–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ECS–3. The ECS–3 subunit consists of approximately 112,179 ac (45,397 ha) in Siskiyou County, California, all of which are Federal lands managed by the USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. The function of this subunit is to provide demographic support in this area of sparsely distributed high-quality habitat and Federal land, and to provide for population connectivity between subunits to the north and south. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 69 percent of the area of ECS–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider a large part of this subunit to have been occupied at the time of listing. There are some areas of younger forest in this subunit that may have been unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat in this subunit is especially important for providing essential connectivity between currently occupied areas to support the successful dispersal of northern spotted owls, and may also help to buffer northern spotted owls from competition with the barred owl.

Unit 9: Klamath West (KLW): Unit 9 contains 1,197,389 ac (484,565 ha) and nine subunits. This unit consists of the western portion of the Klamath Mountains Ecological Section M261A, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994c, Section M261A). A long northsouth trending system of mountains (particularly South Fork Mountain) creates a rainshadow effect that separates this region from more mesic conditions to the west. This region is characterized by very high climatic and vegetative diversity resulting from steep gradients of elevation, dissected topography, and the influence of marine air (relatively high potential precipitation). These conditions support a highly diverse mix of mesic forest communities such as Pacific Douglas-fir, Douglas-fir tanoak, and mixed evergreen forest interspersed with more xeric forest types. Overall, the distribution of tanoak is a dominant factor distinguishing the Western Klamath Region. Douglas-fir dwarf mistletoe is uncommon and seldom used for nesting platforms by northern spotted owls. The prey base of northern spotted owls within the Western Klamath is diverse, but dominated by woodrats and flying squirrels. Subunit Descriptions—Unit 9 KLW–1. The KLW–1 subunit consists of approximately 147,326 ac (59,621 ha) in Douglas, Josephine, Curry, and Coos Counties, Oregon, and comprises lands managed by the State of Oregon and the BLM. Of this subunit 7,682 ac (3,109 ha) are managed by the State of Oregon for multiple uses including timber revenue production, recreation, and wildlife habitat according to the Southwest Oregon State Forests Management Plan (ODF 2010b, entire). Federal lands comprise 139,644 ac (56,512 ha) and are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support to the overall population and for north-south and eastwest connectivity between subunits and critical habitat units. This subunit sits at the western edge of an important connectivity corridor between coastal Oregon and the western Cascades. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 96 percent of the area of KLW–1was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–2. The KLW–2 subunit consists of approximately 148,929 ac (60,674 ha) in Josephine, Curry, and Coos Counties, Oregon, and comprises lands managed by the USFS and the BLM as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support to the overall population and for north-south and east-west connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 71 percent of the area of KLW–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–3. The KLW–3 subunit consists of approximately 143,862 ac (58,219 ha) in Josephine, Curry, and Coos Counties, Oregon, and comprises lands managed by the USFS, the BLM and the State of Oregon. There are 142,982 ac (57,863 ha) of Federal lands managed as directed by the NWFP (USDA and USDI 1994, entire). The 880 ac (356 ha) of State of Oregon lands are managed according to the Southwest Oregon State Forests Management Plan (ODF 2010b, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support to the overall population and for north-south connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 88 percent of the area of KLW–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–4. The KLW–4 subunit consists of approximately 158,299 ac (64,061 ha) in Josephine and Jackson Counties, Oregon, and Del Norte and Siskiyou Counties, California, and comprises lands managed by the USFS and the BLM that are managed as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support to the overall population and for north-south and east-west connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 95 percent of the area of KLW–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–5. The KLW–5 subunit consists of approximately 31,085 ac (12,580 ha) in Josephine County, Oregon, and Del Norte and Siskiyou Counties, California, all of which are Federal lands managed by the BLM and USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 98 percent of the area of KLW–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–6. The KLW–6 subunit consists of approximately 117,545 ac (47,569 ha) in Del Norte, Humboldt, and Siskiyou Counties, California, all of which are Federal lands managed by the USFS as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 91 percent of the area of KLW–6 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–7. The KLW–7 subunit consists of approximately 255,779 ac (103,510 ha) in Del Norte, Humboldt, and Siskiyou Counties, California, all of which are Federal lands managed by the BLM and USFS as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential or physical features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 91 percent of the area of KLW–7 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–8. The KLW–8 subunit consists of approximately 114,287 ac (46,250 ha) in Siskiyou and Trinity Counties, California, all of which are Federal lands managed by the BLM and USFS as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 85 percent of the area of KLW–8 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLW–9. The KLW–9 subunit consists of approximately 149,656 ac (60,564 ha) in Humboldt and Trinity Counties, California, all of which are Federal lands managed by the USFS as directed by the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 89 percent of the area of KLW–9 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Unit 10: Klamath East (KLE): Unit 10 contains 1,052,731ac (426,025ha) and seven subunits. This unit consists of the eastern portion of the Klamath Mountains Ecological Section M261A, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994c, Section M261A), and portions of the Southern Cascades Ecological Section M261D in Oregon. This region is characterized by a Mediterranean climate, greatly reduced influence of marine air, and steep, dissected terrain. Franklin and Dyrness (1988, pp. 137–149) differentiate the mixed-conifer forest occurring on the ‘‘Cascade side of the Klamath from the more mesic mixed evergreen forests on the western portion (Siskiyou Mountains),’’ and Kuchler (1977) separates out the eastern Klamath based on increased occurrence of ponderosa pine. The mixed-conifer/ evergreen hardwood forest types typical of the Klamath region extend into the southern Cascades in the vicinity of Roseburg and the North Umpqua River, where they grade into the western hemlock forest typical of the Cascades. High summer temperatures and a mosaic of open forest conditions and Oregon white oak (Quercus garryana) woodlands act to influence northern spotted owl distribution in this region. Northern spotted owls occur at elevations up to 1,768 m. Dwarf mistletoe provides an important component of nesting habitat, providing additional structure and enabling northern spotted owls to occasionally nest within stands of relatively younger, small trees. Subunit Descriptions—Unit 10 KLE–1. The KLE–1 subunit consists of approximately 242,338 ac (98,071 ha) in Jackson and Douglas Counties, Oregon, and comprises Federal lands managed by the USFS and the BLM under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support to the overall population, as well as northsouth and east-west connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 84 percent of the area of KLE–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLE–2. The KLE–2 subunit consists of approximately 101,942 ac (41,255 ha) in Josephine and Douglas Counties, Oregon, and comprises Federal lands managed by the USFS and the BLM under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for east-west connectivity between subunits and critical habitat units, but also for demographic support. This subunit facilitates northern spotted owl movements between the western Cascades and coastal Oregon and the Klamath Mountains. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 92 percent of the area of KLE–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLE–3. The KLE–3 subunit consists of approximately 111,410 ac (45,086 ha) in Jackson, Josephine, and Douglas Counties, Oregon, and comprises Federal lands managed by the USFS and the BLM under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for east-west connectivity between subunits and critical habitat units, but also for demographic support. This subunit facilitates northern spotted owl movements between the western Cascades and coastal Oregon and the Klamath Mountains. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 97 percent of the area of KLE–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLE–4. The KLE–4 subunit consists of approximately 254,442 ac (102,969 ha) in Jackson, Klamath, and Douglas Counties, Oregon, and comprises Federal lands managed by the USFS and the BLM under the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for east-west connectivity between subunits and critical habitat units, but also for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 81 percent of the area of KLE–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLE–5. The KLE–5 subunit consists of approximately 38,283 ac (15,493 ha) in Jackson County, Oregon, and comprises lands managed by the BLM and USFS. The BLM and USFS lands are managed per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for north-south connectivity between subunits, but also for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 86 percent of the area of KLE–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLE–6. The KLE–6 subunit consists of approximately 167,849 ac (67,926 ha) in Jackson County, Oregon, and Siskiyou County, California, all of which are Federal lands managed by the BLM and USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for north-south connectivity between subunits, but also for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 97 percent of the area of KLE–6 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. KLE–7. The KLE–7 subunit consists of approximately 66,078 ac

(26,741 ha) in Siskiyou County, California, all of which are Federal lands managed by the BLM and USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function for demographic support and also for connectivity across the landscape. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 96 percent of the area of KLE–7 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Unit 11: Interior California Coast (ICC): Unit 11 contains 941,568 ac (381,039 ha) and eight subunits. This unit consists of the Northern California Coast Ranges ecological Section M261B, based on section descriptions of forest types from Ecological Subregions of the United States (McNab and Avers 1994c, Section M261B), and differs markedly from the adjacent redwood coast region. Marine air moderates winter climate, but precipitation is limited by rainshadow effects from steep elevational gradients (328 to 7,847 ft (100 to 2,400 m)) along a series of northsouth trending mountain ridges. Due to the influence of the adjacent Central Valley, summer temperatures in the interior portions of this region are among the highest within the northern spotted owl’s range. Forest communities tend to be relatively dry mixed-conifer, blue and Oregon white oak, and the Douglas-fir tanoak series. Northern spotted owl habitat within this region is poorly known; there are no Demographic Study Areas (DSAs—areas within forested habitats specifically surveyed to determine northern spotted owl occupation and density), and few studies have been conducted here. Northern spotted owl habitat and occupancy data obtained during this project suggests that some northern spotted owls occupy steep canyons dominated by live oak and Douglas-fir. The distribution of dense conifer habitats most suitable for the northern spotted owl is limited to higher elevations on the Mendocino National Forest. Subunit Descriptions—Unit 11 ICC–1. The ICC–1 subunit consists of approximately 332,042 ac (134,372 ha) in Humboldt, Trinity, Shasta, and Tehama Counties, California, all of which are Federal lands managed by the BLM and the USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support, but also for connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 97 percent of the area of ICC–1 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–2. The ICC–2 subunit consists of approximately 204,400 ac (82,718 ha) in Humboldt and Trinity Counties, California, all of which are Federal lands managed by the BLM and the USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support, but also for connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 98 percent of the area of ICC–2 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–3. The ICC–3 subunit consists of approximately 103,971 ac (42,035 ha) in Trinity, Tehama, and Mendocino Counties, California, all of which are Federal lands managed by the BLM and the USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support, but also for north-south connectivity between subunits. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 89 percent of the area of ICC–3 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–4. The ICC–4 subunit consists of approximately 120,997 ac (48,966 ha) in Mendocino, Glenn, and Colusa Counties, California, all of which are Federal lands managed by the BLM and USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 93 percent of the area of ICC–4 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–5. The ICC–5 subunit consists of approximately 34,957 ac (14,147 ha) in Lake and Mendocino Counties, California, all of which are Federal lands managed by the USFS and BLM per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function primarily for demographic support, but also for connectivity between subunits and critical habitat units. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 78 percent of the area of ICC–5 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–6. The ICC–6 subunit consists of approximately 2,072 ac (839 ha) of State and Federal lands in Napa and Sonoma Counties, California. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 90 percent of the area of ICC–6 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–7. The ICC–7 subunit consists of approximately 119,742 ac (48,458 ha) in Trinity and Shasta Counties, California, all of which are Federal lands managed by the BLM and USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats to the essential physical or biological features from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function both for demographic support and for east-west connectivity between subunits in an area of sparse Federal ownership. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 73 percent of the area of ICC–7 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl. ICC–8. The ICC–8 subunit consists of approximately 83,376 ac (33,742 ha) in Siskiyou and Shasta Counties, California, all of which are Federal lands managed by the BLM and the USFS per the NWFP (USDA and USDI 1994, entire). Special management considerations or protection are required in this subunit to address threats from current and past timber harvest, losses due to wildfire and the effects on vegetation from fire exclusion, and competition with barred owls. This subunit is expected to function both for demographic support and for connectivity between subunits in an area of sparse Federal ownership. Our evaluation of sites known to be occupied at the time of listing indicates that approximately 84 percent of the area of ICC–8 was covered by verified northern spotted owl home ranges at the time of listing. When combined with likely occupancy of suitable habitat and occupancy by nonterritorial owls and dispersing subadults, we consider this subunit to have been largely occupied at the time of listing. In addition, there may be some smaller areas of younger forest within the habitat mosaic of this subunit that were unoccupied at the time of listing. We have determined that all of the unoccupied and likely occupied areas in this subunit are essential for the conservation of the species to meet the recovery criterion that calls for the continued maintenance and recruitment of northern spotted owl habitat (USFWS 2011, p. ix). The increase and enhancement of northern spotted owl habitat is necessary to provide for viable populations of northern spotted owls over the long term by providing for population growth, successful dispersal, and buffering from competition with the barred owl.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for the States of Washington, Oregon, and California. Critical habitat for the northern spotted owl includes the following four primary constituent elements. Each critical habitat unit must include primary constituent element 1 and primary constituent element 2, 3, or 4:

(i) Primary constituent element 1: Forest types that may be in early-, mid-, or late-seral stages and that support the northern spotted owl across its geographical range. These forest types are primarily: (A) Sitka spruce; (B) Western hemlock; (C) Mixed conifer and mixed evergreen; (D) Grand fir; (E) Pacific silver fir; (F) Douglas-fir; (G) White fir; (H) Shasta red fir; (I) Redwood/Douglas-fir (in coastal California and southwestern Oregon); and (J) The moist end of the ponderosa pine coniferous forest zones at elevations up to approximately 3,000 ft (900 m) near the northern edge of the range and up to approximately 6,000 ft (1,800 m) at the southern edge.

(ii) Primary constituent element 2: Habitat that provides for nesting and roosting. In many cases the same habitat also provides for foraging (primary constituent element (3)). Nesting and roosting habitat provides structural features for nesting, protection from adverse weather conditions, and cover to reduce predation risks for adults and young. This primary constituent element is found throughout the geographical range of the northern spotted owl, because stand structures at nest sites tend to vary little across the northern spotted owl's range. These habitats must provide: (A) Sufficient foraging habitat to meet the home range needs of territorial pairs of northern spotted owls throughout the year; and (B) Stands for nesting and roosting that are generally characterized by: (1) Moderate to high canopy cover (60 to over 80 percent). (2) Multilayered, multispecies canopies with large (20–30 inches (in) (51–76 centimeters (cm)) or greater diameter at breast height (dbh)) overstory trees. (3) High basal area (greater than 240 ft2/acre; 55 m2/ha). (4) High diversity of different diameters of trees. (5) High incidence of large live trees with various deformities (e.g., large cavities, broken tops, mistletoe infections, and other evidence of decadence). (6) Large snags and large accumulations of fallen trees and other woody debris on the ground. (7) Sufficient open space below the canopy for northern spotted owls to fly.

(iii) Primary constituent element 3: Habitat that provides for foraging, which varies widely across the northern spotted owl's range, in accordance with ecological conditions and disturbance regimes that influence vegetation structure and prey species distributions. Across most of the owl's range, nesting and roosting habitat is also foraging habitat, but in some regions northern spotted owls may additionally use other habitat types for foraging as well. The foraging habitat PCEs for the four ecological zones within the geographical range of the northern spotted owl are generally the following: (A) West Cascades/Coast Ranges of Oregon and Washington. (1) Stands of nesting and roosting habitat; additionally, owls may use younger forests with some structural characteristics (legacy features) of old forests, hardwood forest patches, and edges between old forest and hardwoods. (2) Moderate to high canopy cover (60 to over 80 percent). (3) A diversity of tree diameters and heights. (4) Increasing density of trees greater than or equal to 31 in (80 cm) dbh increases foraging habitat quality (especially above 12 trees per ac (30 trees per ha)). (5) Increasing density of trees 20 to 31 in (51 to 80 cm) dbh increases foraging habitat quality (especially above 24 trees per ac (60 trees per ha)). (6) Increasing snag basal area, snag volume (the product of snag diameter, height, estimated top diameter, and including a taper function), and density of snags greater than 20 in (50 cm) dbh all contribute to increasing foraging habitat quality, especially above 10 snags/ha. (7) Large accumulations of fallen trees and other woody debris on the ground. (8) Sufficient open space below the canopy for northern spotted owls to fly. (B) East Cascades. (1) Stands of nesting and roosting habitat. (2) Stands composed of Douglas-fir and white fir/Douglas-fir mix. (3) Mean tree size (quadratic mean diameter greater than 16.5 in (42 cm)). (4) Increasing density of large trees (greater than 26 in (66 cm)) and increasing basal area (the cross-sectional area of tree boles measured at breast height), which increases foraging habitat quality. (5) Large accumulations of fallen trees and other woody debris on the ground. (6) Sufficient open space below the canopy for northern spotted owls to fly. (C) Klamath and Northern California Interior Coast Ranges. (1) Stands of nesting and roosting habitat; in addition, other forest types with mature and old-forest characteristics. (2) Presence of conifer species such as incense-cedar, sugar pine, and Douglasfir and hardwood species such as bigleaf maple, black oak, live oaks, and madrone, as well as shrubs. (3) Forest patches within riparian zones of low-order streams and edges between conifer and hardwood forest stands. (4) Brushy openings and dense young stands or low-density forest patches within a mosaic of mature and older forest habitat. (5) High canopy cover (87 percent at frequently used sites). (6) Multiple canopy layers. (7) Mean stand diameter greater than 21 in (52.5 cm). (8) Increasing mean stand diameter and densities of trees greater than 26 in (66 cm) increases foraging habitat quality. (9) Large accumulations of fallen trees and other woody debris on the ground. (10) Sufficient open space below the canopy for northern spotted owls to fly. (D) Redwood Coast. (1) Nesting and roosting habitat; in addition, stands composed of hardwood tree species, particularly tanoak. (2) Early-seral habitats 6 to 20 years old with dense shrub and hardwood cover and abundant woody debris; these habitats produce prey, and must occur in conjunction with nesting, roosting, or foraging habitat. (3) Increasing density of small-tomedium sized trees (10 to 22 in; 25 to 56 cm), which increases foraging habitat quality. (4) Trees greater than 26 in (66 cm) in diameter or greater than 41 years of age. (5) Sufficient open space below the canopy for northern spotted owls to fly.

(iv) Primary constituent element 4: Habitat to support the transience and colonization phases of dispersal, which in all cases would optimally be composed of nesting, roosting, or foraging habitat (PCEs 2 or 3), but which may also be composed of other forest types that occur between larger blocks of nesting, roosting, and foraging habitat. In cases where nesting, roosting, or foraging habitats are insufficient to provide for dispersing or nonbreeding owls, the specific dispersal habitat PCEs for the northern spotted owl may be provided by the following: (A) Habitat supporting the transience phase of dispersal, which includes: (1) Stands with adequate tree size and canopy cover to provide protection from avian predators and minimal foraging opportunities; in general this may include, but is not limited to, trees with at least 11 in (28 cm) dbh and a minimum 40 percent canopy cover; and (2) Younger and less diverse forest stands than foraging habitat, such as even-aged, pole-sized stands, if such stands contain some roosting structures and foraging habitat to allow for temporary resting and feeding during the transience phase. (B) Habitat supporting the colonization phase of dispersal, which is generally equivalent to nesting, roosting and foraging habitat as described in PCEs 2 and 3, but may be smaller in area than that needed to support nesting pairs.

Special Management Considerations or Protections

Critical habitat does not include: (i) manmade structures (such as buildings, aqueducts, runways, roads, other paved areas, or surface mine sites) and the land on which they are located; and (ii) meadows, grasslands, oak woodlands, or aspen woodlands as described below existing on January 3, 2013 and not containing primary constituent elements 1 and 2, 3, or 4 as described in paragraph (2) of this entry. (A) Meadows and grasslands include: dry, upland prairies and savannas in valleys and foothills of western Washington, Oregon, and northwest California; subalpine meadows; and grass and forb dominated cliffs, bluffs and grass balds found throughout these same areas. These areas are dominated by native grasses and diverse forbs, and may include a minor savanna component of Oregon white oak, Douglas-fir, or Ponderosa pine. (B) Oak woodlands are characterized by an open canopy dominated by Oregon white oak. These areas may also include ponderosa pine, California black oak, Douglas-fir, or canyon live oak. The understory is relatively open with shrubs, grasses and wildflowers. Oak woodlands are typically found in drier landscapes and on south-facing slopes. This exception for oak woodlands does not include tanoak (Notholithocarpus densiflorus) stands, closed-canopy live oak (Quercus agrifolia) woodlands and open-canopied valley oak (Quercus lobata) and mixedoak woodlands in subunits ICC–6 and RDC–5 in Napa, Sonoma, and Marin Counties, California. (C) Aspen (Populus spp.)

woodlands are dominated by aspen trees with a forb, grass or shrub understory and are typically found on mountain slopes, rock outcrops and talus slopes, canyon walls, and some seeps and stream corridors. This forest type also can occur in riparian areas or in moist microsites within drier landscapes.

An effective critical habitat strategy needs to conserve extant, high-quality northern spotted owl habitat in order to reverse declining population trends and address the threat from barred owls. The northern spotted owl was initially listed as a threatened species due largely to both historical and ongoing habitat loss and degradation. The recovery of the northern spotted owl therefore requires both protection of habitat and management where necessary to provide sufficient high-quality habitat to allow for population growth and to provide a buffer against threats such as competition with the barred owl.

Each of the areas occupied at the time of listing that is designated as critical habitat contains features essential to the conservation of the species that may require special management considerations or protection to ensure the conservation of the northern spotted owl. These special management considerations or protection may be required to preserve and enhance the essential features needed to achieve the conservation of the northern spotted owl.

Special management considerations or protection may be required in areas of moist forests to conserve or protect older stands that contain the conditions to support northern spotted owl occupancy (RA10: USFWS 2011, p. 43) or contain high-value northern spotted owl habitat (RA32: USFWS 2011, p. 67). Special management considerations or protection may be required in the East Cascades to address the effects of past activities associated with EuroAmerican settlement, such as timber harvest, livestock grazing, fire suppression, and fire exclusion, that have substantially altered the inland northwest, modifying the patterns of vegetation and fuels, and subsequent disturbance regimes to the degree that contemporary landscapes no longer function as they did historically (Hessburg et al. 2000a, pp. 74–81; Hessburg and Agee 2003, pp. 44–46; Hessburg et al. 2005, pp. 134–135; Skinner et al. 2006, pp. 178–179; Skinner and Taylor 2006, pp. 201–203; Miller et al. 2009, p. 30; Stephens et al. 2009, pp. 316–318; Stephens et al. 2012b, p. 554; Fontaine and Kennedy 2012, p. 1559; Chmura et al. 2011, p. 1134). The special management considerations or protections that may be required in the Klamath and Northern California Interior Coast Ranges represent a mix of the requirements needed to maintain or enhance the essential physical or biological features in mesic and dry forest types. Special management considerations or protection may be needed in the Redwood Coast Zone to maintain or enhance the essential physical or biological features for the owl.

Life History

Feeding Narrative

Adult: The northern spotted owl is a carnivore; it consumes various arboreal and semi-arboreal small mammals, birds, and, rarely, reptiles and amphibians. Habitat plays an important role in resource availability and prey selection. Dense canopy closure (60 to 90 percent), access to water, a mosaic of suitable old-growth tree structure, and an absence of human disturbance are key aspects of suitable forage habitat. At higher latitudes, flying squirrels (Glaucomys sabrinus) are consumed more than at lower latitudes, where woodrats (Neotoma sp.) are more frequently consumed. The northern spotted owl roosts during the day and has crepuscular feeding habits. However, it may forage opportunistically during the day, leaving its roost temporarily to feed

(NatureServe 2015). The direct competition between the northern spotted owl and the barred owl (various studies strongly suggest that barred owls compete with northern spotted owls for nesting sites, roosting sites, and food; and that they possibly also predate northern spotted owls) has been a critical factor in the decline of the species throughout its historic range (USFWS 2015).The northern spotted owl has a fast growth rate, reaching full growth and sexual maturity at 1 year (NatureServe 2015).

Reproduction Narrative

Adult: Northern spotted owls reach sexual maturity at 1 year old; however, it is rare for them to take on a mate until between 2 and 5 years of age. They are monogamous and oviparous. Pre-laying and courtship behaviors take place from February to early spring, and include preening and roosting together. The northern spotted owl chooses a nesting site with high- quality tree canopy coverage, and nests inside of a hollowed tree cavity (naturally deformed and/or diseased trees) in deep, old-growth forest. In addition to natural tree cavities, cliff ledges, stick platforms (often the abandoned nest of hawk or mammal), and sometimes caves may be used for nesting. Pairs tend to occupy the same nesting territories in successive years, as long as surrounding forage and roosting habitat remains suitable. The breeding season occurs from early spring to late summer, although it may vary with geographic location and elevation. Most northern spotted owl pairs do not attempt to nest every year; when they do attempt to nest, nesting pairs are not necessarily successful every year. If successful, the owl pairs reproduce one per year and produce between one to four eggs per clutch (usually two). The incubation period of the northern spotted owl egg is 30 days, during which the female relies on the male for food. After the eggs are hatched, the male and female show high levels of parental care, feeding and protecting the juveniles until they are able to fly and hunt on their own (fledging occurs in June) and disperse from the area (which can extend into September). The sex ratio of northern spotted owls is 1:1. The reported species longevity ranges from 15 to 17 years in the wild and up to 20 years in captivity. The availability of resources and suitable old-growth habitat are important factors for nest success. Small clutch size, temporal variability in nesting success, and delayed onset of breeding all contribute to the relatively low fecundity of this species (NatureServe 2015; USFWS 2015).

Geographic or Habitat Restraints or Barriers

Adult: Separation from suitable habitat (via large bodies of water, mountain ranges, and areas of unforested lands), and removal or modification of habitat by forest fires, insects, and diseases (77 FR 71876).

Spatial Arrangements of the Population

Adult: Clumped according to resources; population size and density are relatively low at the northern and southern ends of the range (NatureServe 2015).

Environmental Specificity

Adult: Narrow, with key requirements.

Site Fidelity

Adult: High; pairs tend to occupy the same nesting territories in successive years, as long as surrounding forage and roosting habitat remains suitable (NatureServe 2015).

Dependency on Other Individuals or Species for Habitat

Adult: Mating pairs depend on one another to defend territory; the males call through the night to ward off potential threats (USFWS 2015).

Habitat Narrative

Adult: Northern spotted owls occupy forests in western North America, from British Columbia to Marin County, California (USFWS 2015). Northern spotted owls live in and require mixed-conifer forests, Douglas fir (Pseudotsuga menziesii), and redwoods (Sequoia sempervirens) with high canopy closure, dense overstory, old-growth trees with large cavities for nesting, and dense leaf litter that support prey species. These multilayered, multispecies forests are rich with large snags and woody debris, and have open space below canopy for foraging (NatureServe 2015). Heterogeneous habitat (a multi-species mosaic of older forest interspersed with vegetation of varying age) has been noted to result in high fitness for northern spotted owls, with tall overstory canopy cover and sparse understory being important for flight, thermal cover, protection from predators, and foraging (by providing more varied prey habitat) (USFWS 2011; USFWS 2015). Northern spotted owls live in a cooler climate that receives moderate yearly precipitation.Breeding pairs tend to occupy the same nesting territories in successive years, as long as surrounding forage and roosting habitat remains suitable (NatureServe 2015). Mating pairs depend on one another to defend territory; the males call through the night to ward off potential threats (USFWS 2015). The species is restricted or separated from suitable habitat by large bodies of water; mountain ranges; areas of unforested lands; and removal or modification of habitat by forest fires, insects, and diseases (77 FR 71876). Population densities are relatively low at the northern and southern ends of the range (NatureServe 2015).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Moderate

Immigration/Emigration

Adult: Immigrates/emigrates.

Dependency on Other Individuals or Species for Dispersal

Adult: None

Dispersal/Migration Narrative

Adult: The adult northern spotted owl maintains a territory year-round; however, individuals shift their home ranges based on natal and breeding dispersal (occurring between the breeding [February through September] and nonbreeding seasons) (55 FR 26114). Dispersal of juveniles from natal sites typically begins in September and October, and may continue through November and December. Juvenile dispersal occurs in stages, with juveniles settling for up to 7 months at (potentially multiple) temporary locations between larger-distance movements and final establishment of adult territory. The median natal dispersal distance from fledging to "permanent" settlement is about 16 km (10 mi.) for males and 25 km (15.5 mi.) for females. Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies. Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (USFWS 2011).Contiguous habitat is a key resource for the subspecies. They require dense cover for camouflage during foraging, and protection from predators. Dispersal habitat, at a minimum, consists of stands with adequate tree size and canopy closure to provide protection from avian predators, and at least minimal foraging opportunities. Northern spotted owls can disperse through highly fragmented forest landscapes, but the stand-level and landscape-level attributes of forests needed to facilitate successful dispersal have not yet been thoroughly evaluated. Therefore, a more complete description of dispersal habitat may be determined in the future. There is little evidence that small openings in forest habitat influence the dispersal of spotted owls, but large, nonforested areas apparently are barriers to both natal and breeding dispersal. The degree to which water bodies such as the Columbia River and Puget Sound function as barriers to dispersal is unclear, although radio telemetry data indicate that spotted owls move around large water bodies rather than cross them (USFWS 2011).

Additional Life History Information

Adult: The adult northern spotted owl maintains a territory year-round; however, individuals shift their home ranges based on juvenile and breeding dispersal (occurring between the breeding [February through September] and nonbreeding seasons). A "floater" population comprises subadults and adult owls who have not secured territories (55 FR 26114). Dispersal of juveniles from natal sites typically begins in September and October, and may continue through November and December. Juvenile dispersal occurs in stages, with juveniles settling for up to 7 months at (potentially multiple) temporary locations between larger-distance movements and final establishment of adult territory. The median natal dispersal distance from fledging to "permanent" settlement is about 16 kilometers (km) (10 miles [mi.]) for males and 25 km (15.5 mi.) for females. Dispersing juvenile spotted owls experience high mortality rates, exceeding 70 percent in some studies. Known or suspected causes of mortality during dispersal include starvation, predation, and accidents (USFWS 2011).

Population Information and Trends

Population Trends:

Declining (USFWS 2015). Of 11 long-term demographic monitoring areas, seven are experiencing declines in population and four are experiencing stable population demographics (USFWS 2011).

Species Trends:

Declining (USFWS 2015). Short-term trend: decline of 10 to 30 percent. Long-term trend: decline of 30 to 70 percent (NatureServe 2015).

Resiliency:

Low

Representation:

Low

Redundancy:

Moderate

Population Growth Rate:

Declining; these declines are probably largely due to declines in apparent adult survival rates (USFWS 2015)

Number of Populations:

There are 12 physiographic provinces, based on recognized landscape subdivisions exhibiting different physical and environmental features (USFWS 2011).

Population Size:

Estimated 2,500 to 100,000 individuals (NatureServe 2015). Existing survey coverage and efforts are insufficient to produce reliable range-wide estimates of northern spotted owl population size, so demographic data are used to evaluate trends in spotted owl populations (USFWS 2011).

Resistance to Disease:

Unknown; at this time, no avian diseases are significantly affecting spotted owls. It is unknown whether avian diseases such as West Nile virus, avian flu, or avian malaria will significantly affect spotted owls. Parasitic infection may contribute to these causes of juvenile mortality, but the relationship between parasite loads and survival is poorly understood (USFWS 2011).

Adaptability:

Low

Additional Population-level Information:

Population size and density are relatively low at the northern and southern ends of the range (NatureServe 2015).

Population Narrative:

Northern spotted owl populations show a trend of decline. Of 11 long-term demographic monitoring areas, seven are experiencing declines in population and four are experiencing stable population demographics (USFWS 2011). The short-term trend is a decline of 10 to 30 percent, and the long-term trend is a decline of 30 to 70 percent (NatureServe 2015). There are 12 physiographic provinces, based on recognized landscape subdivisions exhibiting different physical and environmental features (USFWS 2011). Currently, there are four extant wild populations, in California, Oregon, Washington, and British Columbia. The exact number within these populations is unknown.The estimated population size of northern spotted owl is between 2,500 and 100,000 individuals. In the late 1980s, some 2,000 pairs were located or reconfirmed from earlier surveys; this number is an unknown fraction of the total population, which is suspected to be between 3,000 and 4,000 pairs. In the late 1980s and early 1990s a total of 3,605 pairs were located range-wide (incomplete survey): 954 pairs in California, 1,977 in Oregon, 660 in Washington, and 14 in Canada (NatureServe 2015). In 1991, the estimated British Columbia population was not more than 100 pairs. In 2002, fewer than 50 breeding pairs occurred in British Columbia. More recently (2004), British Columbia breeding populations have been estimated at fewer than 33 pairs. As of July 1, 1994, there were 5,431 known site centers of northern spotted owl pairs or resident singles: 851 sites (16 percent) in Washington, 2,893 sites (53 percent) in Oregon, and 1,687 sites (31 percent) in California. The number of currently occupied spotted owl locations across the range is unknown, because many areas remain unsurveyed. Population size and density are relatively low at the northern and southern ends of the range (NatureServe 2015). Existing survey coverage and efforts are insufficient to produce reliable range-wide estimates of northern spotted owl population size, so demographic data are used to evaluate trends in the populations (USFWS 2011).It is unknown whether avian diseases such as West Nile virus, avian flu, or avian malaria will significantly affect spotted owls. Parasitic infection may contribute to these causes of juvenile mortality, but the relationship between parasite loads and survival is poorly understood (USFWS 2011).

Threats and Stressors

Stressor: Habitat loss and fragmentation
Exposure: Timber harvest, forest clearing, and young re-planted trees.
Response: Noncontiguous habitat and increased fragmentation, with little canopy cover.
Consequence: Decline in suitable nesting habitat, causing a decrease in reproductive success.
Narrative: Habitat loss and fragmentation have been caused by timber harvest, increased edge effects due to forest clearing, and replanting of young trees. These factors have resulted in noncontiguous habitat, increased fragmentation, and stands with little canopy cover. The lack of suitable habitat leads to a decrease in reproduction (USFWS 2015).

Stressor: Increased interspecies competition for habitat and resources with Strix varia
Exposure: Competition for resources.
Response: Reduced site occupancy, reproduction, and survival.
Consequence: Death of individuals and greatly reduced populations.
Narrative: Increased interspecies competition between the barred owl (Strix varia) and the northern spotted owl (Strix occidentalis caurina) has reduced site occupancy, reproductive success, and survival of the northern spotted owl. This competition has caused the death of individuals, and has greatly reduced populations (USFWS 2015).

Stressor: Human disturbance
Exposure: Timber harvest, deforestation, heavy machinery, outdoor recreation, and hunting.
Response: Increased harvest production causes a reduction in suitable habitat.
Consequence: Low reproductive rates.
Narrative: Human disturbance such as timber harvest, deforestation, heavy machinery in forest areas, outdoor recreation, and hunting has occurred throughout the range of the northern spotted owl. This limits the dispersal of populations and decreases access to necessary resources, causing high mortality rates in the subspecies (USFWS 2015).

Stressor: Loss of genetic variation
Exposure: Geographic isolation.
Response: Increased inbreeding depression and decreased adaptive potential.
Consequence: Population bottleneck.
Narrative: Loss of genetic variation caused by geographic isolation results in population bottleneck. Increased inbreeding depression and decreased adaptive potential are a result of the owls’ inability to find suitable mates (USFWS 2011).

Recovery

Reclassification Criteria:
Reclassification criteria have not been established for this species.

Delisting Criteria:
To consider a species recovered, analysis of five listing factors must be conducted, and the threats from those factors reduced or eliminated. The five listing factors are: A. The present or threatened destruction, modification, or curtailment of the species' habitat or range; B. Overutilization for commercial, scientific, or educational purposes; C. Disease or predation; D. Inadequacy of existing regulatory mechanisms; and E. Other natural or manmade factors affecting its continued existence. There are four Recovery Criteria presented in the Revised Recovery Plan. Recovery Criteria are measurable, achievable goals that we believe will result from implementation of the recovery actions in this Revised Recovery Plan. Achievement of these criteria will take time and is intended to be measured over the life of the plan, not on a short-term basis, and should not be considered near-term recommendations. Not all recovery actions necessarily need to be implemented for the U.S. Fish and Wildlife Service (USFWS) to consider initiating the delisting process based on the statutory criteria for determining whether a species should be listed (16 United States Code § 1533[a][1]).

Stable Population Trend: The overall population trend of northern spotted owls throughout the range is stable or increasing over 10 years, as measured by a statistically reliable monitoring effort (USFWS 2011).

Adequate Population Distribution: Northern spotted owl subpopulations in each province (i.e., recovery unit) (excluding the Willamette Valley Province) achieve viability, as informed by the HexSim population model or some other appropriate quantitative measure (USFWS 2011).

Continued Maintenance and Recruitment of Spotted Owl Habitat: The future range-wide trend in spotted owl nesting/roosting and foraging habitat is stable or increasing throughout the range, from the date of Revised Recovery Plan approval, as measured by effectiveness monitoring efforts (program initiated by the Northwest Forest Plan includes tracking the status and trends of spotted owl habitat) or other reliable habitat monitoring programs. Stable or increasing trend for nesting, roosting, foraging habitat, range-wide (USFWS 2011).

Post-Delisting Monitoring: To monitor the continued stability of the recovered northern spotted owl, a post-delisting monitoring plan has been created and is ready to be implemented in Washington, Oregon, and California. Required in Section 4(g)(1) of the Endangered Species Act (USFWS 2011).

Recovery Actions:
- The Revised Recovery Plan presents 33 actions that address overall recovery through population monitoring and modeling; maintenance and restoration of spotted owl habitat; monitoring of avian diseases and predation; development and implementation of a delisting monitoring plan; and management of the barred owl. These actions are organized following the five listing factors (USFWS 2011).
- Establish population monitoring and modeling: 1) Establish USFWS spotted owl implementation structure. 2) Monitor population trends. 3) Monitor occupancy through surveys and modeling (USFWS 2011).
- Evaluation of present or threatened destruction, modification, or curtailment of the species' habitat or range: 1) Use habitat modeling framework for recovery measures. 2) USFWS to consider climate change impacts on spotted owls, and incorporate them into planning. 3)

West side: Manage to accelerate structural complexity. 4) Create Dry Cascades Work Group. 5) Fire and occupancy data analysis every 3 years. 6) Create Klamath Province Work Group. 7) Conserve spotted owl sites and high-value habitat for demographic support. 8) Design and conduct experiments concerning habitat, prey, and spotted owl fitness and thinning. 9) Post-fire management in lands for spotted owl habitat development. 10) Standardize habitat definitions every 2 years. 11) Encourage development of habitat conservation plans and safe harbor agreements that are consistent with spotted owl recovery. 12) Solicit recommendations for nonfederal landowner incentives. 13) Long-term maintenance of forest management infrastructure (USFWS 2011).

- Monitor and address avian diseases and predation (USFWS 2011).
- Evaluation of inadequacy of existing regulatory mechanisms: 1) Washington State Forest Practices Board evaluation of strategic nonfederal spotted owl contributions every 3 years. 2) Cooperate with Oregon Department of Fish and Wildlife on scientific evaluation of potential role of state and private lands, and the effectiveness of Oregon Forest Practices rules every 5 years. 3) Work with CAL FIRE on recovery role on nonfederal lands and evaluation/implementation of conservation tools every 3 years. 4) Work with CAL FIRE to provide Forest Practice Rules for spotted owls. 5) If necessary, work with the State of California on options to allow lethal control of barred owls every 4 years (USFWS 2011).
- Evaluation of other natural or manmade factors affecting its continued existence: 1) Analyze existing data sets for effects of barred owls every 5 years. 2) Establish protocols to detect barred owls every 2 years. 3) Ensure protocols adequately detect spotted owls every 3 years. 4) Analyze resource partitioning every 5 years. 5) Implement public outreach strategies. 6) Expedite permitting of experimental removals every 3 years. 7) Conduct experimental removal studies every 10 years. 8) Manage negative effects of barred owls. 9) Develop mechanisms to support barred owl management. 10) Maintain high-quality habitat across all landscapes. 11) Develop delisting monitoring plan (USFWS 2011).

Conservation Measures and Best Management Practices:

- Complete scientific evaluation of potential management options to reduce the impact of barred owls on spotted owls (USFWS 2011).
- Establishment of forest reserves on nonfederally owned lands of various sizes within the range of the northern spotted owl; some associated and adjacent to federal reserves (USFWS 2011).
- Implementation and development of forest management practices on nonfederal lands that a) stress restricted harvesting in old-growth forests or defer harvest near specific habitat locations; and b) maintain or develop nesting habitat, foraging habitat, and dispersal habitat (USFWS 2011; USFWS 2015).
- Implementation of the Northwest Forest Plan, a system of late-successional forest reserves on federal land designed to provide suitable nesting habitat over the long term (USFWS 2015).
- Compliance with 17 Habitat Conservation Plans (eight in Washington, three in Oregon, and six in California) intended to provide demographic or connectivity support (USFWS 2015).

Additional Threshold Information:

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SPECIES ACCOUNT: *Strix occidentalis lucida* (Mexican spotted owl)

Species Taxonomic and Listing Information

Listing Status: Threatened; March 16, 1993; Southwest Region (R2)

Physical Description

The Mexican spotted owl is a medium-sized owl without ear tufts. They are mottled with irregular white spots on its brown abdomen, back, and head. The Mexican spotted owl differs from the two other subspecies of spotted owls in plumage coloration; the white spots of the Mexican spotted owl are generally larger and more numerous than in the other two subspecies, giving it a lighter appearance. Wing and tail feathers are dark brown barred with lighter brown and white and, unlike most owls in North America, spotted owls have dark eyes (Gutiérrez et al. 1995). Adult male and female Mexican spotted owls are similar in plumage; however, females are larger, on average, than males. Juveniles, subadults, and adults can be distinguished by plumage characteristics (Forsman 1981, Moen et al. 1991). Juvenile owls (hatchling to approximately five months) have a downy appearance. Subadult owls (5 to approximately 26 months) closely resemble adults, but they have pointed tail feathers with a pure white terminal band (Forsman 1981, Moen et al. 1991). The tail feathers of adults (>27 months) have rounded tips, and the terminal band is mottled brown and white (Appendix B, Fig. B.3).

Taxonomy

The Mexican spotted owl is one of three subspecies of spotted owl recognized by the American Ornithologists' Union (AOU) in the last checklist to include subspecies designations (AOU 1957:285). The other two subspecies are the northern and the California spotted owls. The Mexican subspecies is geographically isolated from both the California and northern subspecies. Studies suggest that the Mexican spotted owl is also genetically isolated from the other subspecies (Barrowclough and Gutiérrez 1990; but see also Funk et al. 2008).

Historical Range

The species' range extended from the southern Rocky mountains in Colorado and the Colorado Plateau in southern Utah southward through Arizona, New Mexico, and far western Texas, through the Sierra Madre Occidental and Oriental, to the mountains at the southern end of the Mexican Plateau.

Current Range

U.S.: Arizona, Colorado, New Mexico, Texas, and Utah. Present range is thought to be similar to the historical range. Populations in Arizona are patchily distributed and occur where appropriate habitat is present throughout all but the arid southwestern portion of the state.

Distinct Population Segments Defined

No.

Critical Habitat Designated

Yes; 8/31/2004.

Legal Description

On August 31, 2004, the U.S. Fish and Wildlife Service (Service) designated critical habitat under the Endangered Species Act of 1973, as amended (Act), for the Mexican spotted owl (Strix occidentalis lucida) (owl). The owl inhabits canyon and forest habitats across a range that extends from southern Utah and Colorado, through Arizona, New Mexico, and west Texas, to the mountains of central Mexico. Approximately 3.5 million hectares (ha) (8.6 million acres (ac)) of critical habitat was designated in Arizona, Colorado, New Mexico, and Utah, on Federal lands. Section 7 of the Act requires Federal agencies to ensure that actions they authorize, fund, or carry out are not likely to destroy or adversely modify designated critical habitat (69 FR 53182 - 53298).

Critical Habitat Designation

52 units are designated as critical habitat for the owl:

Unit SRM–C–1a. Pike’s Peak Area, El Paso, Teller, and Fremont Counties, Colorado: This unit is located west of Colorado Springs on the flanks of Pike’s Peak. It contains FS (Pike Ranger District, Pike/ San Isabel National Forests) and BLM (Royal Gorge Field Office) lands in size. Areas with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with mixed-coniferous forests are included in this unit. State, private, and military lands (Cheyenne Mountain Operations Center) are not designated as critical habitat.

Unit SRM–C–1b. Wet Mountain Area, Fremont, Custer, Pueblo and Huerfano Counties, Colorado: This unit is located in the Wet Mountains, west of the City of Pueblo. It contains primarily FS lands (San Carlos District, Pike/San Isabel National Forests). Areas with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixed-coniferous forests are included in this unit. State and private lands are not designated as critical habitat.

Unit SRM–C–2. Devil’s Head Area, Douglas and Jefferson Counties, Colorado: This unit is located near Deckers within the South Platte Ranger District of the Pike/San Isabel National Forests in Colorado. It contains primarily FS lands. Areas with steep slopes (greater than 40 percent slope), canyons, rocky outcroppings with dense (greater than 70 percent canopy), and mixedconiferous forests are included in this unit. State and private lands are not designated as critical habitat.

Unit SRM–NM–1. Cebollita Mesa, Jemez Mountains, Sandoval County, New Mexico: This unit is located in the Jemez Mountains, in north-central New Mexico. It contains primarily FS (Jemez Ranger District, Santa Fe National Forests) lands. This unit contains mixed-conifer on steep slopes and canyons incised into volcanic rock. WUI project areas, State, and private lands are not designated as critical habitat.

Unit SRM–NM–4. Peralta, Jemez Mountains, Sandoval County, New Mexico: This unit is located in the Jemez Mountains, south of Los Alamos, in north-central New Mexico. It contains primarily FS (Jemez Ranger District, Santa Fe National Forests) lands. Areas with steep slopes (greater than 40 percent slope), canyons incised into volcanic rock, rocky outcroppings with dense, and mixed-coniferous forests are included in this unit. WUI project areas, State and private lands are not designated as critical habitat.

Unit SRM–NM–5a. Santa Fe National Forest, Santa Fe County, New Mexico: This unit is located approximately 9 mi (14.5 km) east of Santa Fe, New Mexico, in the Sangre de Cristo Mountains, in north-central New Mexico. It contains primarily FS lands. Areas contain attributes of owl habitat with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixedconiferous forests. WUI project areas, State and private lands are not designated as critical habitat.

Unit SRM–NM–5b. Santa Fe National Forest, San Miguel, Mora Counties, New Mexico: This unit is located approximately 18 mi (29 km) west of Las Vegas, New Mexico, in the Sangre de Cristo Mountains, in north-central New Mexico. It contains primarily FS (Pecos/ Las Vegas Ranger Districts, Santa Fe National Forests) lands. Areas contain attributes of owl habitat with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixed-coniferous forests. State and private lands are not designated as critical habitat.

Unit SRM–NM–11. Jicarilla Division, Carson National Forest, New Mexico: This unit is located approximately 40 mi (64 km) east and 12 mi (19 km) south of Bloomfield, in northwestern New Mexico. It contains primarily FS (Jicarilla Division, Carson National Forest) lands. Areas with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixed-coniferous forests are included in this unit. This unit contains mixedconifer on steep slopes and canyons incised into volcanic rock. WUI project areas, State and private lands are not designated as critical habitat.

Unit SRM–NM–12. Jicarilla Division, Carson National Forest, New Mexico: This unit is located approximately 40 mi (64 km) east and 6 mi (9.6 km) north of Bloomfield, New Mexico, in northwestern New Mexico. It contains primarily FS (Jicarilla Division, Carson National Forest) lands. Areas with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixed-coniferous forests are included in this unit. This unit contains mixed-conifer on steep slopes and canyons incised into volcanic rock. WUI project areas, State, private, and Tribal lands are not designated as critical habitat.

Unit CP–1. Mount Taylor, Cibola, and McKinley Counties, New Mexico: This unit is located approximately 12 mi (19 km) northeast of Grants, in westcentral New Mexico. It contains primarily FS (Mount Taylor Ranger District, Cibola National Forests) lands. Habitat is naturally fragmented into disjunct canyon systems or isolated mountain ranges. Areas with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixed-coniferous forests are included in this unit. This unit contains mixed-conifer and canyons habitat that contain attributes of owl habitat. State and private lands are not designated as critical habitat.

Unit CP–2. Zuni Mountains, Cibola, and McKinley Counties, New Mexico: This unit is located approximately 30 mi (48 km) southeast of Gallup, in westcentral New Mexico. It contains primarily FS (Mount Taylor Ranger District, Cibola National Forests) lands. Habitat is naturally fragmented into disjunct canyon systems or isolated mountain ranges. Areas with steep slopes (greater than 40 percent slope), canyons, and rocky outcroppings with dense, mixed-coniferous forests are included in this unit. This unit contains mixed-conifer and canyons habitat that contain attributes of owl habitat. State, private, and military lands are not designated as critical habitat.

Unit CP–10. Arizona Strip, and Kaibab National Forest, Coconino County, Arizona: This unit is located in northwestern Arizona, and is predominantly within the boundaries of Kaibab National Forest and Grand Canyon National Park. The majority of this unit contains steepwalled canyon habitat, but the unit also contains forested habitat within the North Kaibab Ranger District and Grand Canyon National Park. State, and private lands are not designated as critical habitat.

Unit CP–11. Iron, Washington, and Kane Counties, Utah: This unit is located in Iron, Washington, and Kane Counties in southwest Utah, approximately 22 mi (35 km) northeast of St. George. Canyons and steep-sloped mixed conifer habitats are included. Foraging and dispersal habitat are also present. State and private lands are not designated as critical habitat.

Unit CP–12. Kaiparowits Plateau, Kane, and Garfield Counties, Utah: This Unit is in the vicinity of the Kaiparowits Plateau and the Cockscomb, in Kane and Garfield Counties. Canyons and steep-sloped mixed conifer habitats are included. Foraging and dispersal habitat are also present. State and private lands are not designated as critical habitat.

Unit CP–13. Glen Canyon Reef, Kane, Garfield, and Wayne Counties, Utah: This unit occurs in Wayne, Garfield, Kane, and San Juan Counties, Utah. It is primarily in the Waterpocket Fold landform extending to Lake Powell. Canyons and steep-sloped mixed conifer habitats are included. Foraging and dispersal habitat are also present. State, private, and Triballands are not designated as critical habitat.

Unit CP–14. Dark Canyon Primitive and Wilderness, San Juan, Wayne, and Grand Counties, Utah: This Unit lies in Wayne, Garfield, San Juan, and Grand Counties, Utah. It includes the Dark Canyon Primitive and Wilderness areas of the BLM and FS, respectively. Canyons and steep-sloped mixed conifer habitats are included. Foraging and dispersal habitat are also present. State and privatelands are not designated as critical habitat.

Unit CP–15. West Tavaputs Plateau: This unit is located approximately 30 mi (48 km) east of Price, in Carbon and Emery Counties. Situated in the West Tavaputs Plateau, it is located largely along the Desolation Canyon area of the Green River. Canyons and steep-sloped mixed conifer habitats are included in this Unit. Foraging and dispersal habitat are also present. State and privatelands are not designated as critical habitat.

Unit BR–E–1a. White Mountain, Lincoln/Cloudcroft in Lincoln Counties, New Mexico: This unit is located in the Sacramento Mountains, New Mexico. It contains primarily Lincoln National Forests lands. Habitat includes ponderosa pine, mixed-conifer, and spruce fir forests and is patchy distributed throughout the higher mountain ranges. State and private lands are not designated as critical habitat. WUI project areas, State, private, and Tribal lands are not designated as critical habitat.

Unit BR–E–1b. Lincoln/Cloudcroft in Otero County, New Mexico This unit is located in the Sacramento Mountains, New Mexico. It contains primarily FS (Sacramento Ranger District, Lincoln National Forests) lands. Habitat includes ponderosa pine, mixed-conifer, and spruce fir forests and is patchy distributed throughout the higher mountain ranges. WUI project areas, Penasco BO project area, State, private, and Tribal lands are not designated as critical habitat.

Unit BR–E–3. Capitan Mountains: This unit is located in the Capitan Mountains, north of Capitan, New Mexico. It contains primarily FS (Smokey Bear Ranger District, Lincoln National Forest) lands. Habitat includes ponderosa pine, mixed-conifer, and spruce fir forests and is patchily distributed. State and private lands are not designated as critical habitat.

Unit BR–E–4. Carrizo in Lincoln County, New Mexico: This unit is located in the Carrizo Mountains, 7 mi (11 km) east of Carrizozo, New Mexico. It contains primarily FS (Smokey Bear Ranger District, Lincoln National Forest) lands. Habitat includes ponderosa pine, mixed-conifer, and spruce fir forests and is patchy distributed. State and private lands are not designated as critical habitat.

Unit BR–E–5. Manzano Mountains, Torrance County, New Mexico: This unit is located in the Manzano Mountains, approximately 24 mi (38.6 km) east of Belen, New Mexico. It contains primarily Cibola National Forest lands. Habitat includes ponderosa pine, mixed-conifer, and spruce fir forests and is patchily distributed. WUI project areas, State and private lands are not designated as critical habitat.

Unit BR–E–7. Sandia Mountain, New Mexico: This unit is located in the Sandia Mountains, 12 mi (19 km) east of Albuquerque, New Mexico. It contains primarily Cibola National Forest lands. Habitat includes ponderosa pine, mixed-conifer, and spruce fir forests and is patchy distributed. WUI project areas, State and private lands are not designated as critical habitat.

Unit BR–W–2. Prescott National Forest, Yavapai County, Arizona: This unit is located south of Prescott, Arizona, on the Prescott National Forest. The northwestern arm of the unit encompasses the area south of Iron Springs and runs south to near Mount Francis. The area located due south of Prescott, Arizona, encompasses Maverick and Lookout Mountains to the west, and stretches east, just beyond the Gila-Salt Meridian. The southernmost portion of this unit includes part of Crooks Canyon. WUI project areas, State and private lands are not designated as critical habitat.

Unit BR–W–3. Prescott National Forest, Yavapai County, Arizona: This unit is located in the Bradshaw Mountains on the Prescott National Forest, and is approximately centered on Crown King, Arizona. The unit runs north to the south slope of Tuscumbia Mountain and runs southeast to the north slope of Lane Mountain. WUI project areas, State and private lands are not designated as critical habitat.

Unit BR–W–4. Tonto National Forest, Yavapai, Gila, and Maricopa Counties, Arizona: This unit is located within the Mazatzal Wilderness on the Tonto National Forest, Arizona. The unit begins in the north at North Peak and runs south encompassing the Mazatzal Mountains south to Buckhorn Mountain. State and private lands are not designated as critical habitat.

Unit BR–W–5. Tonto National Forest, Gila County, Arizona: This unit is located on the Tonto National Forest, Arizona, and runs southeast from Pine Mountain, towards Greenback Peak, south to Round Mountain. The area includes the northern half of the Salome Wilderness and the Sierra Ancha Wilderness. State and private lands are not designated as critical habitat.

Unit BR–W–6. Pinal Mountains Area, Gila County, Arizona: This unit is located south of Miami and Globe, Arizona. It is south of U.S. Highway 60 and west of State Highway 77. It is centered on the Pinal Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Globe Ranger District of the Tonto National Forest. It also contains a small portion of BLM lands. WUI project areas, State, private, and BLM lands are not designated as critical habitat.

Unit BR–W–7. Santa Teresa Mountains Area, Graham County, Arizona: This unit is located south of the San Carlos Indian Reservation and north of Klondyke, Arizona. It is centered on the Santa Teresa Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Safford Ranger District of the Coronado National Forest. State, private, BLM, and Tribal lands are not designated as critical habitat.

Unit BR–W–8. Pinaleno Mountains Area, Graham County, Arizona: This unit is located southwest Safford, Arizona. It is centered on the Pinaleno Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Safford Ranger District of the Coronado National Forest. WUI project areas, State and private lands are not designated as critical habitat.

Unit BR–W–9. Galiuro Mountains Area, Graham County, Arizona: This unit is located south of Klondyke, Arizona. It is centered on the Galiuro Mountains and contains much of the owl habitat within that mountain range. It is on the Safford Ranger District of the Coronado National Forest. State, private and BLM lands are not designated as critical habitat.

Unit BR–W–10. Winchester Mountains Area, Cochise County, Arizona: This unit is located northwest of Willcox, Arizona. It is centered on the Winchester Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Safford Ranger District of the Coronado National Forest. State, private, and BLM lands are not designated as critical habitat.

Unit BR–W–11. Santa Catalina and Rincon Mountains Area, Pima and Pinal Counties, Arizona: This unit is located north and east of Tucson, Arizona. It is centered on the Santa Catalina and Rincon Mountains and contains much of the owl habitat within those mountain ranges. It is primarily on the Santa Catalina Ranger District of the Coronado National Forest. WUI project areas, State and privatelands are not designated as critical habitat.

Unit BR–W–12. Santa Rita Mountains Area, Santa Cruz ,and Pima Counties, Arizona: This unit is located west of Sonoita, Arizona. It is centered on the Santa Rita Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Nogales Ranger District of the Coronado National Forest. State and private lands are not designated as critical habitat.

Unit BR–W–13. Atascosa and Pajarito Mountains Area, Santa Cruz County, Arizona: This unit is located west of Nogales, Arizona. It is centered on the Atascosa and Pajarito Mountains and contains much of the owl habitat within those mountain ranges. It is primarily on the Nogales Ranger District of the Coronado National Forest. State and private lands are not designated as critical habitat.

Unit BR–W–14. Patagonia Mountains Area, Santa Cruz County, Arizona: This unit is located south of Patagonia, Arizona. It is centered on the Patagonia Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Sierra Vista Ranger District of the Coronado National Forest. WUI project areas, State and private lands are not designated as critical habitat.

Unit BR–W–15. Huachuca Mountains Area, Cochise County, Arizona: This unit is located west and south of Sierra Vista, Arizona. It is centered on the Huachuca Mountains and contains much of the owl habitat within that mountain range. It is on the Sierra Vista Ranger District of the

Coronado National Forest. WUI project areas, State, private, and military lands are not designated as critical habitat.

Unit BR–W–16. Whetstone Mountains Area, Cochise County, Arizona: This unit is located southwest of Benson, Arizona. It is centered on the Whetstone Mountains and contains much of the owl habitat within that mountain range. It is primarily on the Sierra Vista Ranger District of the Coronado National Forest. State and private lands are not designated as critical habitat.

Unit BR–W–18. Chiricahua Mountains Area, Cochise County, Arizona: This unit is located northeast of Douglas, Arizona. It is centered on the Chiricahua Mountains and contains much of the owl habitat within that mountain range. It is on the Douglas Ranger District of the Coronado National Forest. WUI project areas, State and privatelands are not designated as critical habitat.

Unit UGM–2. Magdalena Mountains, Socorro County, New Mexico: This unit is located in the Magdalena Mountains, 6 mi (9.6 km) south of Magdalena, New Mexico. It contains primarily FS (Magdalena Ranger District, Cibola National Forests) lands. This unit contains ponderosa pine, mixed-conifer, spruce fir, stringers of deciduous riparian forests. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–3. San Mateo Mountains, Socorro County, New Mexico: This unit is located in the San Mateo Mountains, 36 mi (58 km) southwest of Magdalena, New Mexico. It contains primarily FS (Magdalena Ranger District, Cibola National Forests) lands. This unit contains ponderosa pine, mixed-conifer, spruce fir, stringers of deciduous riparian forests. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–5a. Gila National Forest, Catron, and Grant Counties, New Mexico: This unit is located in the Gila Mountains, north of Silver City, New Mexico. It contains primarily Gila National Forests lands. This unit contains ponderosa pine, mixed-conifer, spruce fir, stringers of deciduous riparian forests. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–5b. Gila National Forest, Sierra, Catron, and Grant Counties, New Mexico: This unit is located in the Gila Mountains, approximately 30 mi (48 km) west of Truth or Consequences, New Mexico. It contains primarily Gila National Forests lands. This unit contains ponderosa pine, mixed-conifer, spruce fir, stringers of deciduous riparian forests. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–6. Gila Mountains, Catron County, New Mexico: This unit is located in the Gila Mountains, North of Silver City, New Mexico. It contains primarily FS (Reserve Ranger District, Gila National Forests) lands. This unit contains ponderosa pine, mixed-conifer, spruce fir, stringers of deciduous riparian forests. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–7. Apache-Sitgreaves and Gila National Forests, Catron County, New Mexico, Graham and Greenlee Counties, Arizona: This unit is located in the Mogollon Rim in Arizona and New Mexico. It contains primarily FS lands . This unit contains ponderosa pine, mixed-conifer, spruce fir, stringers of deciduous riparian forests. WUI project areas, State, private, and Tribal lands are not designated as critical habitat.

Unit UGM–10. Coconino National Forest, Apache-Sitgreaves National Forest, and Tonto National Forests, Coconino, Gila, and Yavapai Counties, Arizona: This unit is located north, northwest, east, and southeast of Payson, Arizona. The western boundary of this unit runs parallel to the Yavapai County— Coconino County line, south to the Mogollon Rim. The southwest boundary runs along the Mogollon Rim. To the north, the unit encompasses the Coconino County portion of West Clear Creek and runs east along Jacks Canyon on the Coconino National Forest. The unit includes portions of West Chevelon, Chevelon, and Wildcat Canyons on the Apache-Sitgreaves National Forest and extends from Heber, Arizona, through the Apache-Sitgreaves National Forest, south along the Tonto National Forest boundary to Gentry Mountain. State and private lands are not designated as critical habitat.

Unit UGM–11. Coconino National Forest, Coconino and Yavapai Counties, Arizona: This unit is located south of Mountainaire, Arizona and runs southsoutheast, encompassing Howard, Mormon, and Hutch Mountains. To the west, the unit parallels Interstate 17, skirting Stoneman Lake. The southern boundary runs from east of Apache Maid Mountain to Happy Jack, Arizona, south to Willow Valley Dam. The unit does not include Mormon Lake and the area due south to Double Cabin Park. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–12. Coconino National Forest, Coconino County, Arizona: This unit is located east of Flagstaff, Arizona. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–13. Coconino National Forest, Kaibab National Forest, Prescott National Forest, and Camp Navajo Army Depot; Coconino and Yavapai Counties, Arizona: This unit is located approximately between Williams and Flagstaff, Arizona, to the north, and runs south to the Mogollon Rim. The western portion of the unit encompasses the area south of Williams, Arizona, south to the Mogollon Rim. This area includes Bill Williams Mountain, Sycamore Canyon Wilderness, and Volunteer Canyon. WUI project areas, State, private, and the Naval Observatory Flagstaff Station are not designated as critical habitat.

Unit UGM–14. Coconino National Forest, Coconino County, Arizona: This unit is located due north of Flagstaff, Arizona, and encompasses the San Francisco Peaks. The unit also includes the Hochderffer Hills, O'Leary Peak, the Dry Lake Hills, and Elden Mountain. WUI project areas, State and private lands are not designated as critical habitat.

Unit UGM–15. Kaibab National Forest, Coconino County, Arizona: This unit is located northwest of Flagstaff, Arizona. The unit is located west of U.S. Highway 180 and encompasses the area from Kendrick Peak northwest to Wild Horse Canyon. State and private lands are not designated as critical habitat.

Unit UGM–17. Kaibab National Forest, Coconino County, Arizona: This unit is located north of Parks, Arizona, and includes Sitgreaves Mountain, RS Hill, and Government Hill. State and private lands are not designated as critical habitat.

Primary Constituent Elements/Physical or Biological Features

The primary constituent elements which occur for the owl within mixed conifer, pine-oak, and riparian forest types that provide for one or more of owl's habitat needs for nesting, roosting, foraging, and dispersing are in areas defined by:

A. Primary constituent elements related to forest structure: (1) a range of tree species, including mixed conifer, pine-oak, and riparian forest types, composed of different tree sizes reflecting different ages of trees, 30 percent to 45 percent of which are large trees with a trunk diameter of 12 inches (0.3 meters) or more when measured at 4.5 feet (1.4 meters) from the ground; (2) a shade canopy created by the tree branches covering 40 percent or more of the ground; and (3) large dead trees (snags) with a trunk diameter of at least 12 inches (0.3 meters) when measured at 4.5 feet (1.4 meters) from the ground.

B. Primary constituent elements related to maintenance of adequate prey species: (1) High volumes of fallen trees and other woody debris; (2) A wide range of tree and plant species, including hardwoods; and (3) Adequate levels of residual plant cover to maintain fruits, seeds, and allow plant regeneration.

C. Primary constituent elements related to canyon habitat include one or more of the following: (1) presence of water (often providing cooler and often higher humidity than the surrounding areas); (2) clumps or stringers of mixedconifer, pine-oak, pinyon-juniper, and/ or riparian vegetation; (3) canyon wall containing crevices, ledges, or caves; and (4) high percent of ground litter and woody debris.

Special Management Considerations or Protections

The areas being designated as critical habitat will require some level of management and/or protection to address the current and future threats to the owl and maintain the primary constituent elements essential to its conservation in order to ensure the overall conservation of the species.

Life History

Feeding Narrative

Adult: The species feeds on small mammals, particularly mice, voles, and woodrats. They will also take birds, bats, reptiles and arthropods. The Mexican spotted owl is a "perch and pounce" predator, using elevated perches to find prey items using sight and sound. They can take prey on the wing, particularly birds. Most hunting is at night, however, there are some reports of diurnal foraging.

Reproduction Narrative

Adult: Mexican spotted owls nest in caves, in stick nests built by other birds, on debris platforms in trees, and in tree cavities (Johnson and Johnson 1985, Ganey 1988, Gutiérrez et al. 1995, Seamans and Gutiérrez 1995, Johnson 1997, Willey 1998a). They do not build nests; instead they rely on existing structures. Spotted owls exhibit one of the lowest clutch sizes among North American owls (Johnsgard 1988, Gutiérrez et al. 1995). Females normally lay one to three eggs, two being most common, and four observed rarely (LaHaye 1997, Gutiérrez et al. 2003). Re-nesting following nest failure is uncommon, but has been observed (Kroel and Zwank 1992, Gutiérrez et al. 1995). Mexican spotted owls have distinct annual breeding periods, with timing that may vary slightly throughout their range but is generally consistent overall. In Arizona, courtship begins in March with pairs roosting together during the day and calling to each other at dusk (Ganey 1988). Eggs are laid in late March or, more typically, early April. Incubation begins shortly after the first egg is laid, is performed entirely by the female, and lasts approximately 30 days. During incubation and the first half of the brooding period, the female leaves the nest only to defecate, regurgitate pellets, or to receive prey delivered by the male, who does most or all of the foraging (Forsman et al. 1984, Ganey 1988). Eggs usually hatch in early May (Ganey 1988). Females brood their young almost constantly for the first few weeks after the eggs hatch, but then begin to spend time hunting at night, leaving chicks unattended for up to several hours (Forsman et al. 1984, Delaney et al. 1999a). Nestling owls (owlets) generally fledge in early- to mid-June, four to five weeks after hatching (Ganey 1988). Owlets usually leave the nest before they can fly, jumping from the nest to surrounding tree branches or the ground (Forsman et al. 1984, Ganey 1988). Fledglings depend on their parents for food early in the fledgling period. Hungry fledglings give a persistent, raspy "begging call," especially when adults appear with food or call nearby (Forsman et al. 1984, Ganey 1988). Begging behavior declines in late August, but it may continue at low levels until dispersal occurs, usually from mid-September to early October (Arsenault et al. 1997, Ganey et al. 1998, Willey and Van Riper 2000). Mexican spotted owls are sporadic breeders. Most of the population nests successfully in good years, whereas only a small proportion of pairs will nest successfully in poor years (Fletcher and Hollis 1994; Gutiérrez et al. 1995, 2003). This life history strategy allows owls to reproduce when conditions are favorable and to survive by reducing reproduction during unfavorable periods. Small clutch size, temporal variability in nesting success, and delayed onset of breeding all contribute to the relatively low fecundity of this species (Gutiérrez 1996).

Geographic or Habitat Restraints or Barriers

Adult: Habitat fragmentation and a lack of corridors to suitable habitat

Environmental Specificity

Adult: High

Tolerance Ranges/Thresholds

Adult: Elevation ranges from 1,249 to 2,743 m (4,100 to 9,000 ft).

Site Fidelity

Adult: High

Habitat Narrative

Adult: Spotted owls are residents of old-growth or mature forests that possess complex structural components (uneven aged stands, high canopy closure, multi-storied levels, high tree density). Canyons with riparian or conifer communities are also important components. In southern Arizona and New Mexico, the mixed conifer, Madrean pine-oak, Arizona cypress, encinal oak woodlands, and associated riparian forests provide habitat in the small mountain ranges (Sky Islands) distributed across the landscape. Owls are also found in canyon habitat dominated by vertical-walled rocky cliffs within complex watersheds, including tributary side canyons. Rock walls with caves, ledges, and other areas provide protected nest and roost sites. Canyon habitat may include small isolated patches or stringers of forested vegetation including stands of mixed-conifer, ponderosa pine, pine-oak, pinyon-juniper, and/or riparian vegetation in which owls regularly roost and forage. Owls are usually found in areas with some type of water source (i.e., perennial stream, creeks, and springs, ephemeral water, small pools from runoff, reservoir emissions). Even small sources of water such as small pools or puddles create humid conditions. Roosting and nesting habitats exhibit certain identifiable features, including large trees (those with a trunk diameter of 12 inches (in) (30.5 centimeters (cm)) or more (i.e., high tree basal area)), uneven aged tree stands, multi-storied canopy, a tree canopy creating shade over 40 percent or more of the ground (i.e., moderate to high canopy closure), and decadence in the form of downed logs and snags (standing dead trees). Canopy closure is typically greater than 40 percent. Owl foraging habitat includes a wide variety of forest conditions, canyon bottoms, cliff faces, tops of canyon rims, and riparian areas. Juvenile owls disperse into a variety of habitats ranging from high-elevation forests to pinyon-juniper woodlands and riparian areas surrounded by desert grasslands. Observations of long-distance dispersal by juveniles provide evidence that they use widely spaced islands of suitable habitat which are connected at lower elevations by pinyon-juniper and riparian forests. Critical habitat was finalized on August 31, 2004(69 FR 53182) in Arizona in Apache, Cochise, Coconino, Gila, Graham, Greenlee, Maricopa, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties. Protection of large contiguous tracts of habitat, capable of supporting multiple pairs, is the most important management need; this includes both occupied habitats and unoccupied areas approaching characteristics of nesting habitat.

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Seasonal

Dispersal

Adult: Juvenile owls disperse into a variety of habitats ranging from high-elevation forests to pinyon-juniper woodlands and riparian areas surrounded by desert grasslands.

Dispersal/Migration Narrative

Adult: Mated pairs of owls are territorial. Adults may or may not leave their territory during the winter. Most adults remain on the same territory year after year. Mexican spotted owls appear to be obligate dispersers, with all juveniles dispersing from natal areas. Juveniles leave their natal territory in September, and while they are capable of moving long distances, many successfully establish themselves nearby. Some juveniles will travel through a variety of vegetation communities until they settle down. Juvenile owls disperse into a variety of habitats ranging from high-elevation forests to pinyon-juniper woodlands and riparian areas surrounded by desert grasslands. Observations of long-distance dispersal by juveniles provide evidence that they use widely spaced islands of suitable habitat which are connected at lower elevations by pinyon-juniper and riparian forests. In the southwestern U.S., these owls are apparently largely nonmigratory, with some vertical migration at higher elevations (Ganey et al. 1988) (i.e., owls move to lower elevations for winter, with some exceptions). Some owls remain year-round in the same general areas but exhibit seasonal shifts in habitat use pattern (USFWS 1995). Some migrate 20-50 km between summer and winter ranges (see USFWS 1995). Some Mexican spotted owls undergo elevational migrations to winter in areas where habitat structure and composition differ from that used during breeding (USFWS 2012).

Population Information and Trends

Population Trends:
Unknown

Species Trends:
Stable or slowly declining.

Resiliency:
Moderate

Representation:
Low

Redundancy:
Low

Population Growth Rate:
Unknown

Number of Populations:
81-300 (NatureServe 2015)

Population Size:
1,300 owl sites (an area with a high probability of being used by a single or a pair of adult or subadult owls for nesting, roosting, or foraging). Based on the number of known owl sites, the total adult population may be roughly a few thousand, assuming a pair at each site (NatureServe 2015).

Minimum Viable Population Size:
Unknown

Resistance to Disease:
Unknown; but disease not known to be a threat

Adaptability:
Low

Population Narrative:
Mexican spotted owl surveys since the 1995 Recovery Plan have increased our knowledge of owl distribution, but not necessarily of owl abundance. For example, 758 owl sites were recorded for the period 1990–1993 (Ward et al. 1995). During a recent review for establishing Critical Habitat, 1,222 owl sites were recorded for the period 1990–2004 (USDI FWS 2004). A more recent tally through 2008 indicated 1,301 cumulative sites occupied by one or more Mexican spotted owls (USDI FWS 2012). An owl site is an area used by a single or a pair of adult or subadult owls for nesting, roosting, or foraging. Based on the number of known owl sites, the total adult population may be roughly a few thousand, assuming a pair at each site (NatureServe 2015).The increase in number of known owl sites is mainly a product of new owl surveys being

completed within previously unsurveyed areas (e.g., several National Parks within southern Utah, Grand Canyon National Park in Arizona, Guadalupe National Park in West Texas, Guadalupe Mountains in southeastern New Mexico and West Texas, Dinosaur National Monument in Colorado, Cibola National Forest and Gila National Forest in New Mexico). Thus, an increase in abundance in the species range-wide cannot be inferred from these data (USDI FWS 2012). However, we do assume that an increase in the number of areas considered to be occupied to be a positive indicator regarding owl abundance.

Threats and Stressors

Stressor: Wildland fire
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: The primary threats to its population in the U.S. (but likely not in Mexico) have transitioned from timber harvest to an increased risk of stand-replacing wildland fire. Current forest conditions have the potential to sustain landscape-scale stand-replacing fires that would positively or negatively alter owl habitat over extensive landscapes in a single fire incident, depending on certain conditions discussed below. Indeed, several large fires— Whitewater-Baldy, Wallow, Las Conchas, Cerro Grande, Rodeo-Chedeski, Hayman as examples—have burned in owl habitat since 1996. Thus, broad-scale, high-severity, stand-replacing fires have had, and will likely continue to have, long-term effects on both watershed and forest function (Fulé et al. 2004). Wildland fires can cause direct and indirect effects from combustion, charring, heating, smoke, and biophysical changes to the burned area. Dense forests with heavy fuel accumulations, like many forests in the southwestern U.S., are at greater risk to high-severity and stand-replacing fires (Fulé et al. 2004). Direct and indirect fire effects on habitat include the alteration of vegetation structure, soil, and watershed conditions. These effects can be detrimental, beneficial, or both depending on the six factors we list above. Evaluation of effects is also dependent on temporal scale; effects that are detrimental in the near-term may have long-term beneficial effects. Conversely, fires may provide short-term benefits, but result in stand degradation over time.

Stressor: Climate variability
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Climate variability combined with current forest conditions may also synergistically result in increased loss of habitat from fire. The intensification of natural drought cycles and the ensuing stress placed upon forested habitats could result in even larger and more severe wildland fires in owl habitat. Mawdsley et al. (2009) identified a number of effects that could impact the Mexican spotted owl. These include: 1) shifts in the distribution of the owl itself, along with major prey species and potential competitors and predators, possibly along elevational or latitudinal gradients; 2) effects on demographic rates, such as survival and reproduction; 3) changes in coevolved interactions, such as prey-predator relationships; 4) direct loss of habitat due to increased fire severity, bark beetle outbreaks, and direct warming of habitats; 5) increased population or range expansion of species that are direct competitors; and, 6) reductions in population size.

Stressor: Livestock grazing
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Grazing by domestic and wild ungulates is a potential threat to spotted owls when managed insufficiently as to its effects on prey species habitat (e.g., reducing herbaceous ground cover), nest/roost habitat (e.g., limiting regeneration of important tree species, especially in riparian areas), and the capacity for resource managers to restore and maintain conditions supporting natural fire regimes within an array of habitat types. Grazing by domestic and wild ungulates is prevalent and recurring within most Mexican spotted owl habitat types. This potential threat occurs throughout the owl's range and often during periods of its reproductive cycle when prey availability is most critical. The magnitude of the threat is greatly dependent on the duration, timing, and intensity of grazing, and if insufficiently managed, both short-term and long-term adverse affects on the owl's habitat and that of its prey species may occur in the future. USFWS (2012).

Stressor: Land development
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Land development poses a potential threat to Mexican spotted owls primarily through habitat fragmentation, alteration of ecological processes (e.g., predation, fire regimes), and increased potential for disturbance. Land development probably threatens foraging and wintering habitat more than nest/roost habitat, although the level of threat is unknown.

Recovery

Delisting Criteria:
Owl occupancy rates must show a stable or increasing trend after 10 years of monitoring; AND

Indicators of habitat conditions (key habitat variables) are stable or improving for 10 years in roosting and nesting habitat.

Recovery Actions:

- Management: Given that the owl is a widespread subspecies with a disjunct and somewhat fragmented distribution, management of the owl and its habitat must be conducted at the landscape scale. Landscape modeling and analysis are critical in evaluating the distribution of owls and habitats, identifying areas where threats are greatest, and then applying Recovery Plan recommendations in such a way as to sustain and improve owl habitat. Three levels of management are recommended in this Recovery Plan. (1) Protected Activity Centers (PACs). PACs encompass a minimum of 600 acres surrounding known owl nest/roost sites. Management recommendations are most conservative within PACs, but by no means advocate a “hands-off” approach. The Recovery Team recognizes situations exist where management is needed to sustain or enhance desired conditions for the owl, including fire-risk reduction, as well as monitoring owl response. Mechanical treatments in some PACs may be needed to achieve these objectives; determining which PACs may benefit from mechanical treatments requires a landscape analysis to determine where the needs of fire risk reduction and habitat enhancement are greatest. PACs are the only form of protected habitat included in this revised Plan. (2) Recovery habitat. This habitat is primarily ponderosa pine-Gambel oak, mixed-conifer, and riparian forest that either currently is, or has the potential for becoming, nest/roost habitat or does or could provide foraging, dispersal, or wintering habitats. Nesting/roosting habitat typically occurs either in well-structured forests with high canopy cover, large trees, and other late seral characteristics, or in steep and narrow rocky canyons formed by parallel cliffs with numerous caves and/or ledges within specific geologic formations. Ten to 25 percent of forested recovery habitat should be managed as recovery nest/roost habitat varying by forest type and Ecological Management Unit (EMU) (formerly called Recovery Units). This habitat should be managed to replace nest/roost habitat lost due to disturbance (e.g., fire) or senescence and to provide additional nest/roost habitat to facilitate recovery of the owl. The remainder of forested recovery habitat should be managed for other needs (such as foraging, dispersing, or wintering) provided that key habitat elements are retained across the landscape. (3) Other forest and woodland types, such as ponderosa pine forest, spruce-fir forest, and pinyon-juniper woodland. No specific management is suggested for these habitat types, recognizing that current emphasis for sustainable and resilient forests should be compatible with needs of the owl.

- Monitoring: As management proceeds, monitoring assesses the efficacy of management actions. Thus, it is critically important to monitor owl populations and habitat to determine whether both are stable or improving. Monitoring population trends provides a real-time assessment of the owl’s status, whereas habitat monitoring allows us to predict if there will be adequate habitat to support a viable owl population in the future. As a surrogate for evaluating trends in actual owl numbers, owl occupancy will be monitored at a sample of fixed sites randomly selected throughout the U.S. range of the Mexican spotted owl. We also recommend that Mexico undertake a monitoring effort consistent with the one recommended for the U.S. No specific design is proposed for monitoring habitat, although Forest Inventory and Assessment data might have application to the owl. Combining owl occupancy and habitat monitoring provides an opportunity to examine relationships between habitat features and owl populations to assess whether a review of current management is warranted (USFWS, 2012).
- Research: The Recovery Team used available data, published papers, unpublished reports, and scientific expertise covering the U.S. and Mexico when developing the Recovery Plan. During the process, it became clear that critical knowledge gaps exist. Four general areas require additional research: (1) habitat relationships, (2) biological interactions, (3) population structure, and (4) ecosystem structure. Under each of these subjects, the Recovery Team has provided specific research recommendations. This research would increase our understanding of the effects of the Recovery Plan management recommendations on the owl and ecosystem composition, structure, and function.
- Implementation: An implementation schedule is provided that details recovery tasks, the entities responsible for implementing them, and the estimated costs. The Recovery Team recommends that a working team be assembled for each EMU to oversee implementation and to provide feedback on successes and failures of the Recovery Plan (USFWS, 2012).

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SPECIES ACCOUNT: *Telespyza cantans* (Laysan finch (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

A 19-cm finch with a heavy bill and delayed plumage maturation (Morin and Conant 2002). Adult male has yellow head, breast, and back, a gray neck collar, and whitish belly; fully adult female has yellow crown with some brown streaking, a gray collar, and yellow throat and breast, back feathers have dark brown spots edged with brown but tinged with yellow (Morin and Conant 2002). Adult male is generally slightly larger than adult female, and adults of both sexes slightly larger than immatures (Morin and Conant 2002) (NatureServe, 2015).

Taxonomy

The Laysan finch is a member of the honeycreeper family. Regarded as conspecific with T. ultima by some authors (AOU 1998). Formerly placed in genus Psittirostra (see Banks and Laybourne 1977). Perhaps congeneric with Loxioides bailleui (Johnson et al. 1989) (NatureServe, 2015).

Historical Range

It is endemic to Laysan Island (population of several thousand); introduced (1967) and established on Pearl and Hermes Reef and adjacent small islands (population of several hundred); introduced population on Midway was exterminated by rats during WW II (NatureServe, 2015).

Current Range

It occurs naturally only on the island of Laysan. There is also an established population on Pearl and Hermes (USFWS, 2014).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Eats seabird eggs, insects, seeds, flower buds, soft parts of grass stems, tender shoots of shrubs, carrion (Berger 1981); also fly larvae obtained from dead seabirds. Adults and immatures are carnivores, invertivores, herbivores, and granivores. This species exhibits a diurnal phenology (NatureServe, 2015).

Reproduction Narrative

Adult: On Laysan Island, nests almost exclusively in the native bunchgrass Eragrostis variabilis, including bunchgrass in viney plant associations (Morin 1992). On Pearl and Hermes Reef, nests in a wide variety of native and alien plants, as well as in various kinds of human-made debris (Morin and Conant 1990). Most egg-laying from late April through May and June; most young fledged by end of July or early Aug. Clutch size is 1 - 5 (mode 3). Modal incubation period is 16 days. Young fledge in 22 - 26 days, dependent for at least 3 additional weeks. Females first breed at 1 year (males vary somewhat) (Dennis et al. 1991). Some birds produce 2 clutches/year. Apparently monogamous. Pairs defend mates and nest sites, but not feeding territories (Morin 1992) (NatureServe, 2015). Eggs may be laid as early as February (USFWS, 1984).

Habitat Narrative

Adult: Inhabits Scaevola thickets, bunchgrass, and low bushy areas (AOU 1983); especially partial to bunchgrass association (Berger 1981). Terrestrial habitat is characterized as grassland/herbaceous and shrubland/chaparral (NatureServe, 2015).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015).

Population Information and Trends

Population Trends:

Significant decline in 1900s, but population has recovered (NatureServe, 2015)

Species Trends:

Stable (NatureServe, 2015)

Resiliency:

Low (inferred from USFWS, 2014; see current range/distribution)

Redundancy:

Low (inferred from USFWS, 2014)

Number of Populations:

2 (USFWS, 2014; see current range/distribution)

Population Size:

Laysan Island: 10,000 (USFWS, 2014); Pearl and Hermes Reef: 411 (NatureServe, 2015). The most recent population estimate for the Laysan Finch was generated in 2013, based on data collected from 1991 to 2012 (Underwood 2013). The population is considered stable and the estimated average population size over the duration of the surveys was 10,029 ± 3,632 (USFWS, 2017).

Resistance to Disease:

Low (NatureServe, 2015)

Population Narrative:

Declined greatly in the early 1900s as a result of habitat destruction by introduced rabbits on Laysan Island. The average population estimates for the 20 years of complete or partial data on Pearl and Hermes reef was 411 birds (Morin and Conant 2002). This species is highly susceptible to avian malaria. Despite large population fluctuations, USFWS (1990) categorized the status as "stable," probably due to lack of a definite increasing or decreasing trend (NatureServe, 2015). In spite of extreme population fluctuations in population estimates (attributable at least in part to spring rainfall patterns), the average population size remains around 10,000 birds (Underwood 2012) (USFWS, 2014).

Threats and Stressors

Stressor: Disease and predation (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Vulnerable to predators and avian diseases (NatureServe, 2015)

Stressor: Non-native vegetation (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Threatened by the spread of the non-native shrub Pluchea indica on Laysan Island (Morin 1992) (NatureServe, 2015).

Stressor: Climate change (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Climate change is believed to pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species (USFWS, 2014).

Stressor: Yellow crazy ants (Anoplolepis gracilipes) (USFWS, 2017)
Exposure:
Response:
Consequence:
Narrative: Although quarantine measures are strictly enforced, these ants are present on Johnston Atoll and at the State of Hawai`i base yard where packing for trips to Kure occurs. The vessels on those trips often stop at Laysan on their way to Kure (Plentovich, in litt. 2017) (USFWS, 2017).

Stressor: Climate change degradation of habitat (USFWS, 2017)
Exposure:
Response:
Consequence:
Narrative: A recent modelling study of passive sea level rise (SLR) showed that approximately 4 percent of the total land areas in the Northwestern Hawaiian Islands will be lost with +1.0 m of SLR and 26 percent will be lost with +2.0 m SLR (Reynold’s et al. 2012). Total area loss with

passive inundation and a concurrent groundwater rise scenario for Laysan Island was predicted to be 7 percent at 1.0 m SLR and 24 percent at +2.0 SLR. Amongst the atolls that are particularly vulnerable, Pearl and Hermes Atoll showed a substantial habitat loss of 43 percent of land area with +1.0 m sea level rise and 92 percent inundated at +2.0 m SLR (Reynold's et al. 2012) (USFWS, 2017).

Recovery

Reclassification Criteria:

1. Place necessary mechanisms in place to protect the islands from invasion by alien species (USFWS, 2014).

2. Establish effective and reliable mechanisms to monitor for alien organisms (USFWS, 2014).

3. Periodically verify the existence of reasonably stable populations of the Laysan finch and the other two NWHI passerines (USFWS, 2014).

1. Viable, self-sustaining populations of the species occur on at least two islands that are resistant to ocean inundation (USFWS, 2019).

2. Over a minimum 15-year period, populations of the species show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring (USFWS, 2019).

3. Threats to the species, including those from small population size, disease, climate variability, and invasive species, are sufficiently managed or addressed to allow Criteria 1 and 2 above to be met (USFWS, 2019).

4. The genetic diversity of extant populations of the species is maintained, and this diversity is represented and maintained in all translocated populations (USFWS, 2019).

Delisting Criteria:

1. Viable, self-sustaining populations of the species occur on at least four islands that are resistant to ocean inundation (USFWS, 2019).

2. Over a minimum 30-year period, populations of the species show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring (USFWS, 2019).

3. Threats to the species, including those from small population size, disease, climate variability, and invasive species, are sufficiently managed or addressed to allow Criteria 1 and 2 above to be met (USFWS, 2019).

4. The genetic diversity of extant populations of the species is maintained, and this diversity is represented and maintained in all translocated populations (USFWS, 2019).

Recovery Actions:

- Prevent unauthorized entry to Laysan and Nihoa Islands (USFWS, 1984).
- Prevent establishment of exotic organisms (USFWS, 1984).
- Prevent the outbreak of avian diseases (USFWS, 1984).
- Monitor populations of the species and its habitat to allow for detection of changes in populations or habitat quality (USFWS, 1984).
- Establish additional, disjunct populations of all three taxa to provide a buffer against catastrophic declines of natural populations (USFWS, 1984).

Conservation Measures and Best Management Practices:

- Habitat and natural process management and restoration – Continue restoration work on Laysan Island (USFWS, 2014).
- Surveys / Inventories - Continue Laysan finch monitoring surveys annually on Laysan Island. Determine feasibility of establishing a consistent monitoring program for the Laysan finch population on Pearl and Hermes (USFWS, 2014).
- Invasive plant monitoring and control – Restore habitat for the Laysan finch population at Pearl and Hermes by eradicating Verbesina encelioides and fostering recovery of native vegetation (USFWS, 2014).
- Reintroduction / translocation – Pursue translocation to establish new Laysan finch populations in secure habitat on other islands (USFWS, 2014).
- Biosecurity planning and monitoring - Implement procedures to minimize the chances of accidental introductions of alien species; Improve monitoring for new introductions of alien species throughout the Northwestern Hawaiian Islands (USFWS, 2014).
- Climate change degradation of habitat – Climate change poses a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs in the near future. Hurricanes may be the main threat to this species as a result of climate change. Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity (5.4%), frequency (2.8%) and duration (1.4%) by 2100, and continue to increase further into the future (Emanuel et al. 2008) (USFWS, 2017).
- Another translocation is in discussion and could occur within the next 5 to 10 years (USFWS, 2017).

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SPECIES ACCOUNT: *Telespyza ultima* (Nihoa finch (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Nihoa Finch is very similar to the Laysan Finch but smaller. The male has a bright yellow head, neck, and breast with a broad grey band between the neck and mid-back. The lower back and rump of the male are gray. Females have a yellow throat and breast streaked with brown, the head and back are brown streaked with black. It measures about 6 inches in length (USFWS, 2016).

Taxonomy

The Nihoa finch was considered a subspecies of the Laysan finch until recently. It was formally considered a member of the Drepanididae family; but is now within the Fringillidae family (A.O.U. 1983) (USFWS, 1984).

Historical Range

It is endemic to Nihoa Island (USFWS, 1984).

Current Range

Occurs on Nihoa Island (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Eats insects, seeds, flower buds, seabird eggs (Berger 1981). Adults and immatures are carnivores, invertivores, herbivores, and granivores. This species exhibits a diurnal phenology (NatureServe, 2015).

Reproduction Narrative

Adult: Clutch size is 2 - 4. Incubation lasts 15 - 16 days in captivity, by female (male may feed female) (Berger 1981). Nests in rock crevices (Pratt et al. 1987) (NatureServe, 2015). Available data show egg laying begins in late February and lasts at least through March (Sincock and Kridler 1977). Conant (1983) estimates that egg laying may extend to early July (USFWS, 1984).

Habitat Narrative

Adult: Rock outcroppings and shrub-covered slopes (AOU 1983). Widespread throughout the island; more often seen near rocky outcroppings; prefers a sparsely vegetated, open habitat (Matthews and Moseley 1990). Terrestrial habitat is characterized as bare rock/talus/scree and shrubland/chaparral (NatureServe, 2015). Conant's data (1983) show significant positive correlation between finch sightings and Sida (USFWS, 1984).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 1984)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (inferred from USFWS, 1984)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015). Finches have been observed to move considerable distances, sometime flying up to halfway across the island (Conant 1983) (USFWS, 1984).

Population Information and Trends

Population Trends:

Unknown (USFWS, 2011)

Species Trends:

Stable (NatureServe, 2015)

Resiliency:

Very low (inferred from NatureServe, 2015)

Redundancy:

Very low (inferred from NatureServe, 2015)

Number of Populations:

1 (NatureServe, 2015)

Population Size:

~3,177 (NatureServe, 2015); 2,063 - 3,551 (USFWS, 2011). The most recent population estimate for the Nihoa Finch was a distance-based abundance estimate in 2014 of 2,963 birds (95% CI: 1,920-5,187; Gorresen et al. 2016). The Nihoa Finch is relatively evenly distributed across Nihoa, but is more abundant toward the west side of the island (Gorresen et al. 2016). The surveys also indicate a near complete use of available habitat during 2010 to 2014 (Gorresen et al. 2016) (USFWS, 2017).

Population Narrative:

There is one occurrence. 1967 through 1996 population estimates averaged 3177 individuals (N = 23 years, range = 946-6686), with a median of 2987 (Morin and Conant 2002). USFWS (1990) categorized the status as "stable." The range extent is less than about 40 - 100 square miles

(NatureServe, 2015). The most recent population estimate is 2,807 (± 744, 95 percent CI) from surveys in 2007 (BirdLife International 2011). Determining the population trend is difficult because population estimates based on survey data fluctuate widely between years (USFWS, 2011).

Threats and Stressors

Stressor: Stochastic events (NatureServe, 2015 and USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Small range makes it susceptible to natural disasters (e.g., hurricane, tidal wave) (NatureServe, 2015). Fire is a past and potential threat as are storms and stochastic events (BirdLife International 2011). The Nihoa finch is at risk from the special threats faced by small, isolated populations. Chance environmental occurrences, such as prolonged droughts or severe storms, or anthropogenic threats such as the introduction of rats or other predators to Nihoa, could lead rapidly to major population decline or extinction owing to loss of prey and cover, reproductive failure, or direct mortality. Single, small populations such as the Nihoa finch’s also face extinction risk from demographic stochasticity, or changes to population traits such as sex-ratio and age-structure that can influence reproduction, population size, and population trend (USFWS, 2011).

Stressor: Disease and predation (NatureServe, 2015 and USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Other threats include rats and various insects that transmit avian diseases (Ehrlich et al. 1992) (NatureServe, 2015). West Nile virus and avian flu may pose a risk to the Nihoa finch if these diseases reach Hawai`i and the Northwestern Hawaiian Islands. The susceptibility of the Nihoa finch to avian malaria and avian poxvirus is unknown, however, both diseases are known to be severe threats to the Laysan finch (Warner 1968, Sincock and Kridler 1977) and most of the endemic forest birds in the main Hawaiian Islands (USFWS, 2011).

Stressor: Gray bird grasshopper (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: It is thought that the introduced grasshopper Schistocerca nitens is causing the degradation and loss of habitat. Periodic population eruptions lead to the virtual defoliation of the island and may prove to be a significant threat (BirdLife International 2011) (USFWS, 2011).

Stressor: Climate change (USFWS, 2011)
Exposure:
Response:
Consequence:
Narrative: Climate change may also pose a threat to the Nihoa finch, as its range includes low-elevation habitat. However, current climate change models do not allow specific predictions as to what those effects, and their extent, would be for this species (USFWS, 2011).

Stressor: Yellow crazy ants (Anoplolepis gracilipes) (USFWS, 2017).
Exposure:
Response:
Consequence:
Narrative: Although quarantine measures are strictly enforced, these ants are present at the Hawai`i base yard where packing for trips to the Northwestern Hawaiian Islands occurs. The vessels on those trips occasionally stop at Nihoa Island (Plentovich, pers. comm. 2017) (USFWS, 2017).

Recovery

Reclassification Criteria:
1. The first of these objectives is to put the necessary mechanisms in place that will protect these islands from invasion by alien species (USFWS, 2011).

2. The second objective is to establish effective and reliable mechanisms to monitor for alien organisms (USFWS, 2011).

3. The third objective is to verify the existence of reasonably stable populations of the Nihoa finch and the other two NWHI passerines at least annually (USFWS, 2011).

1. Viable, self-sustaining populations of the species occur on at least two islands that are resistant to ocean inundation (USFWS, 2019).

2. Over a minimum 15-year period, populations of the species show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring (USFWS, 2019).

3. Threats to the species, including those from small population size, disease, climate variability, and invasive species, are sufficiently managed or addressed to allow Criteria 1 and 2 above to be met (USFWS, 2019).

4. The genetic diversity of extant populations of the species is maintained, and this diversity is represented and maintained in all translocated populations (USFWS, 2019).

Delisting Criteria:
1. Viable, self-sustaining populations of the species occur on at least four islands that are resistant to ocean inundation (USFWS, 2019).

2. Over a minimum 30-year period, populations of the species show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring (USFWS, 2019).

3. Threats to the species, including those from small population size, disease, climate variability, and invasive species, are sufficiently managed or addressed to allow Criteria 1 and 2 above to be met (USFWS, 2019).

4. The genetic diversity of extant populations of the species is maintained, and this diversity is represented and maintained in all translocated populations (USFWS, 2019).

Recovery Actions:
- Prevent unauthorized entry to Laysan and Nihoa Islands (USFWS, 1984).
- Prevent establishment of exotic organisms (USFWS, 1984).
- Prevent the outbreak of avian diseases (USFWS, 1984).
- Monitor populations of the species and its habitat to allow for detection of changes in populations or habitat quality (USFWS, 1984).
- Establish additional, disjunct populations of all three taxa to provide a buffer against catastrophic declines of natural populations (USFWS, 1984).

Conservation Measures and Best Management Practices:
- Prevent unauthorized entry to Nihoa Island (USFWS, 2011).
- Improve monitoring for new introductions of alien species throughout the Northwestern Hawaiian Islands (USFWS, 2011).
- Develop accurate survey methods for estimating Nihoa finch population sizes and trends that minimize impacts to other resident species. Monitor finch populations and their habitat (USFWS, 2011).
- Manage the gray bird grasshopper (Schistocerca nitens) on Nihoa to prevent outbreaks that negatively impact the resident endangered species (USFWS, 2011).
- Prevent outbreak of avian disease (USFWS, 2011).
- Almost all aspects of Nihoa finch natural history are unknown and thus our ability to manage the finch is hampered. Long-term research that does not impact the island negatively is needed to study the species' ecology (USFWS, 2011).
- Pursue translocation to establish new populations in secure habitat on other islands (USFWS, 2011).
- Reintroduction/Translocation – The NEPA process will begin in the immediate future and will be followed by the development of a translocation plan for translocating the Nihoa Finch to another island (USFWS, 2017).
- Climate change degradation of habitat – Climate change may pose a threat to this species. However, current climate change analyses in the Pacific Islands lack sufficient spatial resolution to make predictions on impacts to this species. The Pacific Islands Climate Change Cooperative (PICCC) has currently funded climate modeling that will help resolve these spatial limitations. We anticipate high spatial resolution climate outputs in the near future. Hurricanes may be the main threat to this species as a result of climate change. Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity (5.4%), frequency (2.8%) and duration (1.4%) by 2100, and continue to increase further into the future (Emanuel et al. 2008) (USFWS, 2017).

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SPECIES ACCOUNT: *Todiramphus cinnamominus (=Halcyon c.c.)* (Guam Micronesian kingfisher)

Species Taxonomic and Listing Information

Listing Status: Endangered; 08/27/1984; Pacific Region (R1) (USFWS, 2016)

Physical Description

Other subspecies, Todiramphus [=Halcyon] c. pelewensis and T. c. reichenbachii, exist on Palau (Republic of Palau) and Pohnpei (Federated States of Micronesia), respectively. The Guam subspecies is a small, sexually dimorphic forest kingfisher (Baker 1951, pp. 227–228). The adult male has a cinnamon-brown head, neck, upper back, and underparts. A black line extends around the back of the neck and the eye ring is black. The adult female resembles the male except that the upper breast is paler, as are the chin and throat, with the rest of the underparts and underwing coverts white (Jenkins 1983, p. 21). Immature birds have the crown washed in greenish-blue, and a whitish chin and throat. Underparts are buffy-white in the immature male, but may be paler in the female (Jenkins 1983, p. 21).

Current Range

The kingfisher is endemic to the island of Guam in the Mariana Islands.

Critical Habitat Designated

Yes; 10/28/2004.

Legal Description

On October 28, 2004. the U.S. Fish and Wildlife Service (Service) designated critical habitat for the Guam Micronesian kingfisher (Halcyon cinnamomina cinnamomina) pursuant to the Endangered Species Act, as amended (Act or ESA) (69 FR 62944 - 62990). Approximately 376 acres (ac) (152 hectares (ha)) was designated on the island of Guam for the Guam Micronesian kingfisher. On Guam, the Mariana fruit bat, Mariana crow, and Guam Micronesian kingfisher critical habitat unit boundaries are identical.

Critical Habitat Designation

Designated critical habitat for the Guam Micronesian kingfisher consists of approximately 376 ac (152 ha) of land in the fee simple portion of the Guam National Wildlife Refuge.

The vegetation in this designated unit consists of coastal, limestone, and secondary forests composed of native and introduced species that contain the full range of primary constituent elements required for the long-term conservation of the Guam Micronesian kingfisher in northern Guam. This unit includes forested areas along the northwestern coasts of the island that were occupied by Guam Micronesian kingfishers in the 1970s and early 1980s (Drahos 1977; Maben and Aguon 1980, 1981; Engbring and Ramsey 1984). This unit also encompasses essential conservation areas identified in the forest bird recovery plan for northern Guam (USFWS 1990b).

Primary Constituent Elements/Physical or Biological Features

The critical habitat unit for the Guam Micronesian kingfisher is designated for the Territory of Guam. The primary constituent elements required by the Guam Micronesian kingfisher for the biological needs of foraging, sheltering, roosting, nesting, and rearing of young are found in areas that support limestone, secondary, ravine, swamp, agricultural, and coastal forests composed of native and introduced plant species. These forest types include the primary constituent elements of:

(i) Closed canopy and well-developed understory vegetation; large (approximately 43 cm (17 in) diameter at breast height), standing dead trees (especially Tristiropsis obtusangula (faniok), Pisonia grandis (umumu), Artocarpus spp. (breadfruit), Ficus spp. (fig), and Cocos nucifera (coconut palm)); mud nests of Nasutitermes spp. termites; and root masses of epiphytic ferns for breeding;

(ii) Sufficiently diverse structure to provide exposed perches and ground surfaces, leaf litter, and other substrates that support a wide range of vertebrate and invertebrate prey species for foraging kingfishers; and

(iii) Sufficient overall breeding and foraging area to support kingfisher territories of approximately 25 ac (10 ha) each.

Special Management Considerations or Protections

Critical habitat does not include existing features and structures within the boundaries of the mapped units, such as buildings, roads, aqueducts, antennas, water tanks, agricultural fields, paved areas, lawns, and other urban landscaped areas not containing one or more of the primary constituent elements.

The last wild kingfisher on Guam was seen in 1988, and this subspecies is believed extirpated from the wild (Wiles et al. 2003). The total population now consists of 63 birds in 11 captive breeding institutions in the mainland United States and by the Guam Division of Aquatic and Wildlife Resources (Bahner, in litt. 2003). Because the Guam Micronesian kingfisher does not exist in the wild and all suitable habitat presently is unoccupied, inclusion of unoccupied areas containing the primary constituent elements is essential to the conservation of this species. Recovery to the point where the protection afforded by listing is no longer necessary will require restoration of the Guam Micronesian kingfisher through release of captive birds and subsequent natural dispersal into areas of Guam that formerly were inhabited.

Excluded from designation are 10,838 ac (4,386 ha) of Air Force lands, 7,977 ac (3,228 ha) of Navy lands, 2,989 ac (1,210 ha) of Government of Guam lands, and 1,941 ac (785 ha) of private lands in northern and southern Guam that were proposed as critical habitat in the October 15, 2002, proposed rule (67 FR 63738), leaving a final designation of 376 ac (152 ha). Although Air Force, Navy, Government of Guam, and private lands are excluded from final critical habitat designation, they still contribute to the conservation of the Guam Micronesian kingfisher.

Life History

Feeding Narrative

Adult: In the wild, the kingfisher is known to feed on invertebrates and small vertebrates, including insects, segmented worms, hermit crabs, skinks, geckoes, and possibly other small vertebrates (Marshall 1949, p. 210; Baker 1951, pp. 228–229; Jenkins 1983, p. 23). The species typically forages by perching motionless on exposed branches or telephone lines and swooping down to capture prey off the ground with their bill (Jenkins 1983, p. 24). They also will capture prey off nearby foliage and have been observed gleaning insects from bark (Maben 1982, p. 78).

Reproduction Narrative

Adult: Kingfisher breeding activity in the wild is thought to be concentrated from December to July (Baker 1951, p. 228; Jenkins 1983, p. 24). Pairs may excavate their own nests in soft trees, arboreal termitaria (the nests of termites [Nasutitermes spp.]), arboreal fern root masses, or they may utilize available natural cavities such as broken tree limbs (Jenkins 1983, p. 24; Marshall 1989, p. 474). Jenkins (1983, p. 23) observed that some excavated cavities were never used as nesting sites, which suggests that the process of excavating nest sites may be important in pair-bond formation and maintenance. Both male and female kingfishers incubate eggs, and brood and feed nestlings (Jenkins 1983, p. 24). Clutch sizes from wild populations (n=3) were either one or two eggs (Baker 1951, p. 228; Jenkins 1983, p. 24) and clutch sizes of one to three eggs have been reported in the captive population (Bahner et al. 1998, p. 21). Incubation, nestling, and fledgling periods for populations of kingfishers in the wild are unknown. However, incubation and nestling periods of captive birds averaged 22 and 33 days, respectively (Bahner et al. 1998, p. 21). Although there is still more to learn about the breeding behavior of Guam Micronesian kingfishers, it is known that the nest excavation and courtship stages are crucial to successful reproduction. Kingfishers excavate multiple cavities in trees before selecting a suitable nest site. Courtship includes cavity excavation, male feeding the female, and vocal duetting (simultaneous calling between members of a pair). These activities are common and are thought to function in both pair-bond maintenance and territorial maintenance (USFWS 2008a, p. 24; Bahner et al. 1998, p. 18). The breeding season for this species on Guam is reported to range from December to June, however, within the managed population (in captivity) we have seen reproduction in all months of the year with January through July being the prime breeding period. During the breeding season, it is important to minimize disturbance within the territorial range of breeding pairs. Based on experience with the managed population, Guam kingfishers are especially sensitive to stress which would likely be increased by noise and disturbance, and compounded during the breeding season (B. Bahner, Philadelphia Zoo, pers. comm. 2015). Additionally, anything that disrupts the availability of prey items in their territory would be detrimental would negatively affect kingfishers. There is no known recommended buffer around active kingfisher nests; however in captivity nesting kingfishers have sometimes been monitored by cameras to avoid disturbing breeding birds (Bahner et al. 1998).

Environmental Specificity

Adult: Cavity nester

Habitat Narrative

Adult: In the wild, kingfishers nest in cavities and feed primarily in mature, second growth limestone forest, and, to a lesser degree, in scrub limestone forest (Jenkins 1983, pp. 22–23). Kingfishers are also known to use coastal strand vegetation containing coconut palm as well as riparian habitat. However, Jenkins (1983, p. 22) reported the kingfisher was probably most common along the edges of mature limestone forest. Few data exist about specific nest sites of the kingfisher in the wild, but in one study in northern Guam (Marshall 1989), 16 nest sites were correlated with closed canopy cover and dense understory vegetation. The report by Marshall (1989) indicated that kingfisher nest cavities were excavated from the soft, decaying wood of standing dead trees averaging 43cm (17 in) in diameter (Marshall 1989, p. 475). Kingfisher nests have been reported in a number of tree species including Ficus spp. (banyan), Cocos nucifera (coconut), Artocarpus spp. (breadfruit), Pisonia grandis (umumu), and Tristiropsis obtusangula (faniok) (Baker 1951, p. 228; Jenkins 1983, p. 24; Marshall 1989, p. 475).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-Migratory

Population Information and Trends

Population Trends:

Extirpated in wild

Population Narrative:

The kingfisher is currently extirpated from the wild. It was considered "fairly common" and occurred throughout forested areas on Guam in 1945 (Baker 1951, p. 229). Populations in southern and central Guam disappeared by the 1960s (Jenkins 1983, p. 25) and 3,023 individuals were recorded in 1981 in northern Guam (Engbring and Ramsey 1984, p. 34). The northern Guam population subsequently declined rapidly, and by 1985, fewer than 30 individuals were recorded on Guam (Marshall 1989, p. 474) and the taxon was considered extirpated from the wild by 1988 (Wiles et al. 2003, p. 1,354). Predation by the brown treesnake is considered the main cause of the decline of the kingfisher population on Guam (Savidge 1987, USFWS 2008a, p. iv). Between 1984 and 1986, 29 kingfishers were captured and sent to zoological institutions in the U.S. mainland (Hutchins et al. 1996, p. 4). Currently, the captive population consists of 155 adult kingfishers (86 males and 69 females) in captive rearing facilities (GMKF Recovery Team 2015, p.3). In 2015, the Service provided funding to the Boorkfield Zoo in Illinois to install 30 new cages, which would increase the population by more than 25 percent. The goal of the captive kingfisher propagation program is to grow the population while trying to maintain genetic diversity above 90 percent heterozygosity. The current captive population was founded by 16 of the 29 individuals brought into captivity. The current gene diversity is 87.74 percent; with the potential to reach 92.45 percent (AZA 2014, p. 4).

Threats and Stressors

Stressor: Loss or Degradation of Habitat
Exposure:
Response:
Consequence:
Narrative: The Service intends to reintroduce the kingfisher into the wild on Guam. For that effort to be successful, the following threats need to be addressed. The following discussion is adapted from Service (2014, p. 2): • Loss or Degradation of Habitat

Stressor: Loss or Degradation of Habitat
Exposure:

Response:
Consequence:
Narrative: Incremental habitat loss due to fire, especially in southern Guam (Department of Agriculture 2010), and urban and agricultural development is increasingly threatening the long-term conservation of the kingfisher because of the continued loss of habitat on Guam.

Stressor: Loss or Degradation of Habitat
Exposure:
Response:
Consequence:
Narrative: Ongoing and proposed plans by DoD to expand training and operations on Guam are threatening much of the remaining kingfisher habitat.

Stressor: Loss or Degradation of Habitat
Exposure:
Response:
Consequence:
Narrative: The persistence of large, feral ungulate populations is likely to further degrade remaining forest habitats, thus lowering their value for kingfisher recovery.

Stressor: Predation
Exposure:
Response:
Consequence:
Narrative: Predation: Predation risk from brown treesnakes currently prevents effective reintroduction of the kingfisher to Guam.

Stressor: Stochastic Events
Exposure:
Response:
Consequence:
Narrative: Stochastic Events:

Stressor: Stochastic Events
Exposure:
Response:
Consequence:
Narrative: Typhoons will continue to degrade forest and the affected forest areas may require several years to regenerate.

Stressor: Stochastic Events
Exposure:
Response:
Consequence:
Narrative: Although birds in the Mariana Islands have evolved with typhoons, typhoons in concert with low population numbers, habitat loss, and behavioral and genetic consequences of captive breeding could negatively affect the recovery of the Guam Micronesian kingfisher.

Stressor: Stochastic Events
Exposure:
Response:
Consequence:
Narrative: Climate models indicate that hurricanes in the northwestern Pacific are expected to increase in intensity, frequency, and duration by 2200 and continue to increase further into the future (Emanuel et al. 2008, p. 360). These storm increases will likely have a significant effect on habitat and survival of listed species on Guam.

Recovery

Recovery Actions:

- For purposes of this Opinion, the "survival condition" of the kingfisher in the wild represents the level of reproduction, numbers, and distribution necessary to support a persistent population on Guam that is fully protected by the ESA. For purposes of this Opinion, the "recovery condition" of the kingfisher is the survival condition where the threats to the species have been addressed such that the protections of the ESA are no longer necessary to ensure perpetuation of the survival condition of the kingfisher in the wild. The recovery plan (USFWS 2008a) for the kingfisher calls for a total viable population of 2,000 adult kingfishers on Guam within two subpopulations of 1,000 adults each. One subpopulation would be located in northern Guam, and one subpopulation would be located in southern Guam to reduce the risk of a second extirpation event due to random, stochastic events. For the purpose of population viability modeling to identify viable subpopulations that would meet a minimum population growth rate to achieve recovery, we assumed that the 1,000 adults are 500 breeding pairs (see Environmental Baseline section for kingfisher). The area requirements for a breeding pair (approximately 20.0 acres; Kesler and Haig, 2007a) is less than the combined area for an individual non-breeding adult male (average of 17.5 acres; Kesler and Haig 2007a) and an individual non-breeding adult female (average of 14.1 acres; Kesler and Haig 2007a). Thus the total area for recovery will be minimized by assuming all 1,000 adults are in breeding pairs. Additional area may be needed if a significant number of adult kingfishers forgo breeding in any year. Each subpopulation must have brown treesnakes and other predators controlled to a level where establishment of a sustainable kingfisher population is feasible and habitat to support this population level must be protected and managed. In the interim, the kingfisher also may need to be established in the wild on other islands outside their native range to reduce the detrimental consequences of long-term captivity and to spread the risk from stochastic events. Although any population(s) established on other islands outside of the kingfisher's historical range would be considered temporary and would not contribute toward the recovery goal of two subpopulations of 1,000 adults each on Guam, the ability to translocate wild birds versus captive birds to Guam would increase success of their recovery and survival on Guam. However, ultimately the recovery of the kingfisher is dependent on having adequate protected habitat free of threats on Guam to provide for the two subpopulations. New management actions that have occurred in the last five years include: • Construction of the 136-ac (55-ha) Habitat Management Unit (HMU) brown treesnake and ungulate exclosure fence at Anderson Air Force base. Ungulate removal within the HMU is near completion by DoD per a section 7 consultation requirement (USFWS 2006b). • In 2014, the USDA-APHIS Wildlife Services, in coordination with the National Wildlife Research Center, the DoD-Environmental Security Technology Certification Program, and the Department of Interior-Office of Insular Affairs, conducted a test of aerial application of a brown treesnake toxicant (acetaminophen) over forested areas in AAFB (Dorr et al. 2014, unpublished data). The results of this study within the approximately 136-acre (55-hectare) HMU on AAFB may result in the reduction of snake numbers to a low enough level to allow kingfishers to survive and reproduce within this snake-proofed area on Guam. The knowledge gained from this study will help with potential future improvements to the method and efficiency of the delivery of the acetaminophen to snakes on Guam. • Construction of a 312-ac (112-ha) ungulate exclosure fence at Northwest Field on AAFB by DoD per Biological Opinion requirements (USFWS 2006b and USFWS 2006c). • Construction of a multi-species exclosure fence within the fee simple portion of the GNWR at Ritidian Point, Guam. • Construction of 4,400 ft of coated chain link fence along Route 2A on the perimeter of NBG by DoD per Biological Opinion requirements (USFWS 2010a). The fence provides an ungulate exclosure for the 3,114 ac (1,260 ha) of the main base of NBG. The fencing project is intended to effectively close off Orote peninsula from any new ungulate incursions and only entry control gates will be left unfenced. Ungulate removal within NBG is ongoing.

Conservation Measures and Best Management Practices:

- • Maintain or increase genetic diversity in the captive kingfisher population by implementing management strategies to exploit the potential gene diversity in the captive populations at the DAWR and AZA facilities.
- • Predator Monitoring and Control o Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or eradication efforts on Guam.
- • Reintroduction / Translocation o Develop a reintroduction plan for the kingfisher on Guam and set aside and protect recovery areas to facilitate its de-listing as soon as possible following the reintroduction of the kingfisher on Guam.
- • Protection and restoration of kingfisher recovery habitat, including permanent protection as conservation areas and fencing to exclude brown treesnakes and ungulates.

References

USFWS 2016. Status of the Species and Critical Habitat: Todiramphus cinnamominus cinnamominus (Guam Micronesian kingfisher, sihek). U.S. Fish and Wildlife Service 2600 SE 98TH Ave., Suite 100. Portland, OR 97266. Provided to FESTF from Chris Mullens 9/30/2016.

U.S. Fish and Wildlife Service. 2004. Endangered and Threatened Wildlife and Plants

Designation of Critical Habitat for the Mariana Fruit Bat and Guam Micronesian Kingfisher on Guam and the Mariana Crow on Guam and in the Commonwealth of the Northern Mariana Islands

Final Rule. 69 FR 62944 - 62990 (October 28, 2004).

SPECIES ACCOUNT: *Tympanuchus cupido attwateri* (Attwater's greater prairie-chicken)

Species Taxonomic and Listing Information

Commonly-used Acronym: APC

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016)

Physical Description

The Attwater's prairie chicken is a brownish, chunky, hen-like bird with dark bars above and below. Males have short rounded black tails and female's tails are barred. Males have yellow-orange eye combs and both sexes have elongated dark neck feathers, which in males are longer and erected during courtship. Males have large orange air sacs on the sides of their necks and during mating season, they make a "booming" sound, amplified by inflating the air sacs on their necks that can be heard 1/2 mile away.

Current Range

The Attwater's prairie chicken was formerly found throughout Gulf Coast prairies of southwestern Louisiana and Texas, south to the Rio Grande. Presently, less than 200,000 fragmented acres of coastal prairie habitat remain and it is restricted to a narrow band along the Texas coast, some offshore islands, and remnant inland populations (NatureServe website 2007). Currently only two APC populations exist in the wild, one at the Attwater Prairie Chicken National Wildlife Refuge in Colorado/Austin County and one on private lands in Goliad County, Texas. There are no known populations of APCs in Aransas, Calhoun, Refugio, and Victoria counties (personal communication, T. Rossignol, Attwater Prairie Chicken National Wildlife Refuge, August 2015).

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The APC diet consists mostly of insects, especially grasshoppers during the summer and at other times eats fruit, leaves, flowers, shoots, seeds, or grain (Campbell 1995).

Reproduction Narrative

Adult: Males gather for communal courtship (10-30 birds) called leks. Breeding begins early April. Clutch size averages about 12. Incubation lasts 23-24 days. Young leave the nest a few hours after hatching; tended by female. Nests are usually located on average 1.6 km from the booming grounds and more than 60% are lost to predation.

Habitat Narrative

Adult: The Attwater's prairie chicken uses different areas of coastal prairie grassland, preferring a variety of short, mid and tall grass prairie. The habitat is usually dominated by tall dropseed (Sporobolus asper), little bluestem (Schizachyrium scoparium), sumpweed (Iva frutescens), broomweed (Xanthocephalum texanum), ragweed (Ambrosia psilostachya) and big bluestem (Andropogon gerardii) (Service 1983). They may use grass areas less than 10 inches in height for courtship, feeding, and to avoid moisture. Grass up to 10-16 inches tall is used for roosting and feeding, whereas 16-24 inches of grass (maximum height) are used for nesting, loafing, feeding, and escape. Interspaces between grass clumps should be relatively open to facilitate movement. Densely vegetated areas over 24 inches in height are generally avoided, but may be used occasionally for protection from inclement weather and predators, and as fall feeding grounds (Service 1983).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Population Information and Trends

Number of Populations:

Two

Population Size:

104

Population Narrative:

In Goliad County, the population peaked in 1974 at 486 birds and declined to 62 by 1982. The 1980 estimate for Refugio County was 726 individuals; declined to 438 by 1982 (Service 1983). The 1982 populations in Austin and Colorado counties were 250 and 200, respectively. Aransas County population in 1982 was estimated at 20. As of 1991, over 2/3 of the wild population (318 birds) occurred in a contiguous area of primarily private land (O'Conner Ranch) in Aransas, Goliad, and Refugio counties. Birds previously occurring on the Tatton Unit of Aransas National Wildlife Refuge have since disappeared. About 1/4 (126 birds) of the remaining population occurred in Austin and Colorado counties, mostly on Attwater Prairie Chicken National Wildlife Refuge. About 30 birds survived on a 120-ha island of prairie habitat in Galveston County, and another 18 birds occurred in Victoria County. In 1999, fewer than 50 birds remained in the wild despite the introduction of 167 birds from a captive breeding program in 1995-1998 on the Attwater Prairie-Chicken National Wildlife Refuge, Colorado County and The Nature Conservancy of Texas' Galveston Bay Prairie Preserve, Galveston County (NatureServe website 2007). Currently, a total of 104 birds are estimated at the last two remaining wild populations, Attwater Prairie Chicken National Wildlife Refuge (2015 estimate of 100 birds) and on private lands in Goliad County, Texas (2015 estimate of 4 birds) (personal communication, T. Rossignol, Attwater Prairie Chicken National Wildlife Refuge, August 2015).

Threats and Stressors

Stressor: Habitat loss
Exposure:

Response:
Consequence:
Narrative: Threats to the Attwater's prairie chicken include habitat loss, fragmentation, and degradation of coastal prairie habitat due to agricultural practices, development, brush invasion, overgrazing; and competition with introduced exotic species (pheasants) (Phasianus colchicus). Losses may also be attributed to fire ants (Solenopsis invicta), wild and feral mammals, and raptors. Areas that are no longer suitable due to overgrazing or habitat succession potentially can be restored by reducing livestock numbers or by instituting a program of prescribed burning (Service 1983).

Recovery

Conservation Measures and Best Management Practices:

- Conservation measures to benefit the Attwater's prairie chicken include creating, restoring, and/or enhancing habitat on private lands in an effort to increase their numbers and distribution. Good range management could produce good patchy, open cover and a diversity of forbes that provide the bulk of adult Attwater's prairie chickens diet. Prescribed burning, which should be completed by late February keeps woody plant invasion under control, reduces growth of vegetation that is too dense for Attwater's prairie chickens, improves plant diversity, improves availability of food, and provides nesting sites and booming grounds for Attwater's prairie chickens. Mechanical or chemical management techniques (dozing, roller chopping, or shredding followed by prescribed burn or herbicide application) helps control of large, dense brush and provide feeding areas and brood habitat and control undesirable plant growth. Shredding during the nesting and brooding season (March through June 15) could result in the destruction of nests and incidental take of young chicks unable to fly. Habitat improvements may result in occupancy by Attwater's prairie chickens. If such occupancy does occur, the landowner can return the restored habitat to baseline conditions and incidental take of the species may occur in the future. Improvements of currently unsuitable habitat adjacent to habitat occupied by Attwater's prairie chickens could also cause the movement of Attwater's prairie chickens from the occupied habitat to the improved habitat. Lack of management may result in the loss of Attwater's prairie. However, if newly created habitat functions as successful nesting habitat for the Attwater's prairie chicken it will provide a source for dispersing young to occupy other nearby suitable habitats.

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USFWS 2016. Status of the Species and Critical Habitat: Tympanuchus cupido attwateri (Attwater's Prairie Chicken). U.S. Fish and Wildlife Service 2600 SE 98TH Ave., Suite 100. Portland, OR 97266. Provided to FESTF from Chris Mullens 9/30/2016.

NatureServe. 2015. NatureServe Central Databases. Arlington, Virginia, U.S.A.

SPECIES ACCOUNT: *Vermivora bachmanii* (Bachman's warbler (=wood))

Species Taxonomic and Listing Information

Listing Status: Endangered; Proposed delisting

Physical Description

From NatureServe (2015): A 12-cm-long bird with a thin, somewhat decurved bill and white undertail coverts; male has yellow forehead, chin, belly, and shoulders, and a black crown and bib (some males have less extensive black and yellow); females have a gray crown and cheeks, a gray or yellow throat and breast, and a yellowish eye ring (Peterson 1980, NGS 1983).

Historical Range

From USFWS (2015): The Bachman's warbler (Vermivora bachmanii) was first discovered in 1832 in South Carolina, and much of the census work and research since then has been concentrated in South Carolina (Hamel and Hooper 1979). This warbler inhabited the southeastern United States in the breeding season and wintered in Cuba and the Isle of Youth (formerly Isle of Pines).

Current Range

From NatureServe (2015): Most recent sightings in I'On Swamp, South Carolina and Tensas River NWR, Louisiana; also on wintering grounds in Cuba (1981).

Distinct Population Segments Defined

No (USFWS 2015)

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: From NatureServe (2015): Eats insects; frequents flowers in winter and may seek nectar as well. Forages in dense foliage high in trees.

Reproduction Narrative

Adult: From USFWS (2015): Breeding habitat is described as palustrine forested wetlands (bottomland hardwoods) with a dense understory of palmetto (Sabal minor) or cane (Arundanaria gigantea). However, one of the most photographed and filmed Bachman's warbler was on territory in a predominantly longleaf pine (Pinus palustris) forest near brackish marsh just outside of Charleston, South Carolina (Chamberlain 1958). Nests were typically found low to the ground from late March through June, and average known clutch size is three to four eggs.

Habitat Narrative

Adult: From NatureServe (2015): Moist deciduous woodland and swamp. In migration and winter also open woodland, pine, and scrub (AOU 1983). Apparently adapted to swampy canebreaks or bamboo thickets (Remson 1986). Variously has been regarded as a bird of virgin bottomland forests and swamp forests, and as a second-growth species (see Morse 1989).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe 2015)

Dispersal

Adult: High (inferred from NatureServe 2015)

Dispersal/Migration Narrative

Adult: This species is a long distance migrant, arriving in breeding habitat in mid-March (NatureServe 2015).

Population Information and Trends

Population Trends:

Presumed extinct (USFWS 2015)

Population Narrative:

From USFWS (2015): The Bachman's warbler has been reported as one of the rarest songbirds in North America (Hamel 1986, Hooper and Hamel 1977) and has not been documented in the United States since 1962 (Hamel and Hooper 1979) and was last observed in Cuba in 1984. The species status is presumed extinct.

Threats and Stressors

Stressor: Habitat loss (USFWS 2015)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2015): On breeding grounds, the loss of habitat from clearing of large tracts of palustrine forested wetland beginning in the 1800's was a major factor in the decline of the Bachman's warbler. Most of the palustrine forested habitat in the Mississippi Valley was converted to agriculture. An increase in logging of remaining southeastern old-growth forests occurred during the period 1880-1910 when the Federal government sold large tracts of land confiscated after the Civil War. During World Wars I and II, many of the remaining large tracts of old-growth bottomland forest were cut and the timber was used to support the war effort (Jackson 2002). In many areas of the southeast, palustrine forested wetlands that were logged have become reestablished and matured. As these forests mature, many of them on private land are again being logged, often by clear cutting. On the wintering grounds of Cuba, there was extensive loss of primary forest wintering habitat due to the clearing of large areas of the lowlands for sugarcane production (Hamel 1986).

Stressor: Collection (USFWS 2015)
Exposure:
Response:
Consequence:
Narrative: From USFWS (2015): Collection of adults and eggs for museum specimens occurred in the late 19th and early 20th century (Hamel 1986). These collections reduced the population of the bird that was already rare even at that time. There is not enough historical information to determine the significance of this factor.

Stressor: Hurricanes (USFWS 2015)
Exposure:
Response:
Consequence:
Narrative: From USFWs (2015): Frequent hurricanes on the Cuban wintering grounds, particularly during the 1930's, have been suggested as a factor in the decline of the species. However, the amount of mortality caused by these storms is unknown (Hamel 1986). Any mortality on the wintering grounds would have exacerbated the impacts of loss of breeding and wintering habitat.

Recovery

Reclassification Criteria:
Not available - this species does not have a recovery plan.

Conservation Measures and Best Management Practices:
- Funding should be appropriate for surveys for the Bachman's warbler throughout its range (USFWS 2015).
- Developing partnerships with ornithologists from Cuba should be a priority (USFWS 2015).
- All reports of Bachman's warbler should continue to be thoroughly investigation and recording in the species' file (USFWS 2015).

References

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USFWS 2015. Bachman's Warbler (Vermivora bachmanii) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Ecological Services Charleston, SC.

USFWS. 2015. Bachman's Warbler (Vermivora bachmanii) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Ecological Services Charleston, SC.

SPECIES ACCOUNT: *Vireo bellii pusillus* (Least Bell's vireo)

Species Taxonomic and Listing Information

Commonly-used Acronym: LBV

Listing Status: Endangered; May 2, 1986 (51 FR 16474).

Physical Description

The least Bell's vireo is a small, olive-gray, migratory songbird (51 FR 16474). They are only 11.5 to 12.5 centimeters (about 4.5 to 5.0 inches) long, with short, rounded wings and short, straight bills. Feathers are mostly dull olive-gray above and whitish below, with a faint white eye ring and wing bars (CDFW 2005). This is a common protective marking in birds; seen from below the bird blends into the clouds, from above it blends into the land cover.

Taxonomy

All four of the subspecies of Bell's vireo are similar in behavior and life history, but are isolated from one another on both the breeding and wintering grounds. The least Bell's vireo (Vireo bellii pusillus) breeds in California and northwestern Baja California, Mexico, and winters in southern Baja California; the eastern Bell's vireo (V. b. bellii) is found in the central United States from Colorado to Tennessee; the Texas vireo (V. b. medius) is distributed in southwestern Texas and eastern Mexico; and the Arizona Bell's vireo (V. b. arizonae) occurs in Arizona, Utah, Nevada, California, and Sonora, Mexico. The three latter species winter at different longitudes on mainland Mexico and thus are apparently geographically segregated from one another on wintering grounds (USFWS 1998). The least Bell's vireo is slightly larger than the Arizona Bell's vireo, while the Arizona subspecies is more brightly colored than the least Bell's vireo (CDFW 2005).

Historical Range

The historical breeding range of the least Bell's vireo extended from interior northern California (near Red Bluff, Tehama County) to northwestern Baja California (51 FR 16474). The subspecies was once widespread and common throughout riparian woodlands in the Central Valley and low-elevation riverine valleys of California and northern Baja California (USFWS 1998). Historically, the San Joaquin and Sacramento valleys were considered to be the center of the vireo's breeding range (USFWS 2006).

Current Range

The populations are currently distributed in southern California, with 54 percent of the total population occurring in San Diego County and 30 percent of the population occurring in Riverside County (USFWS 2006). There has not yet been any meaningful recolonization of the San Joaquin and Sacramento valleys, although one breeding pair was observed in the San Joaquin Valley in 2005 and 2006, and there have been incidental sightings in the Salinas Valley (USFWS 2006).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 2/2/1994.

Legal Description
On February 2, 1994, the Fish and Wildlife Service (Service) designated critical habitat for the least Bell's vireo (Vireo bellii pusillus), an endangered species, pursuant to the Endangered Species Act of 1973, as amended (59 FR 4845 - 4867). This designation encompasses a total of about 36,000 acres at 10 localities in portions of 6 counties in southern California. This designation results in additional protection requirements undersection 7 of the Act for activities that are funded, authorized, or carried out by a Federal agency.

Critical Habitat Designation
The Service is designated critical habitat for the least Bell's vireo at 10 areas encompassing approximately 38,000 acres (15,200ha) in Santa Barbara, Ventura, Los Angeles, San Bernardino, Riverside, and San Diego Counties, California. Critical habitat for the vireo occurs on the Santa Ynez River (Santa Barbara County), Santa Clara River (Ventura and Los Angeles Counties), Santa Ana River (Riverside and San Bernardino Counties), and Santa Margarita River, San Luis Rey River, Sweetwater River, San Diego River, Tijuana River, Coyote Creek, and Jamul-DuLzura Creeks (San Diego County).

1. Santa Ynez River, Santa Barbara County. T. 5 N.,R. 27 W: secs. 1, W½, and 12, all except NE1/4. In addition, all adjacent lands within the following circumscribed area: beginning at a point 0.25 mi south of the northeast corner of sec. 12, T. 5 N., R. 27 W.; thence east about 0.5 mi; thence north about 1.25 mi; thence east approximately 1.3 mi to the intersection of Mono Creek and the Los Prietos Y Najalayegua land grant boundary; thence south about 2.5 mi; thence east approximately 2.6 mi to Agua Caliente Creek (at a point about 0.4 mi north and 0.1 mi east of the Pendola Guard Station); thence south about 0.5 mi; thence east about 1.0 mi; thence south about 0.25 mi; thence east about 0.5 mi; thence south about 0.75 mi to the southwest corner of T. 5 N., R. 25 W., sec. 19; thence east to the southeast corner of T. 5 N., R. 25 W., sec 20; thence south about 0.63 mi; thence west to western boundary of T. 5 N., R. 26 W., sec. 25; thence south about 0.16 mi; thence west to eastern boundary of T. 5 N., R. 26 W., sec. 27; thence north about 0.25 mi; thence west to western boundary of T. S N., R. 26 W., sec. 27; thence north to the northeastern corner of T. 5 N., R. 26 W., sec. 27; thence north to the northeastern corner of T. 5 N., R. 26 W., sec. 28; thence west to the northwest corner of T. 5 N., R. 26 W., sec. 28; thence north to the northeast cornerof T 5 N., R. 26 W.. partially unsurveyed sec. 20 thence west to the northeastcorner of T. 5 N., R. 26 W., unsurveyed sec. 19; thence north about 0.5 mi; thence west to the southeast corner of T. 5 N., R. 27 W., sec. 13 NE1/4; and thence north to the southeast corner of T. 5 N., R. 27W., sec. 12.

2. Santa Clara River, Los Angeles and Ventura Counties. T. 4 N., Rs. 17 and 18 W.: all land within 3,500 feet perpendicularly and generally southward or westward of a line commencing at a point 100 yards west of BM 740 (a point about 2.3 mi east of the intersection of Main Street and State Highway 126 in Piru); thence east along State Highway 126 to its intersection with The Old Road at Castaic Junction; and thence eastward and southward along The Old Road to its intersection with Rye Canyon Road.

3. Santa Asia River, Riverside and San Bernardino Counties. All lands belowthe 543-foot contour in partially surveyed T. 3 S., R. 7 W., within the Prado Flood Control Basin (upstream from Prado Dam). In addition, the following adjacent lands above the 543-foot contour in the Santa Ana River

bottom and within the following boundaries: commencing at a point 0.1 mi east and 0.2 mi north of the southwest corner of sec. 2, T. 3 S., R. 7 W.; thence north about 0.4 mi; thence to a point 0.25 mi east and 0.4 mi north of southwest corner of sec. 31, T. 2 S., R. 6 W.; thence to the northeast corner of sec. 31, T. 2 S., R. 6 W.; thence east 0.35 mi; thence to midpoint of southern section line of sec. 21, T. 2 S., R. 6 W.; thence to a point 0.6 mi south of the northwest corner of sec. 25, T. 2 S., R. 6W.; thence east about 0.6 mi; thence to a point 0.2 mi north of the center of sec. 30, T. 2 S., R. 5 W.; thence east about 0.7 mi; thence to a point 0.6 mi east of the southwest corner of sec. 20, T. 2 S., R. 5 W.; thence east about 0.8 mi; thence 0.6 mi south; thence to a point 0.3 mi north of the southwest corner of sec. 28, T. 2 S., R. 5 W.; thence to a point 0.45 mi north of the southwest corner of sec. 29, T. 2 S., R. 5 W.; thence generally westward and southward along the Riverside Corporation Boundary (as shown on USGS Riverside Quadrangle 1980) to its Intersection with Van Buren Blvd.; thence to a point 0.2 mi east and 0.75 mi south ofthe northwest corner of sec. 27, T. 2 S., R. 6 W.; thence 0.25 mi north; thence 0.7 mi west; thence to a point 0.85 mi north of the southwest corner of sec. 32, T. 2 S., R. 6 W.; thence to a point 0.75 mi west and 0.1 mi south ofthe northeast corner of sec. 6, T. 3 S., R. 6 W.; thence 0.5 mi west; and thence to the 543-foot contour at a point 0.3 mi west of the southeast corner of sec. 2, T. 3 5., R. 7 W.

4. Coyote Creek. San Diego County. T. 9 S., R. 5 E.: secs. 22, N½,S E¼;and 23, SW¼.

5. Santa Margarita River, San Diego County. T. 9 S., R. 3 W.: secs. 4, all lands below the 600-foot contour; 5 SE1/4; 7; and 8. In T 9 S., R. 4 W., Sec. 12 E1/2; 13 NE¼.

6. San Luis Rey River, San Diego County. T. 11 S., R. 5 W.:s ecs. 13, S½NE¼, SE1/4NW1/4, SW1/4; 14, SE¾SW¾, S12SE1/4; and 23, NW1/4. T. 11 S., R. 4 W.: secs. 3, all land north of Murray Road; 4, E½NE¼, E1/2 SE¼SW1/4W½NE¼SE1/4E½NW1/4SE1/4, SW1/4 SE1/4; 7,N½NE¼NE1/4, NW¼NE¼, E½W½. SW1/4SW1/4; 8, N½NE1/4,N½N½NW¼; 9, N1/2SNW1/4; and 18, NW1/4. T. 10 S., R. 4 W.: sec. 34, S1/2SW¼. Surveyed and unsurveyed portions according to the following metes and bounds; bordered on the north by a line commencing at the intersection of North RiverRoad and the surveyed eastern section line ofsec. 3, T. 11 S., R. 4 W.; thence east along said road to its junction with Via Puerta Del Sol; thence east approximately 0.5 mi to State Highway 76 nearest the midpoint of sec. 31, T. 10 S., R. 3 W.; thence northward and eastward along said highway to its intersection with theeastern section line of sec. 27, T. 9 S., R. 2 W.; and bordered on the south by a line commencing at the intersection of Murray Road and the surveyed eastern section line of sec. 3, T. 11 S., R. 4 W.; thence southward and eastward along said road to its junction with State Highway 76; thence eastward and northward along said highway to itsjunction with Santa Fe Avenue; thence southeastward 3,000 feet along said avenue; thence northward along a straight line to Guajome Lake Road at a point 800 feet from thejunction of said road and State Highway 76; thence northwestward along Guajome Lake Road to its junction with said highway; thence eastward along said highway to its junction with River Road in sec. 31, T. 105., R. 3 W.; thence northward along said road to its intersection with the surveyed eastern section line of sec. 20. T. 10 S., R. 3 W.; thence north to andnortheasterly along the 250-foot contour in sec. 21 through partially surveyed sec. 15, T. 10 S., R. 3 W.; thence north to a point about 0.2 mi south of the northwest corner of sec. 14 and continuing along the 300-foot contour from the western section line ofsec. 14 eastward through unsurveyed sec. 11, surveyed secs. 13 and 12, T. 10S., R. 3 W.; and surveyed sec. 18, T. 10S., R. 2 W.; thence east to and along the 325-foot contour through sec. 1, T. 10 S., R. 3 W.; thence south to and along the 350-foot contour in secs. 6 and 5, T. 10S., R. 2 W., and secs. 32 and 33, T. 9 S., R. 2 W., to the northern section line of

sec. 33; thence eastapproximately 1.5 mi to the southeastern corner of sec. 27, T. 9 S., R. 2 W.; and thence north about 0.4 mi to State Highway 76 in Pala.

7. San Diego River, San Diego County. T. 15 S., Rs. 1 and 2 W.: commencing at the intersection of the Second San Diego Aqueduct and Mission Gorge Road; thence eastward along said road to the western-most intersection with Father Junipero Serra Trail; thence northward and eastward along said trail to theeastern-most intersection of said trail and said road; thence eastward along Mission Gorge Road to its intersection with Canton Hills Blvd.; thence northward to its intersection with Canton Oaks Drive; thence westward along said drive to its eastern-most intersection with Inverness Road; thence westward alongsaid road to its intersection with Carlton Oaks Drive; thence westward along said drive to its intersection with Mast Street; thence westward and southward along the 320-foot contour to its intersection with the Second San Diego Aqueducton the north side of the Sail Diego River; thence southeastward along said aqueduct to its intersection with Mission Gorge Road.

8. Sweetwater River, San Diego County. T. 16 and 17 S., R. 1 W.: commencing at the intersection of the 320-foot contour and 116o58o14"W longitude immediately north of the confluence of Sweetweter River and Sweetwater Reservoir; thence eastward along the contour to the intersection of said contour with State Highway 94; thence northward along said highway to its intersection with State Highway 54; thence northeastward along said highway to the San Bernardino Meridian; thence south approximately 1,500 feet to the intersection with the 340-foot contour; thence westward and southward along said contour to the south end of the Steele Canyon Bridge on State Highway 94; thence south approximately 900 feet to the 340-foot contour; thence southwesterly along said contour to its intersection with 116o58o14"W longitude; thence north to starting point.

9. Jarnul-Dulzura Creeks, San Diego County. T. 17 and 18 S., R. 1 E.: commencing from a point approximately 2,200 feet west of BM 515 along Otay Lakes Road, in sec. 5, T. 18 S., R. 1 E.; thence east approximately one mile to the crossing of said road at a bridge over Jamul Creek, including all land within 1,500 feet southward of Otay Lakes Road as measured perpendicularly from the road; thence eastward for about 2.4 mi along said road and including all lands within 1,500 feet northward ofsaid road as measured perpendicularly from the road, and including all lands within 500 feet of said bridge not otherwise included above.

10. Tijuana River, San Diego County. T. 18 S., R 2 W.: secs. 34, S½SE1/4SE1/4; and 35, S½SW¼, SW1/4SW1/4SE¼. T. 19 S., R. 2 W.; secs. 1, W½SW¼NW¾: 2, S½NE¼NE¼, NW¼NE¼, N½SE1/4 NE1/4, N½NE¾NW¾, W½NW¼; 3, N½;and 4, NE¾,N½NW¼.

Primary Constituent Elements/Physical or Biological Features

Primary constituent elements: riverine and floodplain habitats (particularly willow-dominated riparian woodland with dense understory vegetation maintained, in part, in a non-climax stage by periodic floods or other agents) and adjacent coastalsage scrub. chaparral, or other upland plant communities.

Special Management Considerations or Protections

Activities that disturb or remove the primary constituent elements within proposed critical habitat areas may constitute destruction or adverse modification of critical habitat. In the case of the vireo, these activities include: (1) Removal or destruction of riparian vegetation, (2) thinning of riparian growth, particularly near ground level, (3) removal or destruction of adjacent chaparral or other upland habitats used for foraging, and (4) increasesin human-associated or human-induced disturbance.

Life History

Feeding Narrative

Juvenile: See Adult life stage narrative.

Adult: Least Bell's vireos are invertivores that opportunistically prey on insects (beetles, grasshoppers, moths, and caterpillars), spiders, snails, and fruits (NatureServe 2015; USFWS 1998). They glean prey from leaves and bark and occasionally by hovering in the air (NatureServe 2015). Foraging occurs most often in dense brush and less frequently in treetops in riparian and adjacent chaparral habitat (51 FR 16474, NatureServe 2015). Approximately 70 percent of foraging occurs about 180 to 270 m (600 to 900 ft.) from the nest site (51 FR 16474).

Reproduction Narrative

Juvenile: See Adult life stage narrative.

Adult: Least Bell's vireos arrive in their breeding habitats in mid-March to early April, with males arriving in advance of females by several days. Males establish and defend territories through counter-singing, chasing, and sometimes physically confronting neighboring males. Monogamous breeding pairs form, and parents construct a nest over the course of 4 to 5 days (USFWS 1998). Nests are constructed in low thickets (within 1 m [3 ft.] of the ground) along willow-dominated riparian habitat. Egg-laying begins 1 to 2 days after nest construction, and females typically lay three to four eggs per nest. Eggs are incubated by both parents for approximately 14 days. Hatchlings remain in the nest and are fed by both parents for 10 to 12 additional days; adults continue to care for the young for at least 2 weeks after fledging (51 FR 16474; USFWS 1998). Breeding pairs may nest as many as five times in a single breeding season, although most pairs fledge young from only one or two nests. Factors leading to nest failure include nest parasitism by brown-headed cowbirds (Molothus ater), and egg predation by various species (USFWS 1998). Annual rates of fledging success per egg laid have ranged from 0.37 to 0.75 fledgling per egg (USFWS 1998). Least Bell's vireos depart in late August and September for their wintering range in Mexico (51 FR 16474).Between 5 and 29 percent of juveniles survive to their first breeding season (USFWS 1998). Those that survive return to breed after their first winter. Individuals can live up to 7 years, and females can produce as many as 140 eggs during their lifetime (7-year lifespan, three to four eggs per nest, up to five nests per breeding season) (USFWS 1998).

Spatial Arrangements of the Population

Juvenile: Random; territory size ranges from 0.2 to 3.0 hectares (ha) (0.5 to 7.5 acres [ac.]) (USFWS 1998).

Adult: Random; territory size ranges from 0.2 to 3.0 ha (0.5 to 7.5 ac.) (USFWS 1998).

Environmental Specificity

Juvenile: Narrow; specialist or community with key requirements common.

Adult: Narrow; specialist or community with key requirements common.

Tolerance Ranges/Thresholds

Juvenile: Moderate

Adult: Moderate

Site Fidelity

Juvenile: Once birds select a breeding site they often return to it year after year, sometimes even nesting in the same nest tree or shrub (USFWS 1998).

Adult: Once birds select a breeding site they often return to it year after year, sometimes even nesting in the same nest tree or shrub (USFWS 1998).

Habitat Narrative

Juvenile: See Adult life stage narrative.

Adult: Least Bell’s vireos inhabit dense, willow-dominated early successional riparian habitat with lush understory vegetation in the immediate vicinity of water courses (51 FR 16474; USFWS 1998). Optimal least Bell’s vireo habitat consists of riparian woodland vegetation that generally contains both canopy and shrub layers, and includes some associated upland habitats. Two habitat features appear to be essential to least Bell's vireo: (1) the presence of dense cover within 1 to 2 m (3 to 6 ft.) of the ground, where nests are typically placed; and (2) a dense, stratified canopy for foraging (USFWS 1998). The selection of breeding sites does not appear to be limited to riparian stands of a specific age, although least Bell's vireos are characterized as preferring early successional riparian habitat. However, vegetation structure more than simply age appears to be the important determinant of site use; early successional riparian habitat typically supports the dense shrub cover required for nesting, and for a structurally diverse canopy for foraging. Little is known about the least Bell's vireo's wintering habitat requirements, although it appears that they are not exclusively dependent on riparian habitat on the wintering grounds (USFWS 1998).Least Bell’s vireos maintain territories ranging from 0.2 to 3.0 ha (0.5 to 7.5 ac.). They have high site fidelity, often returning to the same breeding site year after year and sometimes even nesting in the same tree or shrub (USFWS 1998). The quantity and integrity of least Bell’s vireo habitat is threatened by human activity including agriculture, construction of dams, water diversion into canals, livestock grazing, and urban development (USFWS 1998; USFWS 2006).

Dispersal/Migration

Motility/Mobility

Juvenile: High; individuals travel approximately 3,200 kilometers (km) (2,000 miles [mi.]) annually between breeding and wintering grounds (USFWS 1998).

Adult: High; individuals travel approximately 3,200 km (2,000 mi.) annually between breeding and wintering grounds (USFWS 1998).

Migratory vs Non-migratory vs Seasonal Movements

Juvenile: Migratory

Adult: Migratory

Dispersal

Juvenile: High; most first-time breeders return to their natal sites to nest, but an average of approximately 20 percent disperse to other drainages as far as 210 km (130 mi.) from their natal sites (USFWS 1998).

Adult: Moderate

Immigration/Emigration

Juvenile: High

Adult: Moderate

Dependency on Other Individuals or Species for Dispersal

Juvenile: No

Adult: No

Dispersal/Migration Narrative

Juvenile: See Adult life stage narrative.

Adult: Least Bell's vireos migrate approximately 3,200 km (2,000 mi.) annually between breeding grounds in southern California and northwestern Baja California, Mexico, and wintering grounds in southern Baja California, Mexico (USFWS 1998). Juveniles breed after their first winter, and most first-time breeders return to their natal nest sites (USFWS 1998). However, approximately 20 percent of first-time breeders disperse to other drainages as far as 210 km (130 mi.) from their natal sites (USFWS 1998). After the first breeding year, most least Bell's vireos return to the same breeding location year after year (USFWS 1998).

Population Information and Trends

Population Trends:

Increasing; population growth has been the greatest in San Diego County (621 percent increase) and Riverside County (2,997 percent increase), with lesser but significant increases in Orange, Ventura, San Bernardino, and Los Angeles counties. The population in Santa Barbara County has declined 54 percent since the original listing, although it is uncertain whether this population was historically significant (USFWS 2006).

Species Trends:

Increasing; the population has grown during each 5-year period since the original listing, although the rate of increase has slowed over the last 10 years. The population has increased tenfold since its listing in 1986, from 291 to 2,968 known territories (USFWS 2006).

Resiliency:

Moderate

Representation:
Moderate

Redundancy:
Moderate

Population Growth Rate:
Long-term decline of greater than 90 percent, short-term increase of greater than 25 percent (NatureServe 2015).

Number of Populations:
Eleven populations in southern California contain approximately 90 percent of the known vireo territories (USFWS 2006).

Population Size:
The number of territories in California was estimated as 2,968, with 84 percent in San Diego and Riverside counties (USFWS 2006). Population size in Mexico is unknown but presumably less than that in the United States (NatureServe 2015).

Resistance to Disease:
Low

Additional Population-level Information:
In 2005 and 2006, one least Bell's vireo breeding pair was observed in the San Joaquin Valley. There have also been sightings of individuals in the Salinas Valley. However, least Bell's vireos do not appear to have successfully recolonized the San Joaquin or Salinas valleys as of 2006 (USFWS 2006).

Population Narrative:
In the long term, the abundance of least Bell’s vireos has declined by more than 90 percent. However, the population has begun to rebound since its listing in 1986; the subspecies has grown tenfold in numbers, with a short-term population growth rate of more than 25 percent. Numbers of least Bell’s vireos have grown during each 5-year period since the subspecies’ listing, although the rate of increase has slowed over the last 10 years (USFWS 2006).There are 11 populations of least Bell's vireo in southern California that contain approximately 90 percent of the known vireo territories (USFWS 2006). The number of territories in California was estimated as 2,968, with 84 percent in San Diego and Riverside counties (NatureServe 2015). Population size in Mexico is unknown, but is presumably less than that in the United States (NatureServe 2015). Population growth has been the greatest in San Diego County (621 percent increase) and Riverside County (2,997 percent increase), with lesser but significant increases in Orange, Ventura, San Bernardino, and Los Angeles counties (USFWS 2006). The population in Santa Barbara County has declined 54 percent since the original listing, although it is uncertain whether this population was historically significant (USFWS 2006).In 2005 and 2006, one least Bell's vireo breeding pair was observed in the San Joaquin Valley. There have also been sightings of individuals in the Salinas Valley. However, least Bell's vireos do not appear to have successfully recolonized the San Joaquin or Salinas valleys as of 2006 (USFWS 2006).

Threats and Stressors

Stressor: Habitat loss and degradation
Exposure: Human activities including agriculture, dam construction, flood control, diverting water to canals, livestock grazing, and urban development.
Response: Habitat loss and degradation.
Consequence: Less available habitat for least Bell's vireos.
Narrative: As human populations increased in California, an estimated 95 percent of riparian woodlands were cleared, primarily for agricultural purposes. Rivers were diked to prevent winter flooding of bottomlands. Dams were built to impound water for agricultural, industrial, and domestic use. As a result, large amounts of least Bell's vireo breeding habitat were inundated or removed. Impounding water upstream and diverting water to canals and cropland lowered water tables downstream so that dense vegetation could not grow or was reduced. Flood control projects and channelization of rivers further reduced available least Bell's vireo habitat. Livestock grazing destroyed the choice lower strata of vegetation preferred by the least Bell's vireo, and provided foraging areas for brown-headed cowbirds. As the state's human population continues to increase, highway projects and urban, commercial, and recreational developments continue to encroach on what little riparian habitat remains. Similar activities are responsible for the decline of riparian habitat in Baja California.

Stressor: Brood parasitism
Exposure: Brood parasitism by brown-headed cowbirds.
Response: Reduced nesting success.
Consequence: Declining populations of least Bell's vireos.
Narrative: Declines in the least Bell's vireo population brought about by extensive habitat loss and degradation have been exacerbated by parasitism by the brown-headed cowbird. Cowbirds are distinguished by their unusual reproductive strategy of laying eggs in the nests of other species, leaving the "host" to raise the cowbird young, generally at the expense of the host's own young. The least Bell's vireo is a common host and readily accepts cowbird eggs, leading to lower nesting success. Nest predation rates on vireos can exceed 60 percent of the vireo nests in a given area within a year, but typical nest predation rates average around 30 percent.

Stressor: Urbanization
Exposure: Urban development.
Response: A.) Displacement of former agriculture and grazing, and B.) Increased habitat fragmentation and decreased riparian/urban buffering.
Consequence: A.) Reducing riparian habitat degradation caused by agriculture, potentially leading to recovery of populations, and B.) Habitat degradation due to fragmentation and proximity to urban development, potentially leading to increased predation and reductions in population size.
Narrative: Urbanization appears to have displaced former agriculture and grazing operations in many areas in southern California, thereby indirectly reducing riparian habitat degradation caused by these activities. Agriculture and grazing continue to threaten riparian habitat within the larger historic range, particularly in the Salinas, San Joaquin, and Sacramento valleys. Where the impacts of grazing and agriculture are reduced as a consequence of displacement by urbanization, improved habitat quality may come at the cost of increased habitat fragmentation and decreased riparian/urban buffering.

Stressor: Invasive plants

Exposure: Invasion by giant reed and other exotic plant species.
Response: Displacement of riparian habitat.
Consequence: Less available habitat for least Bell's vireos.
Narrative: In the past decade, control of giant reed and other exotic plants has been and continues to be systemically conducted on both the Santa Ana River and at Camp Pendleton. This effort has been effective at removing giant reed over large portions of these specific population areas. Recovery of riparian habitat after giant reed removal has been limited at some locations, but recovery has been more noticeable on the Santa Ana River near Prado Basin. Although control of giant reed has made great progress since the original listing of the vireo, invasions by other exotic plants (e.g. Tamarix species and perennial pepperweed [Lepidium latifolium]) continue to degrade existing riparian habitat and impede recovery efforts.

Stressor: Predation
Exposure: Increased exposure to predators at urban interfaces.
Response: Higher rates of predation.
Consequence: Potential for local extirpation of small, isolated least Bell's vireo populations.
Narrative: In highly urbanized areas, where habitat is fragmented and upland plant community buffers are minimal or nonexistent, there is a potential for an increase in nest and adult predation due to mesopredator release and/or the addition of nonnative predators (i.e., domestic cats [Felis catus]). This may lead to local extirpation of small, isolated bird populations. Argentine ants (Linepithema humile) has been observed to be a predator of vireo nests where they co-occur. Argentine ants may pose a problem to vireos if the riparian-urban interface of occupied vireo habitat increases without adequate buffers.

Recovery

Reclassification Criteria:
The following criteria are from a draft recovery plan for the least Bell's vireo (USFWS 1998). This plan was never finalized and remains in draft form. The 5-year review suggests revisions that should be made to finalize the recovery plan, including modifying and refining recovery goals and strategies, addressing a solution to the underlying threats that led to the initial decline and listing, and revising downlisting and delisting criteria to incorporate population dynamics and observed growth since the subspecies' listing (USFWS 2006). The 5-year review also recommends downlisting the least Bell's vireo to threatened status (USFWS 2006).

Reclassification to threatened may be considered when the following criterion has been met for a period of five consecutive years: stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, are protected and managed at the following sites: Tijuana River, Dulzura Creek/Jamul Creek/Otay River, Sweetwater River, San Diego River, San Luis Rey River, Camp Pendleton/Santa Margarita River, Santa Ana River, an Orange County/Los Angeles metapopulation, Santa Clara River, Santa Ynez River, and an Anza Borrego Desert metapopulation.

Delisting Criteria:
The following criteria are from a draft recovery plan for the least Bell's vireo (USFWS 1998). This plan was never finalized and remains in draft form. The 5-year review suggests revisions that should be made to finalize the recovery plan, including modifying and refining recovery goals and strategies, addressing a solution to the underlying threats that led to the initial decline and

listing, and revising downlisting and delisting criteria to incorporate population dynamics and observed growth since the subspecies' listing (USFWS 2006). The 5-year review also recommends downlisting the least Bell's vireo to threatened status (USFWS 2006).

Delisting may be considered when the species meets the criterion for downlisting, and the following criteria have been met for five consecutive years:

Stable or increasing least Bell's vireo populations/metapopulations, each consisting of several hundred or more breeding pairs, have become established and are protected and managed at the following sites: Salinas River, a San Joaquin Valley metapopulation, and a Sacramento Valley metapopulation.

Threats are reduced or eliminated so that least Bell's vireo populations/metapopulations listed above are capable of persisting without significant human intervention, or perpetual endowments are secured for cowbird trapping and exotic plant (Arundo) control in riparian habitat occupied by least Bell's vireo.

Recovery Actions:

- The following list includes recovery criteria from the draft recovery plan (USFWS 1998) and recommended future actions from the 5-year review (USFWS 2006). The recovery plan was never finalized and remains in draft form.
- Protect and manage riparian and adjacent upland habitats within the least Bell's vireo's historical range by developing management plans for the 14 population/metapopulation units (Tijuana River, Dulzura Creek/Jamul Creek/Otay River, Sweetwater River, San Diego River, San Luis Rey River, Camp Pendleton/Santa Margarita River, Santa Ana River, Orange County/Los Angeles County, Santa Clara River, Santa Ynez River, Anza Borrego Desert, Salinas River, San Joaquin Valley, and Sacramento Valley), preparing management plans for least Bell's vireo habitats, establishing a protocol for monitoring least Bell's vireo populations and habitat, conducting annual monitoring of the 14 population/metapopulation units, continuing cowbird removal, developing alternative means of controlling cowbird parasitism, controlling nonnative plant species, and establishing perpetual endowments for brown-headed cowbird control and/or exotic plant control in least Bell's vireo habitat (USFWS 1998).
- Conduct research, including identifying additional and potential least Bell's vireo breeding habitat within its historical range (by conducting a statewide inventory of riparian habitat and conducting thorough range-wide surveys); investigating the status of wintering habitat and identifying current or potential threats (including establishing a cooperative agreement with Mexico to obtain information on vireo wintering grounds in Baja California, Mexico); collecting demographic data on least Bell's vireos (by continuing color-banding least Bell's vireos and collecting data for demographic and dispersal analyses, determining the relationships between population density and reproductive characteristics, and determining the relationships between population density and dispersal); investigating the relationship between habitat characteristics, least Bell's vireo behaviors, and access to necessary resources; and developing biocontrol methods for Arundo and other nonnative plant species (USFWS 1998).
- Develop and evaluate least Bell's vireo habitat restoration techniques by implementing long-term monitoring of restoration sites and their use by least Bell's vireos and other riparian species, developing less costly methods of creating sites with the vegetation composition

and structure required by nesting least Bell's vireos, evaluating restoration efforts and effectiveness of methods used, and conducting habitat restoration (USFWS 1998).

- Reintroduce least Bell's vireos to unoccupied habitat in the historical range through translocation (USFWS 1998).
- Evaluate progress of recovery and effectiveness of management and recovery actions, and revise management plans (USFWS 1998).
- Provide public information and education (USFWS 1998).
- Complete a functional recovery plan for the vireo with realistic, objectively based recovery goals (USFWS 2006).
- Provide funding and technical support for further studies investigating continuing threats to the vireo from cowbird parasitism, exotic plant invasion of riparian habitats, and potentially elevated predation pressures due to habitat fragmentation or presence of exotic predators (i.e., domestic cats and Argentine ants) (USFWS 2006).
- Complete an assessment or support other efforts (such as the Riparian Habitat Joint Venture effort) to assess the amount and distribution of riparian habitat in California, including: a) establishment of baseline values for comparison to past and future estimates, including an assessment of various riparian habitat subtypes; b) an evaluation of changes in distribution and connectivity of riparian habitat at different stream-order levels (primary, secondary, tertiary, etc.); and c) an evaluation of the amount of riparian habitat restoration attempted and successfully completed since the listing, including restoration not driven by regulatory compliance (USFWS 2006).
- Develop and implement: a) a systematic survey program to locate vireo re-colonizations of the Salinas, San Joaquin, and Sacramento valleys so that appropriate management can be developed and implemented; and b) systematic survey programs for watersheds in southern California that are no longer regularly surveyed within a given 5-year period (e.g., Dulzura Creek/Jamul Creek/Otay River, San Diego River, San Dieguito River/Santa Ysabel Creek, and San Gabriel River). It is possible that these systematic surveys may need to rely on volunteer efforts organized and supported by the U.S. Fish and Wildlife Service (USFWS 2006).

Conservation Measures and Best Management Practices:

-

Additional Threshold Information:

-
-

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SPECIES ACCOUNT: *Zosterops conspicillatus conspicillatus* (Bridled white-eye)

Species Taxonomic and Listing Information

Listing Status: Endangered/Presumed extinct; Proposed for delisting

Physical Description

Measures about four inches long; has a green upper part and yellow and white lower part. It has a white orbital ring around its eye after which the bird is named. The bridled white-eye has wing and tail feathers that are dark brown with greenish-yellow edges. The females tend to be lighter in color than the males. The Guam subspecies is the largest of the other white-eyes found in Micronesia, and has a gray crown and very prominent "spectacles." (USFWS, 2016).

Taxonomy

The Guam bridled white-eye is a subspecies of Zosterops conspicillatus that is endemic to Guam (USFWS, 2015).

Historical Range

Recorded historically in virtually all habitats at all elevations on Guam (Jenkins 1983). By the mid 1940s, however, the subspecies was considered rare in southern Guam (Stophet 1946), and was last observed in central Guam in the early 1960s (Jenkins - 5 - 1983). By 1983 the population was restricted to northern Guam and was thought to have dropped below 50 individuals (Beck 1984). The last family group, including a fledgling, was observed in the Pajon Basin in 1982, and the last individual was observed at this site in 1983 (Beck 1984). Since 1983, spring bird surveys and other ornithological activities in areas where this species would likely occur have yielded no observations (Wiles et al. 1995; C. Aguon, Guam Division of Aquatic and Wildlife Resources, pers. comm. 2008) (USFWS, 2009).

Current Range

The Guam bridled white-eye has been extirpated in the wild since 1983 (Wiles et al. 1995) (USFWS, 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: It feeds primarily on insects, apparently taking little fruit or nectar (Jenkins 19830 (USFWS, 1990).

Reproduction Narrative

Adult: It apparently nests year-round (Marshall 1949, Jenkins 1983), laying 2 - 3 eggs per clutch (Hartert 1898). The number of clutches per year is unknown (USFWS, 1990).

Habitat Narrative

Adult: The bridled white-eye has been found in the past in most available habitats on Guam including mature, pristine limestone forest (Baker 1951), scrubby second-growth (Tubb 1966), grasslands and foothills of southern and central Guam (Strophet 1946), beach strand (King 1962), wetlands of Agana swamp, and mixed woodlands and second-growth of the northern plateau (Jenkins 1983) (USFWS, 1990).

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available

Population Information and Trends

Population Trends:

Presumed extinct (USFWS, 2015)

Species Trends:

Last seen in 1983 (USFWS, 2015)

Population Narrative:

This subspecies was endemic to Guam, but has not been observed since 1983 and is presumed extinct (USFWS 1990; Wiles et al. 1995; Slikas et al. 2000; USFWS 2009). Captures of individuals for captive breeding were not successful prior to its extirpation (USFWS 2009), therefore recovery is not possible (USFWS, 2015).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: The quantity and quality of potential Guam bridled white-eye habitat on Guam is believed to be declining. However, the extent of these changes is unknown at this time. The U.S. Air Force is in the process of removing approximately 46 hectares (114 acres) of potential habitat from the Northwest Field area of Andersen Air Force Base (U.S. Air Force 2006a; N. Mitton, pers. comm. 2007) and has proposed clearing an additional 74 hectares (183 acres; U.S. Air Force 2006b). While large stands of relatively intact native forest can still be found on military lands and in the rugged interior areas of northern and southern Guam, some of these areas may be further fragmented and degraded by development activities and road building in the coming years (U.S. Air Force 2006b; Daleno 2007; U.S. Navy 2007a, b). In addition, feral pigs and deer are believed to be inhibiting the regeneration of native forest species and thus degrading the remaining habitat (USFWS, 2009).

Stressor: Nonnative species (USFWS, 2009)

Exposure:
Response:
Consequence:
Narrative: Much of the remaining forest also has been severely degraded by introduced Philippine deer (Cervus mariannus), feral pigs (Sus scrofa), and feral Asiatic water buffalo (Bubalus bubalis), all of which were introduced to Guam in the 1600s and 1700s (Conry 1988a, Wiles et al. 1999). These introduced ungulates significantly affect native vegetation on Guam by consuming seeds, fruits, and foliage, ingesting or trampling seedlings, and promoting the spread of introduced weeds (Wiles et al. 1999, Wiles 2005). Philippine deer and feral pigs are found throughout Guam (USFWS, 2009).

Stressor: Predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: By 1988, the brown treesnake had eliminated most of the native birds on the island (Wiles et al. 2003), as well as many other native and exotic animal species (Fritts and Rodda 1998). The Guam bridled white-eye's decline followed the same pattern as other forest birds on Guam, white-eyes having been first extirpated in the southern and central portions of the island, where the snake first colonized. In addition to the brown treesnake, other potential white-eye predators persist on Guam and include feral cats, Polynesian rats (Rattus exulans), roof rats (Rattus rattus), Norway rats (Rattus norvegicus), and monitor lizards (USFWS, 2009).

Recovery

Reclassification Criteria:
1. Control and/or eradicate the brown tree snake on Guam (USFWS, 1990).

2. Capture donor stock to establish captive breeding populations, if possible (USFWS, 1990).

Delisting Criteria:
Not available

Recovery Actions:
- Control brown tree snake and other exotic predators and exotic diseases (USFWS, 1990).
- Conduct research needed to manage forest habitat for birds (USFWS, 1990).
- Conduct necessary management activities at existing locations on Guam (USFWS, 1990).

Conservation Measures and Best Management Practices:
- Surveys / inventories – Conduce 5 years of surveys for this species to verify population numbers (USFWS, 2015).

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SPECIES ACCOUNT: *Zosterops rotensis* (Rota bridled White-eye)

Species Taxonomic and Listing Information

Listing Status: Endangered; 01/22/2004; Pacific Region (R1) (USFWS, 2016)

Physical Description

The plumage is tinged with yellow, and the bill, legs, and feet are yellow-orange. The Rota bridled white-eye is approximately four inches in size and average weight is about one-third of an ounce (USFWS, 2016).

Taxonomy

The nosa Luta was originally classified as one of three subspecies of bridled white-eye (Zosterops conspicillatus) found in the Mariana Islands. Stresemann (1931) described subspecies on the islands of Guam (Z. c. conspicillatus); Saipan, Tinian, and Aguiguan (Z. c. saypani); and Rota (Z. c. rotensis; herein referred to as Guam and Saipan bridled white-eyes and nosa Luta respectively). However, based on genetic analyses (Slikas et al. 2000) and observed differences in plumage, vocalizations, and behavior (Pratt et al. 1987, Collar et al. 1994), the nosa Luta is now considered a full species (USFWS, 2007).

Historical Range

Endemic to the island of Rota, U.S. Commonwealth of the Northern Mariana Islands (CNMI) (USFWS, 2016).

Current Range

Currently, the species is primarily restricted to mature forests above 150 meters (490 feet) in the Sabana region of Rota (USFWS, 2007). New in 2019: The nosa Luta is restricted to approximately 300 hectares (741 acres) at elevations above 150 meters (492 feet) elevation (Zarones et al. 2013; Camp et al. 2014) on an island that is approximately 8,550 hectares (21,120 acres), and is thus is highly range restricted. (USFWS, 2019).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 9/12/2006.

Legal Description

On September 1, 2006, the U.S. Fish and Wildlife Service (Service) designated critical habitat for the Rota Bridled White-eye (Zosterops rotensis) pursuant to the Endangered Species Act of 1973, as amended (Act). In total, approximately 3,958 acres (ac) (1,602 hectares (ha)) fall within the boundaries of the critical habitat designation on the Island of Rota, Commonwealth of the Northern Mariana Islands (CNMI) (71 FR 53589 - 53605).

Critical Habitat Designation

One unit of approximately 3,958 ac (1,602 ha) of forested land is designated as critical habitat for the Rota bridled white-eye.

This area contains forested areas on 3,700 ac (1,498 ha) of public and 258 ac (104 ha) of private lands along the slopes and top of the Sabana plateau. Approximately 62 percent (2,292 ac; 928 ha) of the public land within this proposed designation is within the Sabana Conservation Area. This unit is composed of limestone forest, introduced forest, and secondary vegetation that together contain the full range of primary constituent elements needed for long-term conservation of the Rota bridled white-eye. This area was considered occupied at the time the Rota bridled white-eye was listed (69 FR 3022; January 22, 2004) (Fancy and Snetsinger 2001, p. 276) and contains the high-density areas identified by Fancy and Snetsinger (2001, p. 276); the only known nesting areas for the Rota bridled white-eye (Pratt 1985, p. 93; Lusk and Taisacan 1997, p. 183; Amidon 2000, p. 109); and the areas where larger numbers of Rota bridled white-eyes have been regularly observed during surveys since 1982. This unit also contains the primary threats to the conservation of the Rota bridled whiteeye (introduced rats, black drongos, and habitat degradation and loss [Engbring et al. 1986, pp. 10–11; Amidon 2000, pp. 41–43; Fancy and Snetsinger 2001, pp. 278–280]) and requires special management.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Rota, Commonwealth of the Northern Mariana Islands. The primary constituent elements of critical habitat for the Rota bridled white-eye are the habitat components that provide forest above 490 feet (ft) (150 meters (m)) in elevation containing a midstory and canopy layer, high epiphytic plant volume (typically 11 percent or greater), Elatostema and Procris spp. on the ground, and Elaeocarpus joga (yoga), Hernandia labyrinthica (oschal), Merrilliodendron megacarpum (faniok), Pandanus tectorius (kafu), and/or Premna obtusifolia (ahgao) trees as dominant forest components for foraging, sheltering, roosting, and nesting and rearing of young. In addition, the habitat should contain the specific forest components for foraging, nesting, or both, as follows:

(i) Yoga, oschal, faniok, Macaranga thompsonii (pengua), ahgao, Pipturus argenteus (amahadyan), Persea americana (avocado), Ficus tinctoria (hodda), Aglaia mariannensis (mapunyao), Eugenia thompsonii (atoto), Acacia confusa (sosugi), and/or Tarenna sambucina (sumac-lada) trees, and/or Bambusa vulgaris (piao, bamboo) in the canopy or subcanopy for foraging; or

(ii) Yoga, oschal, faniok, and/or sosugi trees 10 to 49 ft (3 to 15 m) tall and 1 to 24 inches (2 to 60 centimeters) diameter at breast height for nesting.

Special Management Considerations or Protections

Critical habitat does not include manmade structures (such as buildings, aqueducts, airports, roads, and other paved areas) and the land on which they are located existing on the effective date of this rule and not containing one or more of the primary constituent elements.

As stated in the final listing rule (69 FR 3022; January 22, 2004), the available information indicates habitat loss and degradation and predation by introduced rats (Rattus spp.) and birds (black drongos (Dicrurus macrocercus)) are threats to the long-term conservation of the Rota bridled white-eye. In addition, the small population size and limited distribution of the species also make it vulnerable to extinction from random environmental events (e.g., typhoons). To address these threats and conserve the species, the following special management actions may be needed: (1) Protection of the remaining stands of mature limestone forest from clearing and modification; (2) restoration of degraded areas; (3) invasive plant control; and (4) rat and black drongo control.

Life History

Feeding Narrative

Adult: Nosa Luta primarily forage in the outer canopy of forests for insects, fruit, or nectar (USFWS, 2007).

Reproduction Narrative

Adult: Observations of breeding activity indicate that nosa Luta breed from at least December to August (Lusk and Taisacan 1997; Amidon et al. 2004). However, the species may breed year-round, as was reported for the Guam bridled white-eye (Marshall 1949, Jenkins 1983), because nesting has been observed in both the wet and dry seasons. Both male and female nosa Luta incubate, brood, and feed nestlings (Amidon et al. 2004). Eggs are light blue and clutch sizes of one to two eggs have been observed (Yamashina 1932, Amidon et al. 2004). Observations of seven active nests indicate that incubation and nestling periods appeared to be at least 10 and as long as 12 days for nosa Luta (Amidon et al. 2004) (USFWS, 2007).

Geographic or Habitat Restraints or Barriers

Adult: Occurs > 492 ft. elevation (USFWS, 2014; see population narrative)

Spatial Arrangements of the Population

Adult: Small groups, flocks (USFWS, 2007)

Habitat Narrative

Adult: Zarones et al. (2013) documented greater abundance of Rota white-eyes in wetter forests with more dense foliage and higher stem density (USFWS, 2014). Like many of the white-eyes in the family Zosteropidae, nosa Luta are gregarious and are often observed in small groups. In contrast, Craig (1989) typically observed Saipan bridled white-eyes in flocks of 10 to 40 individuals. Sightings of nosa Luta have been recorded in limestone forest, introduced Acacia confusa forest, introduced Leucaena leucocephala forest, and secondary vegetation (Craig and Taisacan 1994; Amidon 2000; Fancy and Snetsinger 2001; F. Amidon, unpubl. data). However, the majority of the nosa Luta sightings have been recorded in limestone forest. The primary constituent elements for the nosa Luta include high epiphytic plant volume (typically 11 percent or greater), Elatostema and Procris spp. on the ground, and yoga, oschal, faniok, kafu, and/or ahgao trees as dominant forest components (USFWS, 2007).

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available

Population Information and Trends

Population Trends:

~90% decline since 1982 (USFWS, 2007)

Resiliency:

Very low (inferred from USFWS, 2014)

Population Size:

5,620 - 20,961 (USFWS, 2014). As of 2019: The maximum average population estimate from these surveys was approximately 14,000 birds. (USFWS, 2019).

Population Narrative:

Occupancy models and current distribution patterns indicated that Rota white-eyes are restricted to a small area of forest (approximately 300 hectares [741 acres]) at elevations above 150 meters (492 feet) (Zarones et al. 2013; Camp et al. 2014). Abundance estimates in 2012 range from 5,620 - 20,961 birds (USFWS, 2014). In conclusion, the nosa Luta population has experienced a severe decline in both numbers and distribution over at least the last five decades. Due to the lack of comparable survey information it is not possible to accurately determine the decline of individuals over the full range of this time period. However, the number of individuals appears to have declined by approximately 90 percent since 1982 (USFWS, 2007).

Threats and Stressors

Stressor: Habitat loss and degradation (USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: According to Kanehira (1936), the island of Rota was covered in impenetrable forest in 1932. By 1935, however, Kanehira found most of the island cleared for sugar cane planting. Clearing for other agricultural activities and phosphate mining also occurred during the Japanese Administration of the CNMI (1914 to 1944). Currently, the native forest remaining on Rota is believed to cover less than 60 percent of the island due to homestead and resort development over the last 2 decades. It appears that large areas of mature native forest are being converted into Pandanus tectorius thickets as canopy trees are damaged during typhoons and then die off. These thickets, along with browsing by introduced Philippine deer (binadu, Cervus mariannus) and Cuban slugs (Veronicella cubensis), may be impacting natural regeneration of these forests (USFWS, 2007).

Stressor: Disease (USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: The impact of avian disease on the nosa Luta and other native forest birds on Rota is uncertain due to the lack of formal studies. However, the presence of avian disease has been noted in white-eye populations on Saipan and Tinian (Marshall 1949, Savidge 1986). Savidge (1986) reported during her sentinel studies for species on Guam that of the 63 Saipan bridled white-eyes collected from Saipan, 2 were infected with Plasmodium (avian malaria), and 46 were infected with Haemoproteus, a red blood cell parasite. Savidge also reported that one Saipan bridled white-eye developed pox-like lesions, but the lesions resolved. West Nile virus may pose a significant risk to the nosa Luta if it reaches the Pacific rim. Research indicates that the Japanese white-eye is highly susceptible to west Nile virus (R. Rameyer, BRD, pers. comm. 2005).

As a member of the same genus (Zosterops), the nosa Luta is also expected to be susceptible (USFWS, 2007).

Stressor: Predation (USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: Predation of nosa Luta by black drongos has been proposed to be one of the primary factors in the population decline and range restriction of the nosa Luta (Craig and Taisacan 1994). The one observation of a black drongo eating a nosa Luta by Amidon (in prep.) in 1998 is the only reported observation of black drongo predation on nosa Luta. The impact of these introduced rats on the nosa Luta population is also uncertain. Of eight active nosa Luta nests observed in 1999, two are presumed to have been abandoned or predated by an unknown predator while the remaining six nests successfully fledged chicks (F. Amidon, unpubl. data). Surveillance of six active nests in 2003, 2004 and 2005 using video cameras indicate that eggs in one nest were scavenged by a rat after being abandoned, one nest was preyed upon by a Mariana crow (aga, Corvus kubaryi). The accidental introduction of brown treesnakes is a constant threat due to cargo and flights from Guam to Rota. Saipan has also reported a large number of brown treesnake sightings and shipments from Saipan to Rota may also be a potential threat as well. Other potential nosa Luta predators include feral cats (katu, Felis cattus); monitor lizards (hilitai, Varanus indicus); collared kingfishers; Micronesian starlings; and Mariana crows (USFWS, 2007).

Stressor: Typhoon (USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: There is some evidence that the frequency of severe storms is increasing in the Mariana Islands. The severity of typhoons in the Northwest Pacific appears to have generally increased in the past several decades (Webster et al. 2005), although this apparent trend may have been affected by changes over time in the methodology used for assessing typhoon intensity (Kossin et al. 2007). With reference to Guam, the historical record shows increasing numbers of mild and severe storms in the 1990s (Figure 9). Furthermore, these data are consistent with trends expected on the basis of increasing sea surface temperatures that have been documented in recent years (e.g., Strong et al. 1998; U.S. Department of State 1999). Direct effects include loss of nests, eggs, and nestlings from high winds or death from exposure to high winds and rain. Indirect effects include the loss or reduction of foraging resources or substrates, increased predation due to the temporary loss of cover, and long-term changes in habitat suitability (USFWS, 2007).

Recovery

Reclassification Criteria:
1. Restore population to 10,000 individuals (USFWS, 2014). Added in 2019: Over a minimum 10-year period, nosa Luta population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring (to support 10,000 individuals). (USFWS, 2019).

2. Reduce decline of habitat and restore enough habitat to sustain a population of at least 10,000 individuals (USFWS, 2014).

3. Assess impact of black drongos and rats and implement control of these species if needed (USFWS, 2014).

4. Implement measures to prevent brown treesnake and other threats (USFWS, 2014). In 2019 criterion 3 and 4 were combined, and were to be managed to support criterion 1. (USFWS, 2019).

Delisting Criteria:
Delisting Criterion 1: Over a minimum 20-year period, nosa Luta population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Lambda, greater than or equal to 1) that is statistically significant, as determined through quantitative surveys of abundance, or an index of abundance derived from quantitative surveys or demographic monitoring; and the average population on Rota throughout that time period as estimated from standardized survey techniques is at least 14,000 individuals; or the average population on Rota throughout that time period as estimated from standardized survey techniques is at least 12,000 individuals, and a second self-sustaining population is established on another island. (USFWS, 2019).

Criterion 2: Habitat within the range of the nosa Luta and/or on another island is protected and restoration has been implemented to the extent that the amount of suitable habitat available has increased sufficiently to meet population targets in Criterion 1. (USFWS, 2019).

Criterion 3: Threats to the species, including predation by introduced predators, pesticides, and disease, are effectively managed and mortality is minimized to the extent that population targets in Criterion 1 are met. (USFWS, 2019).

Recovery Actions:
- Manage factors affecting viability of the wild population (USFWS, 2007).
- Evaluate the need for establishing a second nosa Luta population (USFWS, 2007).
- Develop a public awareness program to promote nosa Luta recovery, including native forest restoration (USFWS, 2007).

Conservation Measures and Best Management Practices:
- Population viability monitoring and analysis – Continue population monitoring to establish greater confidence in abundance estimates (USFWS, 2014).
- Predator / herbivory monitoring and control – Continue and expand brown treesnake interdiction on Rota (USFWS, 2014).
- Population biology research – Continue and expand threat assessments for the Rota white-eye to determine mortality factors Continue and expand research into population dynamics to provide information on nest success and survival (USFWS, 2014).
- Habitat and natural process management and restoration – Restore and protect native forest habitat throughout the historic range of the Rota white-eye (USFWS, 2014).

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