

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 of the 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 (*Accipiter striatus*) 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 Maricao Forest and described as a distinct subspecies, *Accipiter striatus venator* (Wetmore 1914). This subspecies is considered part of the “*striatus* Group” (Bildstein et al. 2020) and is considered a valid species in the Integrated Taxonomic Information System (ITIS 2023). There has been recent genetic evidence that the Puerto Rican sharp-shinned hawk, along with two other endangered endemic Caribbean sharp-shinned hawk subspecies should be elevated to species rank, to *A. venator* on Puerto Rico, *A. striatus* on Hispaniola, and *A. fringilloides* on Cuba (Catanach et al. 2021). Although the Service recognizes that there is suggested new taxonomic information related to the species, this information is relatively new and has not undergone a thorough review by the field of experts or supported by additional research. At this time, the remainder of the review will address the entity as it was listed under the Act (i.e., *Accipiter striatus venator*) (USFWS, 2023).

Historical Range

Although the Puerto Rican sharp-shinned hawk was previously known from the Rio Abajo and Guajataca Commonwealth Forests of the karst region, Cruz and Delannoy (1986) did not find any evidence of its 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 of the 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, Orocovi, 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).

Distinct Population Segments Defined

This species was not listed as a DPS, and we have no new information that would indicate the species should be listed as a DPS under the Service's 1996 DPS Policy (USFWS, 2023).

Critical Habitat Designated

No;

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 of the 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 of this 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 platform nests below the canopy on horizontal branches against the trunk or in crotches away from the trunk. Cruz and Delannoy (1986) found that most of the Puerto Rican sharp-shinned hawk activities during early occupancy of nesting 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 of the 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 of Natural 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 caimitillo 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 of the forest (Delannoy 1992). These activities took place in the elfin woodland, sierra palm, caimitillo-granadillo, and tabonuco forest types of the subtropical wet forest and subtropical lower montane wet forest life zones (Department of Natural Resources 1976). A solitary territorial sharp-shinned hawk pair was reported by Delannoy (1992) in the south-central part of the 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 (USFWS, 2023)

Number of Populations:

4

Population Size:

41 (USFWS, 2023)

Population Narrative:

The population of the sharp-shinned hawk declined significantly after the habitat destruction from Hurricane María (Category 4-5 storm) to a low of 19 individuals (Thorstrom 2019). The Peregrine Fund has been conducting yearly surveys since 2015 across known sharp-shinned hawk habitats (Figure 1; Gallardo and Vilella 2017). These included TNCF, MCF, GCF/La Olimpia Forest, CCF, EYNF, and certain private lands in humid montane zones near these forests. The GCF and La Olimpia Forest are two separate forest units managed by PRDNER and Casa Pueblo (a non-profit environmental community-based organization in the municipality of Adjuntas), respectively, but due to their proximity TPF addressed them both as one region. In 2022, a satellite tagged juvenile female was recorded in the municipality of Florida in the karst region (Weaver, TPF, 2023, pers. comm.), though this location is not believed to support resident individuals. Since 2018 surveys have documented 22-37 adult individuals each year (Table 1; Thorstrom 2019-2022, unpublished data from The Peregrine Fund). As of June 2023, current field season (still ongoing) has reported 41 individuals sighted (USFWS, 2023).

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 hawk 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).

Stressor: Urbanization (USFWS, 2023)

Exposure:**Response:****Consequence:**

Narrative: Urbanization and urban sprawl also contribute to declining habitat for the sharp-shinned hawk. Deforestation as a result of power lines installation and maintenance, road construction, and other human expansion threatens to further decrease the amount of viable forestland for the sharp-shinned hawk (USFWS, 2023).

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/km²; GCF = 0.82 pairs/km²; EYNF = 1.03 pairs/km²; MCF = 1.15 pairs/km²; and TNCF = 1.45 pairs/km²) (USFWS, 2018).

Recovery Priority Number: 3

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:

- Conduct surveys and identify habitat.
- Protect and manage populations and habitat.
- Monitor populations.

- Develop an education program.
- Refine recovery goals.
- Implement a captive breeding program to stabilize population to at least pre-hurricane Maria levels. (USFWS, 2018).
- 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).
- 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.
- Additional Site Specific Recovery Actions: 1. Implement a captive breeding program or hacking program for the SSHA to stabilize the populations to atleast pre-hurricane levels to decrease the risk of imminent extinction. Continuing the hacking program until nesting pair densities reach target levels would greatly speed up recovery. This action relates to recovery task 1.9: study the possibility of translocating individuals. 2. Increase monitoring efforts and in particular coordinate with ongoing island-wide acoustic monitoring, especially in areas known to hold BWA and SSHA (e.g. RACF, MCF, EYNF). This action relates to recovery tasks 1: Monitor BWA and SSHA; 1.1: Conduct surveys within the known range of the species and determine population trends; and 1.5: determine spatial and temporal usage of habitat. 3. Plan and implement forest recovery and enhancement efforts in public lands that hold BWA and/or SSHA, as well as surrounding private lands. The goal of the plans and implementation should be to develop mature closed canopy forest of tree species preferred by BWA and SSHA as quickly as possible. We recommend coordinating with U.S. Forest Service, PRDNER, and other partners on existing, ongoing, and future forest recovery and forest management efforts (e.g., hurricane recovery) to assure that preferred tree species are utilized and efforts focus on population centers and connecting corridors. Coordination with agency programs that purchase land or provide conservation easements through landowner agreements (e.g., USFWS Partners Program, USFS Forest Legacy Program, NRCS) is also recommended. This action relates to recovery tasks 2: Protect and manage populations and habitats of the BWA and SSHA; 2.1: develop management plans; 2.2: implement management plans; and 2.4: obtain protective status for habitat on privately owned lands (USFWS, 2019a)

Conservation Measures and Best Management Practices:

- Recovery Activities • Impose limits on logging in or near areas of critical importance to the species. • Work with local government, NGO's and non-profits to implement recovery and conservation

measures for the sharp-shinned hawk. • Repair/enhance damaged habitat left in the wake of Hurricane María. • Reintroduce the species into locations it historically occupied. • Continue supporting nest management activities to mitigate nest-fly parasitism in wild nests. • Develop forest management plans focused on protecting and expanding healthy stands of Caimitillo forest • Engage on large-scale double-clutching, propagation and release activities (8-15 nests). Monitoring / Research Activities • Monitor population size with annual surveys. • Assess survival rate for this species. • Develop a model to determine population-level effects of management activities. • Assess relevant literature (e.g., Catanach et al. 2021) to determine if the sharpshinned hawk warrants listing as a distinct species. • Monitor and document species dispersal to better understand species connectivity between forests. • Research and investigate the threat of rats on nesting success. (USFWS, 2023)

References

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USFWS. 2019a. Recovery Plan for Puerto Rican Broad-Winged Hawk (*Buteo platypterus brunnescens*) and Sharp-Shined Hawk (*Accipiter striatus venator*). 9 pp.

Species Account: *Acrocephalus luscini* (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. luscini* (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. luscini* 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. luscini* 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)

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 1998b). 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • Strategic planning – 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. • Strategic planning – Develop and implement plans to protect and manage upland habitat on Alamagan for nightingale reed-warblers. • Population viability monitoring and analysis – 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). • Conduct research to collect survival data for all life stages, with an emphasis on females and juveniles as recommended in the population viability analysis by Fantle-Lepczyk et al. (2018) • Predator/herbivore monitoring and control – Develop plans for predator control in key areas, keep abreast of research on improvements in predator control, and implement improved methodology. • Conservation finance – Continue work in the Saipan Upland Mitigation Bank (SUMB Addendum 2009). • Population viability monitoring and analysis – 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. • Habitat and natural process management and restoration – 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. • Population biology research – 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). • Predator/herbivore monitoring and control – Continue brown treesnake interdiction to protect Saipan. • Reintroduction/translocation – Develop and implement a plan for establishing nightingale reed-warblers populations on at least three additional islands (see recovery plan USFWS 1998). • Outreach and education – Develop public support for the protection of this endemic species. (USFWS, 2020)
- New management actions: • Commonwealth of the Northern Mariana Islands Division of Fish and Wildlife began conducting a home range study for the species in 2019, which will help inform habitat conservation and restoration efforts in the future. Results of the study are expected in 2021. (USFWS, 2020)

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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)

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). Currently, the Mariana gray swiftlet is only found on the islands of Guam, Aguiguan, and Saipan. Recovery population goals have been exceeded on Saipan, but the population remains below recommended levels on Aguiguan and Guam, with no active caves in northern Guam (Table 1). In addition, the Mariana gray swiftlet has not yet been reestablished on Rota. The new downlisting criteria also require assessment of trends over a minimum 15-year period and surveys have not been collected regularly to assess this metric. Because population goals have not been met throughout its range, not all of the known occupied caves are protected and managed, and the species is still threatened by human disturbance, predation, and other factors (Table 2), the Mariana gray swiftlet remains in danger of extinction. (USFWS, 2020)

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 catus*) 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: Recovery implementation for the Mariana swiftlet should include the following:
 - Population biology research – Identify limiting factors for Mariana gray swiftlet expansion in the Commonwealth of the Northern Mariana Islands.
 - Threats – predator 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.
 - Site / area / habitat protection – Permanently secure and manage the known active swiftlet 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 swiftlets.
 - o Use acoustic monitoring to find verify potential new colonies.
 - o Use LIDAR and other scanning techniques to determine variables for best reintroduction sites.
 - Captive propagation protocol development – Develop methods for translocating swiftlets.
 - Reintroduction / translocation o Develop reintroduction plan for and reintroduce the swiftlet to Rota.
 - o Develop reintroduction plan for and reintroduce the swiftlet to caves of northern Guam.
 - Population viability monitoring and analysis • Develop and implement plans to monitor swiftlet populations on all islands on a regular basis.
 - Conduct a PVA to determine the minimum viable population number by island needed for recovery.
 - Population biology research / Revise recovery objectives and criteria – Conduct specific research on population biology which includes genetic analysis that can be used to develop criteria for delisting and revise downlisting criteria if necessary.
 - The Navy is planning additional management actions, but implementation has been delayed. The following actions are planned:
 - o Permanently secure and manage active swiftlet caves.
 - o Survey for, secure, and manage additional colonies of swiftlets and potentially usable caves.
 - o Conduct specific research on population biology and suspected limiting factors.
 - o Promote population expansion into suitable historical habitat.
 - o Develop and implement techniques for reintroduction of swiftlets into suitable habitat, as needed.
 - o Monitor populations and develop criteria for delisting.
 - o The Navy plans to conduct radio-telemetry on 30 swiftlets to track intermingling between caves thought to be separate populations. (USFWS, 2020)
- New management actions:
 - Predator/herbivore monitoring and control – Efforts continue on Guam to control the brown treesnake at ports of entry and on military lands. Recently, acetaminophen was used as a toxicant to control snakes within a 55-hectare (136-acre) fenced area on Anderson Air Force Base (AAFB), Guam.
 - The Department of the Navy and the U.S. Fish and Wildlife Service have signed a Memorandum of Understanding for Guam Region-Wide Conservation of Forest Resources under the Readiness and Environmental Protection Integration Program.– Under this agreement, management of swiftlet habitat will be undertaken, including... Will improve habitat and specifically identifies swiftlets.
 - Additional acoustic monitoring will be used by Guam DAWR to determine presence at suspected new locations. (USFWS, 2020)

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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:**

Declining (USFWS, 2023)

Number of Populations:

4 (See current range)

Population Size:

High of 1,398 in 1995. Post hurricane Fiona (2022) low of 30 in the southern population (USFWS, 2023)

Minimum Viable Population Size:

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

Population Narrative:

Although not all locations were monitored in every year, the population counts of yellowshouldered blackbirds ranged from a high of 1398 in 1995 (Service 2018) to a low postHurricane Fiona in 2022 when the southwestern population count dropped from 400 to 30 individuals (Table 1). Although birds may have dispersed as a result of the hurricane, the 2023 southwestern population numbers (479 individuals in Bahia Salina) suggest that an increase in adult population occurred after Hurricane Fiona (González-Crespo 2023c, pers. comm.). From 2018 through 2021, there was zero nests found within natural nesting structures, although searches through all available, potential habitat was limited. In 2022 and 2023, several natural nests were identified, 20 and 12 nests respectively (González-Crespo et al. 2023). Although nesting in natural substrates is occurring, it appears that recently the primary nesting for the species is within the artificial nesting structures, likely because of loss of habitat from hurricane damage in the past (Service 2018). Although variable from year to year, yellow-shouldered blackbird natural nesting attempts have generally declined since 1999. This decline has likely been driven by the lack of natural nesting opportunities since the early 2000's and other threats that have reduced nesting success and breeding population size. An additional contributing factor of decline has been direct habitat loss, indirect impacts to nesting success from hurricane damage to habitat (see further discussion below), and likely direct hurricane impacts over individuals. Based on recent studies, fledgling survival is lowest in the first five days after leaving the nest (USFWS, 2023).

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).

Stressor: Invasive species (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: Invasive species can also negatively affect the yellow-shouldered blackbird's survival and reproductive success. This issue has been particularly prominent in the municipality of Ceiba, where González-Crespo et al. (2022) has observed significant numbers of potential opportunistic predators such as feral dogs and cats, and Small Indian mongooses (*Herpestes auropunctatus*) (PRDNER 2022). However, he did not report any incident of predation from these animals on yellow-shouldered blackbirds. Nevertheless, González-Crespo et al. (2023) reported a population of over 40 feral cats being fed by community members at yellow-shouldered blackbird breeding site areas in Ceiba, which increases the potential for predation (PRDNER 2022). Natural nests and fledglings that have poor flight abilities are both particularly vulnerable to predation events and would be unlikely to be detected during monitoring (USFWS, 2023).

Recovery

Reclassification Criteria:

Recovery Priority Number: 2

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)
- 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 where 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).
- Recovery Activities: The following are additional recommendations to help the recovery of the yellow-shouldered blackbird (see the 2018 five-year review for the prior recommended actions).
 - Continue weekly monitoring of yellow-shouldered blackbird nests and removal of shiny cowbird eggs to maximize nesting success of yellow-shouldered blackbirds.
 - Conduct a study to refine the yellow-shouldered blackbird habitat description and suitability in coastal wetlands based on geographical analyses.
 - Develop and implement a comprehensive habitat restoration plan for southwestern Puerto Rico and implement conservations strategies like mangrove restoration, restore appropriate hydrology and salinity levels to improve the habitat conditions.
 - Establish a shiny cowbird trapping project in eastern and southern Puerto Rico during the yellow-shouldered blackbird breeding season to help increase the species' nesting productivity.
 - Focus on areas where yellow-shouldered blackbirds are observed in the municipalities of Ceiba, Salina, and Guayama.
 - Conduct a study to determine if shiny cowbird brood parasitism has a significant impact on eastern and southern populations.
 - Initiate a head start program with chicks, and probably eggs, from the southwestern yellow-shouldered blackbird population to help boost the yellow-shouldered blackbird populations in southern and eastern Puerto Rico.
 - Implement food supplementation (suet bars) in nesting areas, to both aid adults in locating and providing food to their young, and to reduce competition between nestlings.
 - Assess genetic diversity of the populations of yellow-shouldered blackbirds to inform future recovery activities and head start programs.
 - Install artificial nesting structures equipped with sensors to monitor moisture and temperature, and with motion cameras to help determine causes of nests failures.
 - González-Crespo et al. (2023) installed about 15 new artificial nest structures during the 2023 breeding in the Pitahaya Mangrove Forest.
 - Establish an educational and awareness project with the community to protect the wetlands and the yellow-shouldered blackbird populations. (USFWS, 2023).

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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:

Increasing (USFWS, 2023)

Species Trends:

Increasing (USFWS, 2023)

Number of Populations:

Three (USFWS, 2023)

Population Size:

260 (wild); 533 (captive) (2022 Numbers) (USFWS, 2023).

Population Narrative:

At present, there are three wild populations occurring with the release of captive reared birds into the wild as well as recruitment from wild breeding parrots. This species is breeding in the wild at El Yunque National Forest (EYNF), Río Abajo Forest (RAF), and Maricao State Forest (MSF). All three populations are geographically-isolated and distant from each other in different protected forests of Puerto Rico. Interaction between the RAF and MSF may occurred eventually as we have had records of a parrot moving to Lares, a municipality in central-western Puerto Rico, north of MSF and west of RAF). This bird was located about 9.5 miles from RAF, this birds also moved to Mayaguez, Añasco, Las Marias, and Adjuntas Municipalities(J. Rios-Cruz pers, comm. 2022). Additionally, efforts to continue establishing populations along the historical range of the species in Puerto Rico is ongoing since 2000. As a result of those reintroduction efforts, we have added two distinct new wild population since the species was listed in 1967. Due to this, a healthy population in the northern karst region (RAF) have been established and a third wild population was reinitiated in 2022 in the southern part of Puerto Rico (i.e., Maricao State Forest). 2022 Numbers in the Wild: 32 El Yunque National Forest 210 Rio Abajo State Forest 18 Maricao State Forest In addition to birds in the wild, three facilities hold more than 533 captive

Parrots to support reintroduction efforts: the Iguaca Aviary, the José L. Vivaldi Aviary, and in the Maricao State Forest (MSF)/Puerto Rico Department of Natural and Environmental Resources (PRDNER) Fish Hatchery in south-west central, Puerto Rico. These captive facilities work together to safeguard the species to provide a sustainable source of captive reared parrots for fostering and releasing into the wild and serve as genetic reserves capable of mitigating natural catastrophes or disease outbreaks (USFWS, 2023). 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 brunnescens*), 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 (*Philornis 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).

Stressor: Invasive Species (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: Invasive species In the islands of Puerto Rico, we have several invasive species of psittacines, some of them of the same Genus as the Puerto Rican parrot (i.e., *Amazona*). The following are the most common species: 1. Orange-winged Parrot / Orange-winged Amazon (*Amazona amazonica*) 2. Red-crowned Parrot / Red-crowned Amazon (*Amazona viridigenalis*) 3. Yellow-crowned Parrot / Yellow-crowned Amazon (*Amazona ochrocephala*) 4. Yellow-headed Parrot / Yellow head Amazon (*Amazona oratrix*) 5. Turquoise-fronted Parrot / Blue Fronted Amazon (*Amazona aestiva*) 6. White-fronted Parrot / White-fronted Amazon (*Amazona albifrons*) 7. Hispaniolan Parrot / Hispaniolan Amazon (*Amazona ventralis*) 8. Orange-fronted parakeet (*Eupsittula canicularis*) 9. Monk Parakeet (*Myiopsitta monachus*) 10. White-winged Parakeet (*Brotogeris versicolurus*) 11. Red-masked Parakeet (*Psittacara erythrogenys*) 12. Red-and-green Macaw (*Ara chloropterus*) 13. Blue-and-yellow Macaw / Blue and Gold Macaw (*Ara ararauna*) 14. Scarlet Macaw (*Ara macao*) 15. Salmon-crested Cockatoo (*Cacatua moluccensis*) 16. White Cockatoo / Umbrella Cockatoo (*Cacatua alba*) 17. Tanimbar Corella / Goffin Cockatoo (*Cacatua goffiniana*) 18. Budgerigar / Australian Parakeet (*Melopsittacus undulatus*) Based in the best information available (Camacho-Rodríguez et. al. 1999) all of these species and several other has been in Puerto Rico for over 40 years and none of them have been known to compete directly with the Puerto Rican parrot for territories, food and/or breeding areas/cavities. Due to the limited areas where the Puerto Rican Parrot is distributed and the current management strategies, parrots have been staying near the release site. However, over the years we have documented that some of our radiomarked birds moving to other areas and have interacted with other psittacine species. Populations that have exhibited this behavior have been birds from EYNF

and RAF (e.g., road 186 at EYNF and Morovis Municipality parrots from RAF). These birds have returned to the release and breeding site occasionally. This is a common behavior of this social bird species. Competition for cavities or food resources have not been documented. As previously noted, these species may be confused with the Puerto Rican parrot and complicate enforcement of regulations that protect it. (USFWS, 2023)

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.

Recovery Priority Number: 2

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.
- 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 parrots. 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).

Conservation Measures and Best Management Practices:

- RECOMMENDATIONS FOR FUTURE ACTIVITIES Based on the available information on the species, we recommend the following actions: • Continue to manage the aviaries to maximize production of captive birds suitable for releases and continue working cooperatively to maximize the needs for the wild populations. • Continue monitoring wild populations and active nests to maximize their success by assuring the adaptation in its habitat and reproducing successfully. • Continued support with augmentation and other activities to improve chances of a viable third wild population in MSF. • Control depredation by red-tailed hawks in MSF and EYNF and by other predators (i.e., rats, mongoose, and cats) in all breeding areas. • Supplement wild populations in the EYNF and RAF by releasing individuals produced in the aviaries. • Continue releasing birds in large groups (i.e., 25-30) in MSF and continue implementing management strategies in this new habitat due to the different needs (i.e., implement landowners’ approach to conduct habitat improvements), topography (i.e., difficulties conducting telemetry) and challenges due to dispersion. • Continue developing public education and outreach programs for the Parrot, especially in areas with recently reintroduced populations. • Conduct quantitative efforts to estimate relative abundance of the species at all known populations. (USFWS, 2023).

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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

The current range of the CSSS is reduced relative to its historical range, and sparrows have been extirpated from two areas of historical occurrence (Cape Sable and the Ochopee area; Kushlan and Bass 1983). Since the early 1990s, the distribution of the total population has remained relatively unchanged (i.e., the general locations of the subpopulations are the same), but as some subpopulations have declined in numbers of CSSS, they now occupy smaller areas within the overall area of potential breeding habitat for each subpopulation. The distributions, particularly within subpopulations A and D, have contracted in conjunction with hydrologic alterations and habitat degradation in these areas. The distribution of larger subpopulations (i.e., B and E) has remained relatively unchanged, and most birds, often over 95 percent of the total population, inhabit these two subpopulations. Of the six currently occupied subpopulation areas, A, B, and E have historically been considered core subpopulation areas that were potentially capable of supporting relatively large and stable sparrow populations. These areas were identified as important to the persistence of the sparrow (Walters et al. 2000) and could together provide the spatial distribution necessary for the species to persist across its range (Slater et al. 2009). However, the viability of subpopulation A is uncertain because recent population estimates show few birds remain there (USFWS, 2023).

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 be 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 human-caused 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**Population Trends:**

Declining (USFWS, 2023)

Number of Populations:

Six subpopulations (USFWS, 2023)

Population Size:

2,448 individuals based on 2021 survey (USFWS, 2023)

Population Narrative:

The overall CSSS population and subpopulation estimates from helicopter surveys discussed below are also shown in tabular and graphical format in Appendices A and B, respectively. Overall Population Annual CSSS population (helicopter) surveys have resulted in estimates of population size every year since 1992 except for 2020 (Pimm et al. 2002; Appendix A). In 1993, the total CSSS population declined by approximately half from 1992, from an estimated 6,576 individuals to 3,312 individuals. The majority of the decline occurred within subpopulation A, because of flooding that occurred in the area starting in 1993 and continuing through 1995 (Pimm et al. 2002). Since 1993, the total population size has fluctuated, but has remained between 2,416 and 4,048, though significant declines have occurred within several subpopulations (described below). Only two subpopulations, CSSS-B and CSSS-E, have consistently reported estimates of hundreds or thousands of birds (Benscoter et al. 2021). Counts for 2021 based on the range-wide helicopter surveys estimate the total population at 2,448 birds, with the following break down; CSSS-A at 0 birds, CSSS-B at 1,448 birds, CSSS-C at 112 birds, CSSS-D at 288 birds, CSSS-E at 528 birds, and CSSS-F at 32 birds (Appendix A). Although in correspondence with the Miccosukee Tribe in 2020 we discussed stable subpopulations other than subpopulation A, surveys show that some fluctuations appear to have a downward trend. Surveys conducted from 2015 through 2021 show fluctuating subpopulation numbers: appearance of stability or increases in subpopulations C, D, and F, slight declines apparent in subpopulation B and E, and continued low numbers in subpopulation A (Appendix A). During the 2006 to 2008 nesting seasons, intensive localized ground surveys were conducted in subpopulations C, D, and F to better understand these small subpopulations (Lockwood et al. 2006; Boulton et al. 2009). Data collected in these surveys included territory size, fecundity, nest success and survival rates. Results indicate that the small subpopulations exhibit: 1) suppressed breeding, 2) an excess of single males, 3) nest survival comparable to larger subpopulations, 4) low hatch rate, and 5) larger territory sizes than birds in the larger subpopulations. Boulton et al. (2009) concluded that the small subpopulations are demographically dynamic and subject to the negative effects of low densities (e.g., Allee effects); however, Gilroy et al. (2012) did not find evidence of Allee effects when analyzing CSSS nest survival data (USFWS, 2023).

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 (Lockwood 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).

Stressor: Predation (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: Predation is one of the most common causes of nest failure and may affect more than half, and up to 97 percent, of all CSSS nests (Lockwood et al. 1997; Baiser et al. 2008). Predation events occur throughout the day and night (Boulton et al. 2009); snakes, rice rats (*Oryzomys palustris*), raptors, and other predators have been identified as nest predators (Ogden 1972; Dean and Morrison 2001; Pimm et al. 2002; Lockwood et al. 2006). The risk of nest depredation is related to hydrologic conditions, and as water levels rise, nest losses to predators increase (Lockwood et al. 1997). Although CSSS evolved with much of the above-listed predation, the rarity of CSSS makes any predation event significant to the species and becomes especially problematic if a predation event involves death or injury of a breeding adult or prevents another nesting attempt that season (USFWS, 2023).

Stressor: Small population size (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: Threats resulting from a limited distribution and small population size are relevant to CSSS. The small size of subpopulations A, C, D, and F result in reduced resiliency and reduced ability to withstand unfavorable conditions that occur within the scope of natural environmental variability. These subpopulations may consequently be at higher risk of extirpation. This is demonstrated by the frequent decreases in population counts in these subpopulations, frequently going to zero in several years. The limited distribution of the total population also makes it subject to impacts from catastrophic events such as severe weather events (e.g., hurricanes, see below) or disease outbreaks. The limited dispersal of individuals may also reduce chances of recovery or quick recolonization after an extirpation event. Because the three smallest subpopulations (A, C, and F) also occur at the perimeter of the current species' range, extirpation of any of these small subpopulations would result in a further reduction in the species' range (USFWS, 2023).

Stressor: Contaminants (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: Environmental contaminants, specifically methylmercury, could present a threat to CSSS. "Hot spots" have been identified within ENP (Rumbold et al. 2008), and elevated methylmercury levels have been documented in CSSS feather and egg samples (Krabbenhoft 2009). More recently, Virzi et al. (2018) reported preliminary results of their study measuring methylmercury concentrations in CSSS tissue samples collected from 2016-2017. Researchers collected breast feather samples, a less invasive sampling technique than drawing blood, from 128 sparrows in 5 subpopulations, A, B, C, D and E. Mainly adult males were sampled as they are more easily caught, however, female and free roaming juvenile sparrow samples were also collected. Reported methylmercury concentrations were highest in the eastern subpopulations, where known methylmercury hotspots have previously been identified. The other subpopulations, located further west in the Everglades, reported lower concentrations of mercury. Virzi et al. (2018) and other researchers such as Jackson et al. (2011) concluded that these levels are high enough to cause sublethal impacts to reproductive success (e.g., abnormal incubation behavior, embryo mortality, suppressed "begging" cues from nestlings). In general, those birds showing the lowest concentrations of methylmercury had the highest reproductive success (Virzi et al. 2018). However, the sparrow with the highest concentration of methylmercury in the study successfully fledged three young in a single nest (USFWS, 2023).

Stressor: Hurricanes and Fire (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: Surveys following Hurricane Irma and the Keyhole Hammock Fire indicate that natural disasters pose a serious threat to the continued existence of CSSS. Fire and flood regimes have a significant influence on marl prairie structure and composition; thus, water management decisions, fire management decisions, and hurricanes, can affect the suitability of marl prairie habitat for CSSS. (USFWS, 2023)

Recovery**Reclassification Criteria:**

Recovery Priority Number: 3C

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).

Conservation Measures and Best Management Practices:

- RECOMMENDATIONS FOR FUTURE ACTIVITIES x Planning is ongoing for CERP and other restoration projects. Planning and restoration efforts balance a variety of objectives and constraints, some of which may affect the timing or magnitude of the benefits of these actions with regards to CSSS. However, every effort should be made to ensure that restoration plans are consistent with the recovery objectives for CSSS, including water management plans that provide suitable conditions for CSSS to breed within the three core subpopulations (CSSS-A, CSSS-B, and CSSS-E) and provide conditions that allow for habitat restoration in degraded areas. Restoring appropriate hydrological conditions to subpopulation A should be a priority. This area contains the largest amount of potential

sparrow habitat and may have supported more CSSS than any other subpopulation prior to 1981 (Slater et al. 2009). x Near-term implementation of the MWD to Everglades National Park Project and the associated COP should also be consistent with CSSS recovery objectives and aid in improving habitat conditions to allow population recovery. The Service will continue to serve as an active participant in the multi-agency planning efforts for CERP, MWD, and other restoration efforts. x Habitat management and enhancement activities, such as prescribed fire and woody vegetation removal, should be conducted where appropriate in all subpopulations to increase the amount of suitable breeding habitat. x Consistent and intensive population monitoring and research related to habitat management and restoration should continue. x Efforts should be made to maintain and enhance habitat within each subpopulation to improve the potential for dispersal between subpopulations so that genetic diversity can be maintained without the need for captive breeding, translocation, or other artificial genetic augmentation. However, possible translocation projects and genetics research should be considered as translocation may ultimately be the only way to achieve genetic movement between subpopulations. x Consolidate and evaluate the best available scientific information in a Species Status Assessment (SSA) Report (Service 2016b), which includes in-depth evaluation of the species' needs, current condition, and future condition (using threats-based scenarios) to help inform future management actions. Consider developing a Population Viability Analysis to incorporate into an SSA Report (USFWS, 2023).

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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)

Historical Range

The historical range of the Florida grasshopper sparrow is not known with certainty, but there are records from Collier, Miami-Dade, DeSoto, Glades, Hendry, Highlands, Polk, Okeechobee, and Osceola counties (Service 1999). The subspecies' range has contracted considerably and is now known only from remnant habitat patches in Highlands, Okeechobee, Osceola, and Polk counties (USFWS, 2023).

Current Range

As of the 2008 status review (Service 2008), the sparrow was known from three discrete breeding aggregations on public conservation lands at Three Lakes Wildlife Management Area (Three Lakes, Osceola County), Kissimmee Prairie Preserve State Park (Kissimmee Prairie; Okeechobee County), and Avon Park. These breeding aggregations, or spatially disjunct populations, are connected through relatively common dispersal events to form one metapopulation (Delany et al. 2014, Hewett Ragheb et al. 2022 in press). In 2013, an aggregation of grasshopper sparrows was discovered on a private cattle ranch in Osceola County, during a partial survey of the property (FGSP Working Group 2013). The ranch property is located about 14 miles southeast of the core breeding aggregation at Three Lakes and shares approximately 2 miles of its southern border with Kissimmee Prairie. The 27,000-acre property includes an area of about 1,500 to 2,000 acres that is occupied by the Florida grasshopper sparrow. In 2020, the property was donated to the University of Florida, with a conservation easement through Ducks Unlimited, and is now known as the DeLuca Preserve (USFWS, 2023).

Distinct Population Segments Defined

This subspecies was not listed as a DPS, and we have no new information that would indicate the subspecies should be listed as a DPS under the Service's 1996 DPS Policy.

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: The Florida grasshopper sparrow is endemic south-central Florida and occurs in fire-maintained dry prairie and semi-improved pasture habitats. The known range is restricted to four management units under public ownership (Three Lakes, Kissimmee Prairie, Corrigan Ranch, and Avon Park) and one property (DeLuca Preserve) protected in perpetuity with a conservation easement. Evidence suggests that additional birds likely exist on other private lands that are not currently accessible (USFWS, 2023).

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:

3 breeding aggregations (USFWS, 2023)

Population Size:

102 breeding pairs in 2022 (USFWS, 2023)

Additional Population-level Information:

As of the 2008 status review (Service 2008), the sparrow was known from three discrete breeding aggregations on public conservation lands at Three Lakes Wildlife Management Area (Three Lakes, Osceola County), Kissimmee Prairie Preserve State Park (Kissimmee Prairie; Okeechobee County), and Avon Park. These breeding aggregations, or spatially disjunct populations, are connected through relatively common dispersal events to form one metapopulation (Delany et al. 2014, Hewett Ragheb et al. 2022 in press). In 2013, an aggregation of grasshopper sparrows was discovered on a private cattle ranch in Osceola County, during a partial survey of the property (FGSP Working Group 2013). The ranch property is located about 14 miles southeast of the core breeding aggregation at Three Lakes and shares approximately 2 miles of its southern border with Kissimmee Prairie. The 27,000-acre property includes an area of about 1,500 to 2,000 acres that is occupied by the Florida grasshopper sparrow. In 2020, the property was donated to the University of Florida, with a conservation easement through Ducks Unlimited, and is now known as the DeLuca Preserve (USFWS, 2023).

Population Narrative:

As of 2022, there are five known breeding aggregations with 102 confirmed Florida grasshopper sparrow breeding pairs (J. Oteyza pers. comm. 2023), which includes 136 singing males (see

Table 1, above): 1. Three Lakes - Osceola County (Wildlife Management Area): 52 breeding pairs; 70 singing males 2. Kissimmee Prairie - Okeechobee County (State Park): 2 breeding pairs; 4 singing males 3. Avon Park - Polk/Highlands counties (Air Force Range): 18 breeding pairs; 19 singing males 4. DeLuca Preserve - Osceola County (University of Florida conservation easement): 8 breeding pairs; 17 singing males 5. Corrigan Ranch - Okeechobee County (FLDEP ownership): 22 breeding pairs; 26 singing males (USFWS, 2023).

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

Reclassification Criteria:

Recovery Priority Number: 3C

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.

Conservation Measures and Best Management Practices:

- RECOMMENDED FUTURE ACTIVITIES A detailed discussion of recovery actions and criteria are presented in the Recovery Plan and Amendment (Service 1999 and Service 2019) and Recovery Implementation Strategy (Service 1999 and Service 2019). In addition, the Florida Grasshopper Sparrow 5-Year Strategic Vision – a recovery implementation strategy (Vision) outlines necessary objectives and actions to achieve the goal stabilizing and growing the wild population over an initial 5-year period (2019-2023; FWC and Service 2019). The Vision provides recommendations for habitat management, wild population management, and conservation breeding and release, while recognizing the need to identify management actions that can reverse the population decline, reduce and eventually eliminate the need for future captive rearing. During this status review new

and/or targeted potential recovery activities were identified and are included below. 1. The Vision has guided the recovery implementation strategy since 2019. The Vision has a formal checkpoint at years 3 and 5, as well as midpoint check-ins each fall and midbreeding season. At this point we have met the goals and success criteria outlined in the Vision through year 3. The year 5 check-in is coming up in 2024 where the FWC and Service will evaluate success of the recovery implementation strategy according to the following measures: a. Released birds exhibit reproductive behaviors (e.g., song patterns, territory establishment, pair formation) comparable to wild birds. b. Demonstration that at least one of the released age classes can achieve a mean recruitment rate of $\geq 15\%$ for females during 2022–2023. c. All properties with known wild Florida grasshopper sparrow populations have met their habitat management goals. d. FWC staff and partners have continued monitoring and nest protection activities. e. The wild Florida grasshopper sparrow population is extant and has remained stable or increased following the release of captive-reared birds. f. Priority research projects have been completed, and research results indicate promising avenues for arresting and reversing the decline of wild populations without the need for continued captive breeding. Although the 5-year evaluation is not scheduled until January 2024, we have already demonstrated success for measures “a” through “e” above. Though priority research projects identified in the Vision have been completed and the release of captive-reared birds, in combination with the nest protection efforts, have succeeded in arresting and reversing the decline in the wild, there is still a need to continue and expand on the releases to reestablish breeding aggregations at Kissimmee Prairie, and supplement and grow existing populations on other conservation lands, which will facilitate connectivity and gene flow among all breeding aggregations. 2. The trust agencies (FWC and Service) are tasked with drafting a new vision document in 2024 to set the goals and future recovery actions to achieve those goals over the next 5 years, or other time period determined appropriate. This is a recovery priority for the Florida grasshopper sparrow. 3. Little is known about how altered hydrology as a result of land use change affects the reproductive success of the Florida grasshopper sparrow. As ground-nesters, we know that Florida grasshopper sparrow nests are vulnerable to flooding. Changes in rainfall patterns and intensity and frequency of storms as a result of climate change has a potential to impact sparrow reproductive output, which affects the ability of the subspecies to recover. Thus, we recommend the next version of the Vision addresses this research question. 4. Continue to prioritize habitat management using prescribed fire (1-3 year interval) wherever possible on all conservation lands to maintain early-successional prairie habitat. Transition or growing season burns are recommended in unoccupied habitat, which mimic natural fire regimes. In occupied Florida grasshopper sparrow habitat, we recommend burning outside the breeding season to avoid destroying nests and increase the reproductive potential of the resident birds. For working landscapes where prescribed fire may not be available, we recommend mowing as a surrogate to fire with the goal of maintaining open habitat, low grasses and shrubs, and preventing the establishment of trees, which Florida grasshopper sparrow strongly avoid. 5. Continue nest protection efforts (fencing, fire ant treatments) at all monitored sites until solutions can be found to overcome high rates of predation. 6. Continue “lifting” nests, as appropriate, to reduce the impacts of flooding. Though none of the above recommendations are feasible long-term solutions, they are necessary while the population remains vulnerable to extinction. As the population grows and additional breeding aggregations are established, it will be less reliant on these conservation interventions for its persistence.

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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). Island Distribution: Found on Kauai, Hawaii, Molokai, Niihau and Oahu. (USFWS, 2021c)

Critical Habitat Designated

Yes;

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

Number of Populations:

1 (USFWS, 2021c)

Population Size:

2,000 (USFWS, 2021c)

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).

Recovery Actions:

- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: 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. • Other threat monitoring and control – Develop and implement a statewide humane feral mallard and hybrid duck removal plan. • Outreach and education – Conduct a public information and awareness program regarding the mallard-koloa maoli 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 maoli. • 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 maoli. Ensure new stocks of mallards and closely related ducks are not brought into the state. • Predator / herbivore monitoring and control – Continue predator control and implement improved methods as they become

available. • Invasive plant monitoring and control – 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. • 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 maoli as well as other federally listed waterbirds. • Habitat quality monitoring – Research and survey montane stream habitat for koloa maoli. Determine the best way to accurately estimate koloa maoli use of montane stream habitats and incorporate this methodology into the state-wide waterbird surveys. (USFWS, 2021b)

- New management actions: • Climate change degradation of habitat – Climate change is believed to pose a threat to this species. According to the Intergovernmental Panel on Climate Change, human activities have caused a 1 degree Celsius (°C) (1.8 degrees Fahrenheit [°F]) increase in temperature above pre-industrial levels, and if the current rate of warming remains constant, we could reach an increase of 1.5°C (2.7 °F) by the year 2030 (IPCC 2018, A1, p. 6). Regional climate change models predict that the wet windward parts of the Hawaiian Islands may become wetter or remain stable in their seasonal rainfall, while the dry leeward sides would become drier (Timm et al. 2015, p. 92; Ghazal et al 2019, p. 2). Ghazal et al. (2019, entire) assessed the impacts of land use and climate changes on water balance components of the He'eia coastal wetland on Oahu. Based on modeling it is believed that the applied scenarios may negatively affect groundwater recharge and baseflow that in turn adversely influence the groundwater sustainability of wetlands and the ecological functioning of coastal areas (Ghazal et al 2019, p. 14). Under future climate scenarios, rainfall variation was the determining factor most negatively impacting water balance components. Recharge and baseflow components had the highest sensitivity to the combined effects of land use and climate change, particularly during the dry season (Ghazal et al 2019, p. 1). The uncertainty analysis indicated that streamflow is projected to slightly rise by the middle of 21st century, but then likely decline by 40 percent during the late 21st century (Ghazal et al 2019, p. 1). • Recent research by Malachowski (2020, pp. 72–73) found avian botulism to be the primary cause of adult mortality in the koloa maoli. More research should be conducted to better understand the relationship between environmental variables and avian botulism outbreaks (Malachowski 2020, p. 74). (USFWS, 2021b)

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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 (*Cyanocitta 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, Gilchrist, 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, beetles, 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, blueberries, 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. Breninger (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 peninsular 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:

Nevertheless, these four very highly resilient populations support 73% of known family groups on conservation lands (1,580 out of 2,160). The two remaining populations classified with high resiliency have roughly 50 to 45 family groups each (Avon Park Air Force Range and St. Sebastian River Preserve State Park respectively). There are 16 populations (roughly 25%) with moderate resiliency (10 - 39 family groups), and greater than 65% of the assessed populations (42 out of 65) have low resiliency and currently support fewer than 10 family groups. The total number of family groups on conservation lands, based on the 2009-2010 surveys, represent a > 25% decline in abundance since the 1992-1993 surveys (USFWS, 2019a).

Representation:

Genetically diverse species have a higher evolutionary potential and are better able to adapt to changes in their environment over time. Despite the presumed loss of genetic variability that has occurred since pre-settlement times, the variation that still exist is robust. A significant component of this genetic variation occurs across genetic units, several of which exhibit a high

degree of differentiation from one another. Of the 10 genetic units, only 4 genetic units currently have populations with high resiliency and redundancy, which will certainly affect the species' future representation outside of these 4 genetic units (USFWS, 2019a).

Redundancy:

Redundancy refers to the distribution and number of the populations across the landscape (rangeland); redundant, resilient populations reduce the threat of a single catastrophic event threatening the entire species. There are currently 65 Florida Scrub-Jay populations on conservation lands, spanning the entire width and nearly the length of the Florida peninsula, with the highest redundancy in the central inland ridges and the east coastal area (Figure 9). Forty-nine populations (75%) occur in four of the genetic units (A, B, C, and D) with various degrees of connectivity among the populations. Only 7 of the 49 populations in these four genetic units have high population resilience. Eleven populations are categorized as moderate and 31 populations ranked as having low resiliency within these four genetic units. The remaining 16 populations (25%) occurring in the other six genetic units (E, F, G, H, I and K) have low resiliency ranging from one group up to five groups (see Table 5). If the habitat is not well managed with prescribed fire, demographic rates will be lower and local populations will be less resilient. As the population's resiliency declines, inbreeding and loss of genetic diversity are likely to lead to reduced fitness over time, even at population levels considered resilient to demographic and environmental stochasticity. The majority of the local populations are small, highly fragmented, and have poor connectivity. This is exacerbated by the relatively low dispersal distances of Florida Scrub-Jays (USFWS, 2019a).

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 must exhibit a stable or increasing trend 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).
- 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: *Branta (=Nesochen) sandvicensis* (Hawaiian goose (nene))

Species Taxonomic and Listing Information

Listing Status: Region (R1) (USFWS, 2019) The 4(d) rule will provide for the conservation of the nene by specifically prohibiting the following actions that can affect nene, except as otherwise authorized or permitted: Import or export; take; possess and other acts with unlawfully taken specimens; deliver, receive, transport, or ship in interstate or foreign commerce in the course of commercial activity; or sell or offer for sale in interstate or foreign commerce. Start Printed Page 69943 These prohibitions will result in regulating a range of human activities that have the potential to affect nene, including agricultural or urban development; energy development; recreational and commercial activities; introduction of predators; and direct capture, injury, or killing of nene. Regulating these activities will help preserve the species' remaining populations. Under the 4(d) rule, take will generally continue to be prohibited, but the following specific take will be excepted under the Act, provided the additional measures described in the rule are adhered to: Take by landowners or their agents conducting intentional harassment in the form of hazing or other deterrent measures not likely to cause direct injury or mortality, or nene surveys; Take that is incidental to conducting lawful control of introduced predators or habitat management activities for nene; and Take by authorized law enforcement officers for the purposes of aiding or euthanizing sick, injured, or orphaned nene; disposing of dead specimens; and salvaging a dead specimen that may be used for scientific study.

Physical Description

A medium-sized, heavily barred, gray-brown 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). 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 nene 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 nene 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, Molokai, and Hawaii. Highest densities on the Big Island occur in Hawaii Volcanoes National Park 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). 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 tameiameia*, 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). Nene 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 in a variety of habitats, including shrublands, grasslands, and lava flows, and nests are usually concealed under vegetation. 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 reneest in same season if first attempt fails. Nonbreeders form loose flocks during breeding season (NatureServe, 2015). Nene 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 reneested 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: Does not require open water. Commonly returns to same area to nest in successive years. 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. Formerly occupied lowland habitats now destroyed or inhabited by predators. 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)

Number of Populations:

4 (USFWS, 2021c)

Population Size:

As of 2019, the Statewide population of wild Hawaiian geese was estimated to have reached 3,492 individuals; the wild populations on the islands of Hawaii, Maui, Molokai, Kauai were estimated to have 1,107, and 1,077, 497, 27, and 1,891 individuals, respectively (Nene Recovery Action Group [NRAG] 2019, unpublished).

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). 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, Hoshida 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 through 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 (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 (*Megathyrus 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 Niño 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 Kawaihoa 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. 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 (Hoshida 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).
- 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).
- 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 (Bowditch 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 *Callophyllum 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

Population Growth Rate:

Slow (see reproduction narrative)

Number of Populations:

3 (see current range/distribution)

Population Size:

~43 Current island-wide population estimate for the species is 43 individuals, compared to 123 individuals estimated during 2016-2017 (USFWS, 2024).

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. Current island-wide population estimate for the species is 43 individuals, compared to 123 individuals estimated during 2016-2017 (USFWS, 2024).

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).

Recovery Priority Number: 6

Delisting Criteria:

1. Puerto Rican broad-winged hawks and Puerto Rican sharp-shinned hawks occur in at least 75% of their respective suitable habitat (USFWS, 2024).
2. Within the island-wide distribution there will be at least three (3) populations of each species within existing protected areas that show stable or increasing population trends, evidenced by natural recruitment and multiple age classes (USFWS, 2024).
3. Habitat corridors exist between at least three (3) protected areas that support Puerto Rican broad-winged hawks and Puerto Rican sharp-shinned hawk populations (USFWS, 2024).

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).
- 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.

Conservation Measures and Best Management Practices:

- RECOMMENDED FUTURE ACTIVITIES A detailed discussion of recovery actions and criteria are presented in the Recovery Plan Amendment (Service 2019b). During this status review, the following additional recovery activities was identified: Recovery Activities • Plan and implement forest recovery and enhancement efforts on public lands where Puerto Rican broad-winged hawks occur, as well as adjacent private lands. The goals should be to develop mature closed-canopy forest and to improve forest connectivity through the creation of corridors. • Developed and implement a captive breeding program similar to the current Puerto Rican Sharp-shinned hawk propagation program where chicks are released to the wild using hacking techniques in order to increase broad-winged hawk island-wide population to pre-hurricane levels (USFWS, 2024).

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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

Nonbreeding Range: Geolocator and resightings data show definitively that the *rufa* nonbreeding range includes nearly the entire Atlantic and Caribbean coasts of South America and the Caribbean islands; Chiloé Island on the south-central Pacific coast of Chile; the Pacific coast of Panama; the North American Gulf and Atlantic coasts from Tamaulipas, Mexico through Quebec, Canada; the interior of South America; and the interior of the United States and Canada west at least as far as the Great Plains. *Calidris canutus roselaari* also occurs in certain parts of this established *rufa* nonbreeding range. Available data are limited but suggest that the nonbreeding ranges of *C.c. roselaari* and *C.c. rufa* overlap, at least in Texas during spring and in Panama and Chiloé (Newstead pers. comm. 2020) during winter. However, geolocator and resightings data provide strong evidence that *Calidris canutus* on the Pacific coast from northeastern Russia to Las Garzas, Mexico are the *roselaari* subspecies, and we conclude from the best available data that the *rufa* red knot does not occur in this region of the Pacific. Wintering Areas: Wintering areas for the *rufa* red knot include the Atlantic coasts of Argentina and Chile (particularly the island of Tierra del Fuego that spans both countries); the northern coast of South America (particularly in the Brazilian State of Maranhão); the western Gulf of Mexico from the (Mexican State of) Tamaulipas through Texas (particularly at Laguna Madre) to Mississippi, and extending south along both coasts of Central America; and the Southeast United States from Florida (particularly the central Gulf coast) to North Carolina with additional birds throughout the Caribbean (including the Bahamas). Smaller numbers of knots winter in Uruguay and Lagoa do Peixe (Brazil), and along the mid-Atlantic and the Northeast United States. *Calidris canutus* is also known to winter along the Pacific coasts of Mexico, Central America, and South America (between Las Garzas and Chiloé), but it is not yet clear if all these birds are the *rufa* subspecies. Winter area fidelity appears to be high, with minimal intra- and inter-annual movement of birds among wintering regions. Researchers often distinguish between those *rufa* red knots that winter the farthest south (in Argentina and Chile), and therefore undertake the longest-distance migrations ("southern-wintering"), from those that winter farther north in northern Brazil and the Southeast United States ("northern-wintering"), with some notable physiological, genetic, and ecological differences between the two groups. (USFWS, 2020) Breeding Range: The red

knot breeds in the central Canadian Arctic, from the islands of northern Hudson Bay to the Foxe Basin shorelines of Prince Charles and Baffin Islands, and west to Victoria Island (Lathrop et al. 2018, pp. 652, 660). The distribution of rufa red knots from different wintering regions across the breeding grounds is poorly known. (USFWS, 2020)

Critical Habitat Designated

Yes;

Life History**Feeding Narrative**

Adult: On the breeding grounds, the red knot's diet consists mostly of terrestrial invertebrates such as insects and other arthropods. However, early in the breeding season, before insects and other macroinvertebrates are active and accessible, *Calidris canutus* will eat grass shoots, seeds, and other vegetable matter. Nonbreeding Diet: Across all six subspecies, *Calidris canutus* is a specialized molluscivore, eating hard-shelled mollusks, sometimes supplemented with easily accessed softer invertebrate prey, such as shrimp- and crab-like organisms, marine worms, and horseshoe crab (*Limulus polyphemus*) eggs. (USFWS, 2020)

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 tended mostly by males. Females leave the nest soon after hatching and before fledging. Young can fly in about 18 days. (NatureServe, 2015). Pair bonds form soon after the birds arrive on the breeding grounds, in late May or early June, and remain intact until shortly after the eggs hatch. Female rufa red knots lay only one clutch per season and, as far as is known, do not lay a replacement clutch if the first is lost (Niles et al. 2008, p.27). Some knots are thought to be able to lay a second clutch if the first is lost early in incubation, though not later (Morrison pers. comm. 2020). The usual clutch size is four eggs, though three-egg clutches have been recorded. The incubation period lasts approximately 22 days from the last egg laid to the last egg hatched, and both sexes participate equally in egg incubation. Young are precocial, leaving the nest within 24 hours of hatching and foraging for themselves. Females are thought to leave the breeding grounds and start moving south soon after the chicks hatch in mid-July. Thereafter, parental care is provided solely by the males, but about 25 days later (around August 10) males also abandon the newly fledged juveniles and move south. Not long after, they are followed by the juveniles. Breeding success of High Arctic shorebirds such as *Calidris canutus* varies dramatically among years in a somewhat cyclical manner. Two main factors seem to be responsible for this annual variation: abundance of arctic lemmings (*Dicrostonyx torquatus* and *Lemmus sibiricus*) (by indirectly affecting predation pressure on shorebirds) and weather. The growth rate of *C. canutus* chicks is very high compared to similarly sized shorebirds nesting in more temperate climates and is strongly correlated with weather-induced and seasonal variation in availability of invertebrate prey (USFWS, 2020)

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: Breeding Habitat and Diet: Red knots generally nest in dry, slightly elevated tundra locations, often on windswept slopes with little vegetation. Best available information indicates nest sites are within 600 feet of a freshwater wetland, and, although nests are typically within 31 miles (50 kilometers [km]) of the ocean, knots do not typically use saltwater habitats on the breeding grounds. However, the total number of rufa red knot nests studied to date is small and highly concentrated on just one island (Smith pers. comm. 2019). Thus, it is possible that a greater diversity of nesting and foraging habitats is utilized across the breeding range but not yet documented. Nests may be scraped into patches of mountain avens (*Dryas octopetala*) plants, or in low spreading vegetation on hummocky ground containing lichens, leaves, and moss. After the eggs hatch, red knot chicks and adults quickly move away from high nesting terrain to lower, freshwater wetland habitats. Nonbreeding Habitat: Coastal habitats used by red knots in migration and wintering areas are similar in character, generally coastal marine and estuarine habitats with large areas of exposed intertidal sediments. Migration and wintering habitats include both high-energy ocean- or bayfront areas, as well as tidal flats in more sheltered bays and lagoons. Preferred wintering and migration habitats are muddy or sandy coastal areas, specifically, bays and estuaries, tidal flats, and unimproved tidal inlets. Along the U.S. Atlantic coast, dynamic and ephemeral features are important red knot habitats, including sand spits, islets, shoals, and sandbars, features often associated with inlets. In many wintering and stopover areas, quality high-tide roosting habitat (i.e., close to feeding areas, protected from predators, with sufficient space during the highest tides, free from excessive human disturbance) is limited. In nonbreeding habitats, *Calidris canutus* require sparse vegetation and open landscapes to avoid predation. (USFWS, 2020)

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).

Resiliency:

Resiliency describes the ability of populations to withstand stochastic events. Resiliency is positively related to population size and growth rate and may be influenced by the degree of connectivity among populations. Generally speaking, populations need abundant individuals within habitat patches of adequate area and quality in order to withstand or bounce back from environmental or demographic stochastic events (Service 2016, p. 12). *Rufa* red knot populations experience high levels of environmental stochasticity stemming from several aspects of their life history. For example, the coastal habitats occupied by red knots for most of the year are highly dynamic and subject to seasonal and multi-year cycles of erosion and accretion, as well as landform migration (Service 2014, pp. 67, 134). Stochastic weather events commonly affect food availability in both stopover and breeding habitats, and major storms can dramatically alter migration routes (Service 2014, pp. 253-265). Breeding success varies dramatically among years based largely on stochastic factors of weather and predation pressure (Service 2014, p. 32), as discussed above. (USFWS, 2020)

Representation:

Representation describes the ability of a species to adapt to changing environmental conditions over time. It is characterized by the breadth of genetic and environmental diversity within and among populations. Measures may include the number of varied niches occupied, gene diversity, heterozygosity, or alleles per locus (Service 2016, p. 12). Here, we focus primarily on the extent to which this aspect of a species' current condition reflects changes from its historical condition.

See Adaptive Capacity, below, for additional discussion of inherent adaptive capacity and its role in shaping the red knot's future condition. (USFWS, 2020)

Redundancy:

Redundancy describes the ability of a species to withstand or bounce back from catastrophic events (e.g., rescue effect); it's about spreading risk among multiple populations to minimize the potential loss of the species from catastrophic events. Redundancy is characterized by having multiple, resilient populations distributed within the species' ecological settings and across the species' range. It can be measured by population number, resiliency, spatial extent, and degree of connectivity (Service 2016, p. 13). (USFWS, 2020)

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, Bahía 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. 2010a, p. 292; Tulp and Schekkernan 2008, p. 48; Meltote 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).

Criterion 1 (Resiliency, Representation, Redundancy). 10-year average of 35,000 rufa red knots wintering in the Southern Recovery Unit, based on aerial surveys consistent with those conducted in the 1980s and again since 2000. In addition, all of the following are met: a. No fewer than 20,000 birds in any of the most recent 3 years. b. At least 15 percent of the birds, on average, are distributed outside of the main wintering location at Bahía Lomas. These numbers may be adjusted as appropriate if survey methods change and may be updated if new information or assessments indicate that a different level of abundance is necessary to maintain the viability of this population (USFWS, 2023).

Criterion 2 (Resiliency, Representation, Redundancy). 10-year average of 10,000 rufa red knots wintering in the Western Gulf of Mexico/Central America/Pacific Recovery Unit, based on best available information. In addition, all of the following are met: a. 10-year average distribution as follows: i. 3,000 birds in Mississippi/Louisiana; ii. 6,000 birds in Texas/northeastern Mexico; and iii. 1,000 birds on either coast from central Mexico through Panama and along the Pacific coast of South America through Chiloé Island in Chile (with good evidence that these birds are rufa). b. No fewer than 6,000 birds Unit-wide in any of the most recent 3 years. These numbers may be revised if new information or assessments indicate that a different level of abundance is necessary to maintain the viability of this population. This distribution may be updated if new information or assessments indicate that a different geographic distribution is necessary to maintain distinct mid-continental migration flyways (e.g., Mississippi River basin versus central plains) (USFWS, 2023).

Criterion 3 (Resiliency, Representation). Best available information indicates that abundance of rufa red knots in both the North Coast of South America Recovery Unit and the Southeast United States/Caribbean Recovery Unit is stable or increasing for a period of at least 10 years relative to a 2015 baseline (date of listing). This criterion may be revised if new information or assessments indicate that a different level of abundance is necessary to maintain the viability of these populations (USFWS, 2023).

Criterion 4 (Resiliency, Representation). A network of Tier 1 wintering habitats is protected. Tier 1 wintering habitats are likely to be clustered within, but are not limited to, Winter Focal Areas. Tier 1 wintering habitats may include regional habitat complexes if available tracking or resighting data indicate that birds are using a group of habitats as a single wintering unit. When possible, Tier 1 wintering habitats should be delineated to include areas that are important for both roosting and foraging. A Tier 1 wintering habitat is defined as an area meeting one or more of the following conditions, based on best available information. a. Supported at least 5 percent of that Recovery Unit's total wintering population in at least 3 of the past 10 years; b. Supported at least 100 wintering juveniles in at least 3 of the past 10 years. c. Typically (i.e., in at least half of the years) supported at least 10 percent of that Recovery Unit's total wintering population between 11 and 20 years ago, and still provides suitable habitat conditions including adequate food resources; can include sites where rufa red knot use is currently precluded by reversible management practices (USFWS, 2023).

Criterion 5 (Resiliency, Representation). A network of Tier 1 stopover habitats is protected. Tier 1 stopover habitats are likely to be clustered within, but are not limited to, Migration Focal Areas. Tier 1 stopover habitats may include regional habitat complexes if available tracking or resighting data indicate that birds are using a group of habitats as a single stopover unit. When possible, Tier 1 stopover habitats should be delineated to include areas that are important for both roosting and foraging. A Tier 1 stopover habitat is defined as an area meeting any one or more of the following conditions during spring and/or fall migration, or during the breeding season, based on best available information. a. Meets the definition of a rufa red knot migration staging area as per Warnock (2010) (see footnotes 5 and 6). b. In at least 3 out of the past 10 years, supported at least: i. 5 percent of the total rangewide rufa population during migration, regardless of the composition of birds from various Recovery Units; or ii. 5 percent of the Southern Recovery Unit during migration; or iii. 5 percent of the Western Gulf of Mexico/Central America/Pacific Recovery Unit during migration; or iv. 10 percent of the North Coast of South America Recovery Unit during migration; or v. 10 percent of the Southeast United States/Caribbean Recovery Unit during migration; or vi. 100 or more birds during full or partial molt of the flight feathers; or vii. 100 or more juvenile birds during migration and/or the breeding season; or viii. 250 or more nonbreeding adults during the breeding season. c. Typically (i.e., in at least half of the years) supported at least 10 percent of the total rangewide rufa population during migration between 11 and 20 years ago, and still provides suitable habitat conditions including adequate food resources; can include sites where rufa red knot use is currently precluded by reversible management practices (USFWS, 2023).

Criterion 6 (Resiliency, Representation). Robust, long-term, site-specific plans are in place and being implemented for each Tier 1 wintering and stopover habitat (collectively known as Tier 1 nonbreeding habitats), as defined in Criteria 4 and 5, with adequate commitments to ensure that each Tier 1 area is: a. Protected from new/increased impacts associated with development, shoreline stabilization, and incompatible coastal engineering practices. b. Managed to avoid/minimize impacts to rufa red knots from human activities (e.g., recreation, incompatible beach management, aquaculture, hunting). c. Monitored and managed to maintain habitat quality including sufficient food availability and sustainable predation pressure. d. Included in

applicable planning and emergency response documents to minimize risks from oil spills and to appropriately respond to harmful algal blooms. e. Managed to prepare, respond, and adapt to long-term changes such as from accelerating rates of sea level rise, in order to provide continuity of ample, high-quality habitat. The plans will address rufa red knot habitat and conservation needs for all seasons in which knots are present, which may include June and early July if the Tier 1 area supports juvenile birds and/or nonbreeding adults during the breeding season. The plans will include specific threat-abatement activities and commitments to achieve measurable metrics sufficient to support the population targets listed under Criteria 1 through 3 above. Examples of activities include seeking conservation ownership; developing regulatory protections (including compensatory mitigation for unavoidable adverse effects); limiting practices that reduce food availability; managing human activities that cause disturbance; managing predator densities; managing risks from oil spills, wind turbines, and harmful algal blooms; restoring habitat; facilitating the migration of shoreline habitats; and maintaining/restoring natural coastal processes that create and maintain habitat (USFWS, 2023).

Criterion 7 (Resiliency, Redundancy). Assessments and management strategies are complete for Tier 2 nonbreeding habitats. a. A Tier 2 wintering habitat is defined as an area that supports at least 1 percent of that Recovery Unit's total wintering population in at least 3 of the past 10 years, but that do not meet any of the Tier 1 wintering habitat criteria (under Criterion 4). The assessment of Tier 2 wintering habitats will be at the scale of the Recovery Unit. b. A Tier 2 stopover habitat is defined as an area that does not meet any of the Tier 1 stopover habitat criteria (under Criterion 5) but that meets any one or more of the following conditions during spring and/or fall migration. In at least 3 out of the past 10 years, the area supported at least: i. 1 percent of the total rangewide rufa population, regardless of the composition of birds from various Recovery Units; or ii. 1 percent of the Southern Recovery Unit; or iii. 1 percent of the Western Gulf of Mexico/Central America/Pacific Recovery Unit; or iv. 5 percent of the North Coast of South America Recovery Unit; or v. 5 percent of the Southeast United States/Caribbean Recovery Unit. The assessment(s) will attempt to quantify the amount of Tier 2 stopover habitat at a regional, national, or state/provincial scale; the scale of the assessment(s) may vary across the species' range based on data availability. c. Tier 2 habitats also include areas that supported 25 to 99 juvenile birds during any season, in at least 3 of the past 10 years. d. The management strategies will identify threats at Tier 2 nonbreeding habitats and will include commitments to carry out activities and achieve measurable metrics for abating those threats, sufficient to support the population targets listed under Criteria 1 through 3 above (USFWS, 2023).

Criterion 8 (Resiliency). Indices of southbound migrants at the northern-most stopover areas (e.g., James Bay, Mingan Islands, Massachusetts) indicate that reproductive rates are, on average, consistent with stable or increasing population sizes as needed to achieve the population targets identified in Criteria 1 through 3. Indices may include any one or more of the following: (a) two peaks of adult passage (because a single peak suggests males left early after failed breeding); (b) ratios of juveniles to adults; (c) measures of surrogate species whose reproductive patterns have been shown to track well with those of rufa red knots; (d) other metrics developed by species and demographic experts. If newer tracking technology permits more direct measures of reproductive rates, then such measures will be used in place of indices

of migrating birds. Preliminary analysis suggests that an average reproductive rate in the range of 1.5 to 2 chicks hatched per pair may be necessary for a stable population (Wilson and Morrison 2018). However, other target levels of reproductive output may be identified based on updated modeling, and considering the need to increase population sizes in the Southern and the Western Gulf of Mexico/Central America/Pacific Recovery Units. Target reproductive levels may also be refined as new information becomes available regarding the geographic distribution of birds from each Recovery Unit across the breeding grounds. Breeding success of Arctic-breeding shorebirds varies dramatically among years in a somewhat cyclical manner, based largely on stochastic factors of weather and predation pressure (Service 2014, p. 383). Thus, any measure of reproductive rates needs to be a multi-year average. This criterion will initially track a 5-year moving average, but a different time horizon may be adopted if warranted by new information (USFWS, 2023).

Criterion 9 (Resiliency). Mechanisms are in place to monitor breeding habitat via remote sensing, supplemented with direct field observation to the extent warranted and practicable. Key metrics include long-term (20+ years) trends in landscape-scale vegetation patterns, distribution of freshwater wetlands, timing of snowmelt, timing of insect hatch, indices of rodent cycles, and the distribution/abundance of predators. Conservation plans are developed and implemented for any discrete threats to breeding habitat that may be identified, for example to abate habitat damage from goose overpopulation, or to prevent habitat degradation from increased human activities associated with warming conditions (e.g., increased shipping or energy exploration/development) (USFWS, 2023).

Criterion 10 (Resiliency). Juvenile survival and recruitment rates are, on average, consistent with stable or increasing population sizes as needed to achieve the population targets identified in Criteria 1 through 3. Ratios of juveniles to adults on the wintering grounds can be combined with resighting data (e.g., of juveniles marked during southbound migration or on wintering grounds) through modeling to produce estimates of juvenile survival and recruitment and to track these rates over time. However, other methods will be substituted if newer data or alternate techniques produce more robust estimates. Modeling by Schwarzer (2011) found that the Florida population was stable at around 8.75 percent juveniles among wintering birds; the modeled population grew at 13 percent juveniles. Due to high variability in reproductive rates, and high stochasticity in weather and food conditions, we conclude that, on average, at least 10 percent of the Southeast United States/Caribbean and North Coast of South America wintering populations need to be juveniles to maintain stability; and that at least 15 percent of the Southern and Western Gulf of Mexico/Central America/Pacific wintering populations need to be juveniles in order to grow. These target levels may be revised if new information or assessments indicate that different rates/measures of juvenile survival and recruitment are needed to achieve the above targets for each Recovery Unit. For example, other modeling suggests that a higher percentage of juveniles may be needed for population growth (Wilson and Morrison 2018, p. 2), and several factors can bias estimates of juvenile-to-adult ratios. Further work is needed to refine this criterion (USFWS, 2023).

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)(1) 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).
- 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).

- Action 1. Develop methods and track progress toward the recovery criteria. Action 2. Abate threats in nonbreeding areas. Action 2.1 Maintain, enhance and restore habitat (e.g., through land acquisition/protection, avoiding/minimizing degradation and loss, restoration, facilitating shoreline migration, restoring coastal processes, sediment management, nature-based coastal management such as living shorelines). Action 2.2 Maintain and restore ample food supplies. Action 2.3 Limit disturbance and displacement from preferred habitats (e.g., caused by humans, predators, gulls). Action 2.4 Limit direct mortality (e.g. from oil spills, harmful algal blooms, wind turbines, hunting, research). Action 3. Fill key data gaps that limit the effectiveness of recovery activities, including but not limited to tracking technologies, resightings, genetic and chemical analyses, modeling (e.g., demographic, ecological), and research involving captive birds. Action 4. Coordination, communication and outreach. Action 5. Identify and address emerging threats (i.e., threats that were unknown or not fully appreciated at the time of this Recovery Plan). (USFWS, 2023)

Conservation Measures and Best Management Practices:

- The accelerating global and regional rates of sea level rise cannot be slowed by direct action under a recovery plan. However, recovery actions can include responses to sea level rise aimed at slowing or offsetting the associated habitat impacts. For example, carefully designed living shorelines or beach nourishment projects may help retain or restore intertidal habitats impacted by sea level rise. (USFWS, 2020)
- Under the Low Threat/High Conservation Effort scenario shown in table 7, it is likely that, were this to be the future realized, red knot populations would be viable and self-sustaining, and that a status assessment conducted at some point in the future would likely conclude that the rufa subspecies no longer meets the definition of threatened. Under this scenario, ambitious climate mitigation would allow red knots to avoid the most catastrophic systematic impacts (e.g., no loss of essential prey species in migration and wintering areas from marine ecosystem change; no rapid, widespread loss of nonbreeding habitat from sea level rise; no persistent reproductive failures from arctic ecosystem change). This scenario is also optimistic in assuming that the current representation of the rufa red knot remains high and that the inherent adaptive capacity of the rufa red knot (discussed further below) is sufficient to offset the still significant climate-related changes that will occur. Under the Low Threat/High Conservation Effort scenario, red knot population increases are achieved through successful and ongoing conservation actions including careful management of horseshoe crabs; highly protective management of nonbreeding habitats (i.e., sharp reductions in threats such as disturbance and human-facilitated predators); and an increase in the supply of nonbreeding habitats (i.e., due to human retreat from the coasts and unprecedented restoration efforts). (USFWS, 2020)

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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

An analysis of the genetics of this species, resulted in a change to the species' genus from *Caprimulgus* to *Antrostomus* (Han et al. 2010). This change was included in the 53rd supplement to the American Ornithologists' Union Check-list of North American Birds (Chesser et al. 2012) and the Integrated Taxonomic Information System (ITIS 2023). This new taxonomy is accepted by the Service and was included in a proposed rule to recognize the change (Service 2022). Until a final rule is published, we will continue to reference the species using the name as it was listed, *Caprimulgus noctitherus*. (USFWS, 2023).

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. Possibly more numerous than thought (USFWS, 2023)

Population Size:

1,400–2,000 male nightjars distributed across approximately 10,000 hectare (USFWS, 2023)

Population Narrative:

The first study on the abundance of the nightjar was conducted from 1969 to 1971 by Kepler and Kepler (1973). During the study, they reported records of nightjars in the Guánica Commonwealth Forest and the Susúa Commonwealth Forest. They estimated a total population of 450–500 breeding pairs, most of which (80%) were thought to be restricted to the section of the Guánica Commonwealth Forest east of the Guánica Bay (Kepler and Kepler 1973). Vilella and Zwank (1993) conducted a more extensive study during 1985–1992 in more localities across southwest Puerto Rico. Nightjars were found in three main areas in the coastal dry and lower cordillera forests of southwestern Puerto Rico. These included Guánica-Ensenada, SusúaMaricao, and Guayanilla-Peñuelas (Figure 1). They reported the first nightjar records in the Parguera Hills and Sierra Bermeja in southwest Puerto Rico and estimated a population of 1,400–2,000 male nightjars distributed across approximately 10,000 hectares. Historically, its distribution may have included the northern karst from where it was originally described, but currently it is mostly restricted to southern Puerto Rico from Cabo Rojo to Guayama (Reynard 1962, Vilella and Zwank 1993). For example, Vilella and González (2009) detected the presence of the species in the municipalities of Sabana Grande and Guayama. Their study also included searches in the historical karst forest habitat of the Island's north-central region; however, no relict populations were found. We have no new population estimates for the species at this time. Research on abundance suggests nightjars may be more numerous and widely distributed than previously reported (González 2010). On November 24, 2015, Service biologists Angel ColónSantiago and Omar Monsegur conducted a site visit to the location of a proposed residential development in El Tuque in the municipality of Ponce and observed Puerto Rico nightjar individuals in various lots of the proposed development (Residential-Elderly Project; El Tuque, Ponce, FWS/R4/CESFO/72113-002). These observations confirmed the species' presence in the southern dry forest region of the municipality of Ponce (USFWS, 2023).

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).

Stressor: Tourism (USFWS, 2023)

Exposure:

Response:

Consequence:

Narrative: A primary concern revolves around the promotion of tourism and residential development in the coastal municipalities of southwestern Puerto Rico. These activities are expected to have direct or indirect impacts on the dry coastal and lower montane forest habitats that the species depends on for nesting, foraging, and shelter (Factor A). For instance, land use pressures are evident in the areas surrounding the Guánica and Susúa Commonwealth Forests, and even within these protected reserves (Service 2012). The nightjar habitat on private lands in the periphery of the Susúa Commonwealth Forest continues to be disturbed due to road construction and residential development. Additionally, the absence of forest reserves in the

Guayanilla-Peñuelas and El Tuque Ponce region has led to increased fragmentation and deforestation for residential purposes (USFWS, 2023).

Recovery

Reclassification Criteria:

Not available

Recovery Priority Number: 5C

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
- 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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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 range 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, carpal, 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

The eight GUSG populations in southwestern Colorado and southeastern Utah are: • Gunnison Basin; • Poncha Pass; • Crawford; • Cerro Summit-Cimarron-Sims Mesa; • Piñon Mesa; • San Miguel Basin; • Dove Creek; and • Monticello. These eight small GUSG populations occur in eight counties in Colorado and one county in Utah (Figure 4). 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 mi²). 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 (Figure 4). The eight populations of GUSG occupy six different ecoregions, which are areas delineated by common geology, landforms, soils, vegetation, climate, land use, wildlife, and hydrology (EPA 2018). We summarize these ecoregions to highlight ecological differences between the eight GUSG populations, which influence the resources and demographic factors that we later identify, as species needs and drive current condition. We will reference these ecoregion descriptions when evaluating current condition. The Gunnison Basin population is the only population occurring almost entirely in the Southern Rockies ecoregion, Sagebrush Park. Dominant physiographies in this ecoregion are high intermontane valleys, moderate gradient perennial streams with cobble, gravel, and sandy substrates. Primary vegetation includes Wyoming big sagebrush, mountain big sagebrush, black sagebrush, western wheatgrass, bottlebrush squirreltail, and elk sedge, with areas of bunchgrasses including Arizona fescue and mountain muhly (EPA 2006, 21i.). Soils in the Gunnison Basin primarily fall into the Mollisols order, meaning soils are dark, have relatively high amounts of organic matter, are quite fertile, and characteristically formed under grass in climates that have a moderate to pronounced seasonal moisture deficit (USDA 1999, p. 555). These soils are also generally found between the Aridisols of arid environments and Alfisols of more humid environments (USDA 1999, p. 555). Poncha Pass, to the east of Gunnison Basin, falls almost completely in the Arizona/New Mexico Plateau ecoregion, San Luis Shrublands and Hills, which is on the periphery of mid-elevation forests, and the Southern Rockies. This ecoregion contains low mountains, hills, mesas, and foothills ranging in elevation from 7,900 to 9,100 feet. Common soils here are a mix of Aridisols and Mollisols. Aridisols are soils in which water is not available to mesophytic plants (plants not adapted to dry or wet environments) for long periods (USDA 1999, p. 329). Because of the imbalance between evapotranspiration and precipitation, many Aridisols contain salts (USDA 1999, p. 329). This ecoregion also contains Mollisols soils, as described for the Gunnison Basin. Mean annual precipitation is 10 to 14 inches. Natural vegetation includes shrublands, grasslands, and piñon-juniper woodlands at highest elevations. Species include big sagebrush, rubber rabbitbrush, winterfat, western wheatgrass, green needlegrass, blue grama, and needle-and-thread (EPA 2006, 22a). Three populations (Piñon Mesa, Crawford, and CSCSM)

and three subpopulations (Hamilton Mesa, Miramonte Reservoir, and Gurley Reservoir) of the San Miguel population fall in the Colorado Plateau ecoregion of Semiarid Benchlands and Canyonlands. Benches, mesas, cuernas, alluvial fans, hillslopes, cliffs, arches, and canyons characterize this ecoregion, although not all of these features occur in all of these populations (EPA 2006, 20c.). Soil are arid-type soils (Entisols, Aridisols, and Mollisols), often slightly saline and/or calcareous, and mineral soils (NRCS 1999, pp. 421, 555). Natural vegetation includes piñon-juniper woodland, Gambel oak woodland, and sagebrush steppe with black sagebrush, winterfat, Mormon tea, fourwing saltbrush, shadscale, galleta grass, and blue grama (EPA 2006, 20c.). The Dry Creek Basin of the San Miguel population is the westernmost subpopulation of the San Miguel population and primarily falls within the Shale Deserts and Sedimentary Basins ecoregion in the Colorado Plateau (EPA 2006, 20b.). The physiography of Dry Creek Basin is nearly level, with some rolling plains and basins, with benches, low rounded hills, and badlands (EPA 2006, 20b.). The elevation is around 1,940 m (6,365 ft.) above sea level and contains diverse soil groups including Entisols, Aridisols, and Mollisols. Entisol soils occur in areas of recently deposited parent materials or where erosion rates are faster than rates of soil development, such as dunes, steep slopes, and floodplains (USDA 1999, p. 389). Aridisols are too dry for growth of mesophytic (plants adapted to moderate moisture) plants and often accumulate gypsum, salt, and calcium carbonate (USDA 1999, p. 329). Mollisols are more fertile and typically contain more organic matter compared to Aridisols and Entisols. The two eastern-most subpopulations of the San Miguel Basin (Beaver Mesa and Iron Springs) occur in the Southern Rockies ecoregion Sedimentary Mid-Elevation Forests. These subpopulations are near the ecoregion border of Semiarid Benchlands and Canyonlands described previously, so some mixing of physiography, soils, and vegetation is likely. Additionally, there are some small overlaps of the Piñon Mesa, Gunnison Basin and CSCSM occupied ranges onto this ecoregion. Physiography in the Sedimentary Mid-Elevation Forests ecoregion contains low mountain ridges, slopes, and outwash fans. There are moderate to high gradient perennial streams with boulder, cobble, and bedrock substrates (EPA 2006, 21f.). Primary soil orders include Alfisols, Entisols, and Mollisols (EPA 2006, 21f.). Alfisols tend to form a belt between the Mollisols if grasslands and other soil types in climates that are more humid. Mollisols are typically more fertile types of soils, occurring in semiarid to moist areas (USDA 1999, pp. 163, 555). Entisols are soils that are essentially unaltered from their parent material (mineral), thus showing no horizons or layers (USDA 1999, p. 389). Natural vegetation in this ecoregion is Ponderosa pine forest, Gambel oak woodland, and aspen forest, with areas of mountain mahogany and two-needle piñon pine. Shrub vegetation includes antelope bitterbrush, fringed sage, serviceberry, and snowberry and understory grasses of Arizona fescue, bluegrass, Junegrass, needlegrasses, mountain muhly, pine dropseed, and mountain brome (EPA 2006, 21f.). The two western-most populations, Monticello (Utah) and Dove Creek (CO), primarily occur in the Colorado Plateau ecoregion, Monticello-Cortez Uplands. This ecoregion is nearly level to rolling plains and basins containing stream terraces, alluvial fans, and low rolling hills and ridges (EPA 2006, 20a.). Elevation in this ecoregion ranges from 6,000 to 7,300 feet. Primary soil types here fall in the orders of Aridisols, Alfisols, and Entisols (EPA 2006, 20a.) and precipitation ranges 10 to 15 in per year. Natural vegetation includes sagebrush steppe and associated grasses, with scattered piñon-juniper woodland. The dominant species include Wyoming big sagebrush, western wheatgrass, and Indian ricegrass

(EPA 2006, 20a.). Land use and land cover are primarily dryland cropland with some areas of irrigated cropland, shrubland, and rangeland. (USFWS, 2019)

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 pinonjuniper 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 pinonjuniper 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 Pinon 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 Pinon 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, drought-related 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 pinon-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 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-Cimarron-Sims 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 pinonjuniper 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 sage-grouse. 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 pinon-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 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 pinonjuniper 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 reneest if they lose their first nest. In greater sage-grouse (*Centrocercus 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 Committee 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:

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:

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 GRSB (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:

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 mi²). 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 discrete 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 brachyrhynchos*), 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 are not available.

Conservation Measures and Best Management Practices:

- Warm and Wet In the Warm and Wet scenario, annual temperature increases by 2°F by 2035 and 4°F by 2050. Under this scenario, summer temperatures will last a week longer; annual precipitation will increase by 10 percent by 2035 and 8 percent by 2050 (in terms of soil moisture and stream flows, a 5 percent increase in precipitation is needed to offset the 2°F increase in temperature with its associated higher rate of evapotranspiration). Drought years, such as 2002, will occur every 15th year, similar to today's frequency. However, the intensity and severity of droughts will increase because of higher temperatures. While the water stress from 2°F-temperature increase will be offset by a 10 percent increase in precipitation, ecosystems will change in measurable ways. For example, the ratio of warm season to cool season grasses will change, and we could see declines in western wheatgrass and needle and thread grass, while blue gramma and galleta grass expand. The snowline will shift upwards by 600 ft. In this scenario, heat waves similar to 2002 (5°F above normal) will occur once every decade. The fire risk in this scenario is the lowest of any scenario, but fires will be present, and intermittent dry conditions may cause severe fire hazards because of high fuel loads. A 2°F increase in temperature will increase the fire frequency up to four times and the annual area burned by six times. In this scenario, there will be greater than normal winter snowpack above 10,000 ft, and spring, summer, and fall precipitation will increase at all elevations. The increase in year-round moisture coupled with a moderate increase in temperature will promote invasive species (more so than any other scenario). Current invasive species present in the southwestern Colorado such as leafy spurge, knapweed, cheatgrass, yellow toadflax will expand into low to montane elevations and new invasive species such as Japanese brome or purple loosestrife will likely move into higher elevations area. Further, invasive species will out-compete the native vegetation, degrading rangelands. Seeps, springs, and other groundwater dependent wetlands will increase or experience very little change. Higher soil moisture will likely eliminate or reduce invasive species in wetlands. There is uncertainty about how more snow could affect winter sage grouse habitat. It is possible some areas could see sagebrush mortality due to higher winter moisture (USFWS, 2019)

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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 Magdalena, 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 Carpinteria, 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 Oyuhut 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 HCP-covered 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 is located to the north and south of the Euchre Creek and is bounded by HCP-covered 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 (Riensch 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 (Riensch 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 (Riensch 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 (Robinson-Nilsen 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 (Robinson-Nilsen 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 (Robinson-Nilsen 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 CDPH land. The essential features of this unit include sandy beach above and below the high tide 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 (Ephydriidae), 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* spp., *Ampithoe* spp., and *Allorchestes angustus*), tanadacians (*Leptochelia dubia*), shore flies (Ephydriidae), 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).

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:

~ 2,217 (USFWS, 2019)

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 Magdalena, 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). Our current estimate (2,217 breeding adults; Table 1) remains below the population size of 3,000 birds listed as a recovery objective in the recovery plan (USFWS, 2019)

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 cunicularia*), 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 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).
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Conservation Measures and Best Management Practices:

- **RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS** The following actions will help guide continuing recovery of the Pacific coast population of western snowy plover by providing

information to improve management of nesting and wintering sites. Conservation of the western snowy plover is dependent on continued cooperation with our partners to minimize impacts from current threats and aid in future restoration. 1. Continue to coordinate with Point Blue Conservation, state wildlife managers, federal agencies, university/academic affiliations, and other researchers and data specialists to conduct analysis of existing snowy plover data, to determine trends; create reliable, accurate population models; quantify long-term trends; and direct future management priorities to determine population and breeding stability. 2. Continue to work with DOD (the Navy, the Marine Corps, and Air Force), state fish and wildlife offices, state parks, and other partners to continue current successful site management to minimize impacts of encroaching vegetation, predation, and human disturbance. Where feasible, expand management techniques to other sites to improve habitat conditions for nest and brood survival, particularly in areas where no active management is ongoing. Investigate innovative techniques of site management and monitoring to reduce costs and better protect the species. 3. Collaborate with Mexican nongovernmental organizations, scientists, and federal agencies on potential recovery and management actions at nesting and wintering sites in Mexico. 4. Develop banding protocol to create unified data collection rangewide. Continue banding and recapture studies to determine reproductive success, survival, and movement. 5. Develop standardized monitoring protocols and on-line data portal to facilitate synthesis, analysis, and sharing of data. 6. Consider reconvening an ad-hoc recovery team to determine feasibility and support for a reevaluation of the delisting criteria based upon the active source-sink processes of the Pacific coast metapopulation. 7. Continue to support public-private partnerships, such as collaborative resighting databases or movement studies using GPS technologies, to identify natal origin, dispersal matrices, and other irruptive movements of snowy plovers across the Pacific coast. (USFWS, 2019)

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; Westbrook 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 north-south 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 State-owned 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 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 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 one-third 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 State-owned 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 of 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: Deveau Bank. 130 ha (322 ac) in Charleston County. The entire unit is within Deveau Bank Heritage Preserve. This unit includes all of Deveau 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 (5.9 mi) 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 (Bowditch 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 unnamed 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 Racoon, 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-vegetated 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 site 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, gravel, 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 linear mi (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 mi (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)

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; Westbrook 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).

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).

Conservation Measures and Best Management Practices:

Recommendations for Great Lakes Population Breeding Range 1. Identify and secure additional sources of reliable funding for recovery partners to ensure continued coordination and management of threats from human disturbance and predation, as described in recovery plan tasks 1.22, 1.34, and 1.36 2. Expand partnership efforts to increase participation of non-governmental organizations, state agencies and volunteers as in recovery plan task 6.0 3. Monitor the population for disease outbreaks,

particularly focused on the threat of Type E botulism. Continue to improve response activities when an outbreak occurs. 4. 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. 5. Continue efforts to purchase habitat and increase protection through conservation easements, deed restrictions, and other mechanisms (recovery task 1.362). 6. Conduct further research on the genetic fitness and adequate effective size of the population through molecular genetic and pedigree analysis (recovery task 4.6). 7. Assess and potentially modify recovery goals for the population (recovery task 4.7). 8. Develop strategies to reduce threats from the potential for water level decreases, or increases associated with climate change. Identify sites most likely to maintain or increase areas of suitable piping plover habitat under different climate change scenarios. 9. Undertake studies addressing merlin and other predator foraging ecology and the relationships between merlins and piping plover breeding areas in the Great Lakes. 10. Continue to pursue opportunities for habitat restoration, particularly at previously occupied breeding locations. Habitat creation projects, similar to the Cat Island effort near Green Bay Wisconsin, should also be considered depending on location and the level of commitment for future management. 11. Conduct studies using geolocators, nanotags or similar technology to learn more about wintering locations and migratory pathways of Great Lakes piping plovers.

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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 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 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 State owned 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 one-third 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 of 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 Harbor 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 (5.9 mi) 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 (Bowditch 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 unnamed 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-vegetated 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) north-south 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, gravel, 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 linear mi (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 mi (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)

Population Size:

2,959 adults; 1,212 breeding pairs (USFWS, 2009)

Minimum Viable Population Size:

1,300 breeding pairs (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 overwash and 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Northern Great Plains Population Breeding Range 1. Design and implement over-arching monitoring framework to track breeding habitat and population performance over time. 2. Create partnerships with conservation organizations and the public where the primary goal is to work together to ameliorate the threat of habitat loss. (USFWS, 2020)

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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/distribution.

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 Coast piping plover (*Charadrius melodus*) population breeds on coastal beaches from Newfoundland to North Carolina (and occasionally in South Carolina) and winters along the Atlantic Coast from North Carolina south, along the Gulf Coast, 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 et al. 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 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 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-to-Market 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 of 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: Deveau Bank. 130 ha (322 ac) in Charleston County. The entire unit is within Deveau Bank Heritage Preserve. This unit includes all of Deveau 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 Harbor 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 unnamed 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 Racoon, 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-vegetated 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, sandflats at the ends of sandspits and barrier islands, gently sloping foredunes, blowout areas behind primary dunes, sparsely vegetated dunes, and washover areas cut into or between dunes. Nests are usually found in areas with little or no

vegetation although, on occasion, piping plovers will nest under stands of American beachgrass (*Ammophila breviligulata*) or other vegetation (Patterson 1988, Flemming et al. 1990, MacIvor 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 (MacIvor 1990), and March 28 in Nova Scotia (Mills 1976, cited in Cairns 1977). By early April, males begin to establish territories (Patterson 1988, MacIvor 1990, Cross 1991), which they defend aggressively against adjacent males by performing "horizontal threat," "parallel run," and aerial displays, characterized by Cairns (1982). Piping plovers are monogamous, but usually shift mates between years (Wilcox 1959, Haig and Oring 1988c, MacIvor 1990) and, less frequently, between nesting attempts in a given year (Haig and Oring 1988c, MacIvor 1990, Strauss 1990). Plovers are known to breed at one year of age (MacIvor 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 April 21 in Virginia (Cross 1991), April 15 in New York (C. Brittingham, The Nature Conservancy, pers. comm. 1994), April 20 in Massachusetts (MacIvor 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 shore of New Brunswick, with a peak of nest initiation in mid-May to early June (Morse 1982, Tull 1984, Shaffer and Laporte 1992). Although nests may be initiated as late as July 25, few nests hatch after July 15, and the latest recorded hatch date is July 31 in Massachusetts (MacIvor 1990). Piping plovers generally fledge only a single brood per season, but may re-nest several times if previous nests are lost or, infrequently, if a brood is lost within several days of hatching (Wrenn 1991, Goldin 1994a, 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 of the clutch, averages 27-30 days, and is shared equally by both sexes (Wilcox 1959, Cairns 1977, MacIvor 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)

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 criterion 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; Amiraault-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 overwash and 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Atlantic Coast Population Breeding Range 1. Increase efforts to restore and maintain natural coastal habitat formation processes, including overwash and dynamic inlets (recovery task 1.2). This action is critical to near-term availability of sufficient habitat to attain targets for breeding abundance and productivity. It is also key to preserving adaptive capacity of beach habitats in response to current and accelerating rates of sea-level rise. 2. Incorporate protocols for rapid assessment of storm-induced habitat changes into procedures for protecting habitat from degradation during post-storm management of beach habitat and beach recreation. Newly formed habitats should be protected from degradation by activities that directly or indirectly alter topography or accelerate succession of vegetation (recovery tasks 1.22 and 1.23). New and improved habitats should also be appropriately managed to prevent human disturbance that disrupts territory establishment and courtship and causes nest loss and chick mortality (recovery task 1.3). 3. 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 potential changes in coastal management that may decrease adverse effects of sea-level rise on coastal piping plover habitats and locations where they might be implemented. 4. Incorporate new information about effects of disturbance on survival of piping plover chicks into specific beach management practices that will avoid incidental take (recovery task 1.3). 5. Continue and accelerate development and implementation of monitoring and decision support tools to improve and streamline piping plover conservation, including effective and efficient predator management and implementation of activities to prevent disturbance and indirect mortality of piping plovers due to beach recreation and other activities (recovery task 1.1, 1.3, and 1.4). 6. Assess the ability and willingness of state wildlife agencies to assume primary responsibility for protection and management of piping plovers and their habitat sufficient to maintain population targets and productivity. Develop long-term agreements for implementing specific protections that are independent of ESA sections 6 and 9 (recovery task 1.6). 7. Engage Federal agencies, including the NPS, the USACE, the FEMA, the BOEM, and others to ascertain their authorities (independent of ESA section 7) to incorporate conservation of Atlantic Coast piping plovers into activities that they implement, authorize, or fund. Develop long-term commitments for implementing specific protections that are consistent with each agency's other (non-ESA) regulatory authorities, funding, and personnel resources (recovery task 1.6). 8. Identify and secure reliable funding to support continuing management by landowners and recovery partners of threats from human disturbance and predation, as described in recovery plan tasks 1.1, 1.3, and 1.4. 9. Ascertain whether and to what extent landowners and other partners would be willing to conduct predator management activities if piping plovers are no longer classified as a threatened species under the ESA. Assess effects of foreseeable changes in predator management activities on piping plover abundance and productivity (recovery task 1.6). 10. Implement and refine communications tools and activities to increase public understanding of threats to breeding Atlantic Coast piping plovers and the recovery activities required to address them (recovery task 4). 11. Conduct full life-cycle demographic modeling to elucidate effects of variation in productivity, annual survival rates, dispersal rates, and carrying capacity of habitat on population viability within individual recovery (representative) units and the Atlantic Coast population as a whole. This information may be used (as warranted) to revise recovery criterion 3 to provide recovery unit-specific productivity targets sufficient to secure populations (recovery task 3.5) and facilitate more effective conservation efforts. 12. Increase efforts to understand disturbance and other threats to post-breeding and migrating piping plovers within the Atlantic Coast breeding range, and implement activities to ameliorate them. 13. Continue studies to understand potential effects of wind turbine generators that may be located or proposed for

construction within and between nesting and foraging habitats and along migration routes. Continuing information needs include (but are not limited to) weather factors affecting migration altitude, northward migration routes, and avoidance rates under varying light and weather conditions. 14. Support effective integrated predator management (recovery plan task 1.4) through studies of ecology and foraging behavior of key predators and effects of predation management on predator communities. (USFWS, 2020)

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SPECIES ACCOUNT: *Chasiempis ibidis* (= *C. sandwichensis i.*) (Oahu Elepaio)

Species Taxonomic and Listing Information

Listing Status: Endangered; 04/18/2000; Pacific Region (R1) (USFWS, 2016)

Physical Description

The O'ahu 'elepaio is a small monarch flycatcher in the Monarchidae family endemic to the island of O'ahu. It is dark brown above and white below, with light brown streaks on the breast. The tail is 6.5 centimeters (cm, 2.6 inches [in]) long and often cocked up at an angle. Adults have conspicuous white wing bars, 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 2006, page 2-2). Their average weight is 12.5 grams (0.4 ounces) and total body length is 15 cm (5.9 in). Males are 10% larger than females (USFWS, 2024).

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

Their range is small and divided into several isolated fragments totaling approximately 5,187 hectares (12,817 acres) at elevations of 100–550 meters (m, 328–1,805 feet [ft]) in the southern and central Ko'olau Mountains, and 500–850 m (1,640–2,789 ft) in the Wai'anae Mountains (VanderWerf 2020, entire). The largest remaining subpopulations occur in the central and southern Ko'olau Mountains (USFWS, 2024).

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 tameiameia*), 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:**

Stable (USFWS< 2019)

Number of Populations:

9 - 11 (USFWS, 2016)

Population Size:

>400 (USFWS, 2019)

Population Narrative:

This species has experienced 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). The current geographic range of the O'ahu 'Elepaio encompasses about 5,187 hectares, declining by about 75 percent since 1975, and becoming fragmented into four larger subpopulations with 100 or more birds each and twelve smaller subpopulations, many of which are isolated by urban and agricultural development (VanderWerf et al. 2001, 2013; Dittmar and VanderWerf, 2018). (USFWS, 2019)

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 (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, 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).

Recovery Priority Number: 2

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 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 O`ahu `elepaio. Although O`ahu `elepaio are adaptable, they are forest birds and require some form of forest in which

- to forage and nest. Suitable habitat for recovery of O'ahu 'elepaio 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 O'ahu 'elepaio 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 O'ahu 'elepaio 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 O'ahu 'elepaio 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 'elepaio in those areas (USFWS, 2013).
 - **Captive propagation for genetic storage and reintroduction** - Captive propagation and release of O'ahu 'elepaio are not necessary for recovery at this time because the number of O'ahu 'elepaio 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 O'ahu 'elepaio have not been corrected in most areas, and no suitable release sites are currently available. Captive propagation and/or rear and release of O'ahu 'elepaio 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).

Conservation Measures and Best Management Practices:

- **Recommendations for Future Actions:**
 - **Habitat and natural process management and restoration** - Protecting remaining forest habitat on O'ahu is fundamental to the survival and recovery of the O'ahu 'Elepaio. Although the O'ahu 'Elepaio are adaptable, they are forest birds and require some form of forest in which to forage and nest. Suitable habitat for recovery of the O'ahu 'Elepaio 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.
 - **Predator / herbivore control** - Control rodents over a larger areas. Rodent control programs should be continued and expanded by whatever methods are available. Groundbased 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 O'ahu 'Elepaio requires large-scale rat control, which can be achieved more efficiently through aerial broadcast methods which the OANRP has just begun to use in 2018 in certain recovery areas. Alternatively, a strategy of constructing predator proof fencing around areas with a high density of the O'ahu 'Elepaio nests could be developed although costs maybe unfeasible at this time.
 - **Threats research** - No areas of O'ahu are of sufficient elevation to be free from disease carrying mosquitoes, and all populations of the O'ahu 'Elepaio 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.
 - **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 mist-netting, banding, and re-sighting 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 Waikāne/Kahana, Southern Ko'olau Mountains, and Makaha/Wai'anae Kai to determine if there are any populations of the O'ahu 'Elepaio in those areas.
 - **Captive propagation for genetic storage and reintroduction** - Captive propagation and release of the O'ahu 'Elepaio are not necessary for recovery at this time because the number of the O'ahu 'Elepaio 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 the O'ahu 'Elepaio have not been corrected in most areas, and no suitable release sites are currently available. Captive propagation and/or rear and release of the O'ahu 'Elepaio 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.
 - **Alliance and partnership development** - Initiate planning and contribute to implementation of ecosystem-level management and restoration to benefit this species. (USFWS, 2019)
- **New management actions:** In 2013, rat control in OANRP recovery areas consisted of deploying small Victor® snap trap grids around resources, maintaining large-scale trapping grids consisting of Victor®

or Ka Mate™ traps, constructing predator exclusion fences, and until August, collecting data from a Goodnature® A24 trap temporary research grid (ANRP 2013). In 2014, installing and maintaining large-scale trapping grids of Goodnature® A24 traps were added to rat control measures. Snap traps at Ēkahanui were secured on elevated tree limbs, resulting in a 40% increase in rodent catches over the previous breeding season (ANRP 2014). In 2016, the deployment of an experimental broadcast of Diphacinone-50 was used to minimize seasonal fluctuations of rat populations at Kahanahaiki. Hand broadcasted rodenticide was also conducted at Ohikilolo Mitigation Unit in June (ANRP 2016). In 2018, OANRP conducted two drops of aerial broadcast of rodenticide before the start of the breeding season at Schofield Barracks Military Reservation, resulting in <10 percent rat activity during the nesting season. All Victor® snap traps were replaced with A24 traps with Automatic Lure Pumps (ALPs) which provides continuous attractive bait for up to six months (ANRP 2018). Victor Professional rat snap traps and automated A24 Goodnature traps (started in 2013) were deployed in Wailupe Valley by Pacific Rim Conservation. Snap traps were tied to trees off the ground or placed in small caves and overhangs to discourage scavenging, but were not covered. The automated A24 Goodnature traps were screwed onto trees about 10 centimeters off the ground, as prescribed by the manufacturer (VanderWerf 2013, 2014, 2015, 2016, 2017; Dittmar and VanderWerf 2018). The use of Ramik mini-bars® containing 0.005% diphacinone was discontinued after 2013 because the new product label was more restrictive and precluded its use in Wailupe (VanderWerf 2014). When the toxins were used in 2013 they were placed in tamper-resistant Protecta® plastic bait stations to shield them from rain and reduce the risk of poisoning to non-target species. Bait stations were secured in trees at least one meter off the ground to restrict access by dogs (*Canis familiaris*) and feral pigs (*Sus scrofa*) (VanderWerf 2013). (USFWS, 2019)

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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

Yes; 5/21/2021.

Legal Description

We, the U.S. Fish and Wildlife Service (Service), designate critical habitat for the western distinct population segment of the yellow-billed cuckoo (western yellow-billed cuckoo) (*Coccyzus americanus*) under the Endangered Species Act. In total, approximately 298,845 acres (120,939 hectares) are now being designated as critical habitat in Arizona, California, Colorado, Idaho, New Mexico, Texas, and Utah. This rule extends the Act's protections to critical habitat for this species. (USFWS, 2021)

Critical Habitat Designation

for Arizona, California, Colorado, Idaho, New Mexico, Texas, and Utah, on the maps in this entry. (2) Within these areas, the specific physical or biological features essential to the conservation of western yellowbilled cuckoo consist of three components: (i) Rangewide breeding habitat. Riparian woodlands across the Distinct Population Segment (DPS); Southwestern breeding habitat, primarily in Arizona and New Mexico: Drainages with varying combinations of riparian, xeroriparian, and/or nonriparian trees and large shrubs. This physical or biological feature includes breeding habitat found throughout the DPS range as well as additional breeding habitat characteristics unique to the Southwest. (A) Rangewide breeding habitat (including areas in the Southwest). Rangewide breeding habitat is composed of riparian woodlands within floodplains or in upland areas or terraces often greater than 325 ft (100 m) in width and 200 ac (81 ha) or more in extent with an overstory and understory vegetation component in contiguous or nearly contiguous patches adjacent to intermittent or perennial watercourses. The slope of the watercourses is generally less than 3 percent but may be greater in some instances. Nesting sites within the habitat have an aboveaverage canopy closure (greater than 70 percent), and have a cooler, more humid environment than the surrounding riparian and upland habitats. Rangewide breeding habitat is composed of varying combinations of riparian species including the following

nest trees: Cottonwood, willow, ash, sycamore, boxelder, alder, and walnut. (B) Southwestern breeding habitat. Southwestern breeding habitat, found primarily in Arizona and New Mexico, is more variable than rangewide breeding habitat. Southwestern breeding habitat occurs within or along perennial, intermittent, and ephemeral drainages in montane canyons, foothills, desert floodplains, and arroyos. It may include woody side drainages, terraces, and hillsides immediately adjacent to the main drainage bottom. Drainages intersect a variety of habitat types including, but not limited to, desert scrub, desert grassland, and Madrean evergreen woodlands (presence of oak). Southwestern breeding habitat is composed of varying combinations of riparian, xeroriparian, and/or nonriparian tree and large shrub species including, but not limited to, the following nest trees: Cottonwood, willow, mesquite, ash, hackberry, sycamore, walnut, desert willow, soapberry, tamarisk, Russian olive, juniper, acacia, and/or oak. In perennial and intermittent drainages, Southwestern riparian breeding habitat is often narrower, patchier, and/or sparser than rangewide riparian breeding habitat and may contain a greater proportion of xeroriparian trees and large shrub species. Although some cottonwood and willow may be present in Southwestern riparian habitat, xeroriparian species may be more prevalent. Mesquite woodland may be present within the riparian floodplain, flanking the outer edges of wetter riparian habitat, or scattered on the adjacent hillsides. The more arid the drainage, the greater the likelihood that it will be dominated by xeroriparian and nonriparian nest tree species. Arid ephemeral drainages in southeastern Arizona receive summer humidity and rainfall from the North American Monsoon, with a pronounced green-up of grasses and forbs. These arid ephemeral drainages often contain xeroriparian species like hackberry or nonriparian species associated with the adjacent habitat type like oak, mesquite, acacia, mimosa, greythorn, and juniper. In southeastern Arizona mountains, breeding habitat is typically below pine woodlands (~6,000 ft (1,829 m)). (ii) Adequate prey base. Presence of prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies, moth larvae, spiders), lizards, or frogs for adults and young in breeding areas during the nesting season and in post-breeding dispersal areas. (iii) Hydrologic processes. The movement of water and sediment in natural or altered systems that maintains and regenerates breeding habitat. This physical or biological feature includes hydrologic processes found in rangewide breeding habitat as well as additional hydrologic processes unique to the Southwest in southwestern breeding habitat: (A) Rangewide breeding habitat hydrologic processes (including the Southwest). Hydrologic processes (either natural or managed) in river and reservoir systems that encourage sediment movement and deposits and promote riparian tree seedling germination and plant growth, maintenance, health, and vigor (e.g., lower-gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). In some areas where habitat is being restored, such as on terraced slopes above the floodplain, this may include managed irrigated systems that may not naturally flood due to their elevation above the floodplain. (B) Southwestern breeding habitat hydrologic processes. In southwestern breeding habitat, elevated summer humidity and runoff resulting from seasonal water management practices or weather patterns and precipitation (typically from North American Monsoon or other tropical weather events) provide suitable conditions for prey species production and vegetation regeneration and growth. Elevated humidity is especially important in southeastern Arizona, where cuckoos breed in intermittent and ephemeral drainages. (3) Critical habitat does not include humanmade structures (such as buildings, aqueducts, runways, roads, bridges, and other

paved or hardened areas as a result of development) and the land on which they are located existing within the legal boundaries of the critical habitat units designated for the species on May 21, 2021. Due to the scale on which the critical habitat boundaries are developed, some areas within these legal boundaries may not contain the physical or biological features and therefore are not considered critical habitat. (4) Data layers defining map units were created on a base of the Natural Resources Conservation Service National Agriculture Imagery Program (NAIP 2011), and critical habitat was then mapped using North American Datum (NAD) 83, Universal Transverse Mercator Zone 10N coordinates. The maps in this entry, as modified by any accompanying regulatory text, establish the boundaries of the critical habitat designation. The coordinates or plot points or both on which each map is based are available to the public at the Service's Sacramento Fish and Wildlife Office's internet site at <http://www.fws.gov/sacramento>, or on <http://www.regulations.gov> at Docket No. FWS-R8-ES-2013-0011. You may obtain field office location information by contacting one of the Service regional offices, the addresses of which are listed at 50 CFR 2.2. (USFWS, 2021)

Primary Constituent Elements/Physical or Biological Features

Physical or Biological Feature 1— Rangewide breeding habitat. Riparian woodlands across the DPS; Southwestern breeding habitat, primarily in Arizona and New Mexico: Drainages with varying combinations of riparian, xeroriparian, and/or nonriparian trees and large shrubs. This physical or biological feature includes breeding habitat found throughout the DPS range as well as additional breeding habitat characteristics unique to the Southwest. a. Rangewide breeding habitat (including areas in the Southwest). Rangewide breeding habitat is composed of riparian woodlands within floodplains or in upland areas or terraces often greater than 325 ft (100 m) in width and 200 ac (81 ha) or more in extent with an overstory and understory vegetation component in contiguous or nearly contiguous patches adjacent to intermittent or perennial watercourses. The slope of the watercourses is generally less than 3 percent but may be greater in some instances. Nesting sites within the habitat have an aboveaverage canopy closure (greater than 70 percent), and have a cooler, more humid environment than the surrounding riparian and upland habitats. Rangewide breeding habitat is composed of varying combinations of riparian species including the following nest trees: Cottonwood, willow, ash, sycamore, boxelder, alder, and walnut. b. Southwestern breeding habitat. Southwestern breeding habitat, found primarily in Arizona and New Mexico, is more variable than rangewide breeding habitat. Southwestern breeding habitat occurs within or along perennial, intermittent, and ephemeral drainages in montane canyons, foothills, desert floodplains, and arroyos. It may include woody side drainages, terraces, and hillsides immediately adjacent to the main drainage bottom. Drainages intersect a variety of habitat types including, but not limited to, desert scrub, desert grassland, and Madrean evergreen woodlands (presence of oak). Southwestern breeding habitat is composed of varying combinations of riparian, xeroriparian, and/or nonriparian tree and large shrub species including, but not limited to, the following nest trees: Cottonwood, willow, mesquite, ash, hackberry, sycamore, walnut, desert willow, soapberry, tamarisk, Russian olive, juniper, acacia, and/or oak. In perennial and intermittent drainages, Southwestern riparian breeding habitat is often narrower, patchier, and/or sparser than rangewide riparian breeding habitat and may contain a greater proportion of xeroriparian trees and large shrub species. Although some cottonwood and willow may be present in Southwestern riparian habitat, xeroriparian species may be more

prevalent. Mesquite woodland may be present within the riparian floodplain, flanking the outer edges of wetter riparian habitat, or scattered on the adjacent hillsides. The more arid the drainage, the greater the likelihood that it will be dominated by xeroriparian and nonriparian nest tree species. Arid ephemeral drainages in southeastern Arizona receive summer humidity and rainfall from the North American Monsoon (PBF 3), with a pronounced green-up of grasses and forbs. These arid ephemeral drainages often contain xeroriparian species like hackberry or nonriparian species associated with the adjacent habitat type like oak, mesquite, acacia, mimosa, greythorn, and juniper. In southeastern Arizona mountains, breeding habitat is typically below pine woodlands (~6,000 ft (1,829 m)).

Physical or Biological Feature 2— Adequate prey base. Presence of prey base consisting of large insect fauna (for example, cicadas, caterpillars, katydids, grasshoppers, large beetles, dragonflies, moth larvae, spiders), lizards, and frogs for adults and young in breeding areas during the nesting season and in postbreeding dispersal areas.

Physical or Biological Feature 3— Hydrologic processes. The movement of water and sediment in natural or altered systems that maintains and regenerates breeding habitat. This physical or biological feature includes hydrologic processes found in rangewide breeding habitat as well as additional hydrologic processes unique to the Southwest in southwestern breeding habitat:

a. Rangewide breeding habitat hydrologic processes (including the Southwest): Hydrologic processes (either natural or managed) in river and reservoir systems that encourage sediment movement and deposits and promote riparian tree seedling germination and plant growth, maintenance, health, and vigor (e.g., lower-gradient streams and broad floodplains, elevated subsurface groundwater table, and perennial rivers and streams). In some areas where habitat is being restored, such as on terraced slopes above the floodplain, this may include managed irrigated systems that may not naturally flood due to their elevation above the floodplain.

b. Southwestern breeding habitat hydrologic processes: In southwestern breeding habitat, elevated summer humidity and runoff resulting from seasonal water management practices or weather patterns and precipitation (typically from North American Monsoon or other tropical weather events) provide suitable conditions for prey species production and vegetation regeneration and growth. Elevated humidity is especially important in southeastern Arizona, where western yellow-billed cuckoos breed in intermittent and ephemeral drainages. Because the western yellow-billed cuckoo exists in noncontiguous areas across a wide geographical and elevational range and its habitat is subject to dynamic events, the areas described below (see Final Critical Habitat Designation) are essential to the conservation of the western yellowbilled cuckoo because they provide opportunities for breeding, allow for connectivity between habitat, assist in dispersal, provide redundancy to protect against catastrophic loss, and provide representation of the varying habitat types used for breeding, thereby helping to sustain the species. The physical or biological features essential to the conservation of the western yellow-billed cuckoo are present in the areas designated, but the specific quality of habitat for nesting, migration, and foraging will vary in condition and location over time due to plant succession and the dynamic environment in which they exist. As a result, the areas that are designated may not contain at any one time all of the physical and biological features that have been identified for the western yellow-billed cuckoo. Based on use of the areas for breeding, we conclude that all of the areas identified contain all or most of the physical or biological features, but in some cases, these features are less prevalent, or their presence is variable over time due to the changing nature of habitat from hydrologic processes. As stated

above, all critical habitat units are considered to have been occupied at the time of listing. (USFWS, 2021)

Special Management Considerations or Protections

. The special management considerations include actions to address the main threats to western yellow-billed cuckoo habitat and are grouped into three categories: (1) Threats from alteration of hydrology; (2) threats from floodplain encroachment; and (3) other identified threats. (USFWS, 2021)

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 the cicadas, 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

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 western North 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 modification of natural hydrological processes on riparian habitat, 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 Río Conchos, Yaqui, and Mayo, Río Bambuto, Río Bravo, Tubutama, La Reforma, Cuchujaqui River in Alamos, Aconchi and Baviacora in Río Sonora, and Upper San Pedro River in Sonora (Instituto del Medio 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 sustain riparian 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, the ability 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 Río Altar in northern Mexico, completion of the Cuauhtémoc Dam and Reservoir (Presa Cuauhtémoc) 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 Río 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), Río Grande,

and several river courses in northern Mexico including, but not limited to, the Río Yaqui, Río Mayo, Río Bambuto, Río Tubutama, and Río Sonora (Russell and Monson 1998, p. 11; IMADES 2003, p. 4; Villasenor-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),

Río Conchos (Cornell et al. 2008, p. 96), Río Bambuto, Tubutama, La Reforma, and Cucujaqui River in Alamos, Aconchi and Baviacora in Río Sonora, and upper San Pedro River (IMADES 2003, p. 4), and several other rivers in central Sonora, Mexico (Villasenor-Gomez 2006, p. 108). Grazing also occurs extensively along watercourses in a protected reserve on the Río Aros and Río 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 (Haltermann 1991, p. 35) and higher 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 favored by 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 in response 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 allow a greater number of seedlings and

saplings of cottonwoods and other nesttrees to attain maturity as suitable nesting sites. In another example, livestock grazing was 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 some cases, after livestock removal (Krueper et al. 2003, p. 615), and that damage to riparian vegetation from grazing is at least partly reversible. They also illustrate 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 Río 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 native-dominated 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 yellow-billed 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 principle mechanism 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 tamarisk-dominated 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 and other nonnative vegetation, coupled with the inability of native vegetation to regenerate under altered hydrological conditions, is a significant threat to the western yellow-billed 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 yellow-billed 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 human-caused 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 the California 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 Río Grande; and also in parts of northern Mexico in the vicinity of floodplain farming along the Sonora, Magdalena, and Moctezuma Rivers (Villasenor-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 affecting yellow-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 Power Towers, 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 yellow-billed 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 yellow-billed 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 available

Delisting Criteria:

Not available

Recovery Actions:

- Develop a recovery plan.

References

USFWS. 2014. Determination of Threatened Status for the Western Distinct Population Segment of the Yellow-billed Cuckoo (*Coccyzus americanus*) Final Rule. 79 Federal Register 192, October 3, 2014. Pages 59991 - 60038.

USFWS. 2021. Final Rule. Endangered and Threatened Wildlife and Plants Designation of Critical Habitat for the Western Distinct Population Segment of the YellowBilled Cuckoo. FR Vol. 86, No. 75. Pages 20795-21005.

USFWS. 2001. 12-Month Finding for a Petition To List the Yellow-billed Cuckoo (*Coccyzus americanus*) in the Western Continental United States July 25, 2001

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

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).
- 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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References

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USFWS (U.S. Fish and Wildlife Service). 2014. Masked Bobwhite (*Colinus virginianus ridgwayi*) 5-Year Review: Summary and Evaluation. March 2014. Buenos Aires National Wildlife Refuge. Sasabe, Arizona. Available online at: http://ecos.fws.gov/docs/five_year_review/doc4370.8.14.pdf.

USFWS. 2019. Recovery Plan for Masked Bobwhite (*Colinus virginianus ridgwayi*), Draft Amendment 1. USFWS, Southwest Region, Albuquerque, NM. 13. pp.

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 (Bowditch 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. inornata* 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 tremo (*Trema lamarckiana*), and white prickly (*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 produced 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

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 caused 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.
- 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 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 fledgling 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). (USFWS, 2016) The Mariana crow population is now extirpated from Guam, and appears to have stabilized at a small population size on Rota (Table 1). Current models from mark-resight data suggest that juvenile and adult mortality rates have remained stable but are lower than expected for a healthy corvid

population. None of the criteria for downlisting (USFWS 2005) have fully been met (Table 2). While cat predation was a cause of mortality in 2010-2011, no recent evidence of cat predation on crows has been found, despite lack of cat control since 2016. Inflammatory disease was recently identified as a major mortality factor, but efforts to identify the cause of this disease and mitigate its impact are still underway. Other unknown factors are suspected to contribute to Mariana crow mortality, but intensive monitoring and management actions are required to identify and control those threats. Therefore, the Mariana crow still meets the definition of endangered as it remains in danger of extinction. (USFWS, 2020)

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 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 preying on 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).

Stressor: Cat Predation (USFWS, 2020)

Exposure:**Response:****Consequence:**

Narrative: While cat predation was a cause of mortality in 2010-2011, no recent evidence of cat predation on crows has been found, despite lack of cat control since 2016. Inflammatory disease was recently identified as a major mortality factor, but efforts to identify the cause of this disease and mitigate its impact are still underway. Other unknown factors are suspected to contribute to Mariana crow mortality, but intensive monitoring and management actions are required to identify and control those threats. Therefore, the Mariana crow still meets the definition of endangered as it remains in danger of extinction (USFWS, 2020)

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.

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: Recovery implementation for the Mariana crow should include the following:
 - Implement priority actions identified in the Mariana crow SDM exercise:
 - o Captive propagation for genetic storage and reintroduction –Rear and release should continue, including the retrieval of eggs and/or chicks from the wild population, hand-rearing until birds are passed the age of highest mortality risk, and releasing birds back to the wild on Rota. Future efforts may use founder birds from rear and release program for more intensive efforts in captive propagation or for translocation.
 - o Disease investigation: The most critical step to moving forward with recovery of the species lies in the identification of the cause of the inflammatory syndrome, AEX, which has been the primary cause of death in crows of all ages since 2010. Despite investigation into the cause of this syndrome for the past 9 years, it remains a mystery. Support should be given to current, ongoing investigations within USGS and SDZG, and additional collaborations should be sought to increase the chances determining the cause of AEX (Sarah Faegre, Rota Avian Behavior Ecology Project, pers. Comm. 2020).
 - Population viability monitoring and analysis
 - o Continue field research to identify sources of adult and juvenile mortality and implement appropriate management measures to increase adult and juvenile survival.
 - o Continue population and demographic monitoring on Rota.
 - o Continue nest-monitoring to identify and mitigate causes of nest failure.
 - Decrease the probability for human persecution by improving public perception of the crow—Involve Rotanese locals in the conservation effort, including hiring locals when possible, and increasing education and outreach.
 - Habitat and natural process management and restoration – Set aside and protect recovery areas for Mariana crow on Guam.
 - Predator / herbivore monitoring and control – Continue support of efforts to reduce brown treesnake populations over large areas of Guam, and interdiction efforts on Rota. (USFWS, 2020)
- New management actions:
 - Population viability monitoring and analysis
 - o Banding: The University of Washington's Rota Avian Behavioral Ecology Program (RABEP) has banded 306 Mariana crows since 2005 (Ha unpublished data). Mark re-sight data has been used to develop agespecific survivorship models (see "New status information" above) (Sarah Faegre, Rota Avian Behavior Ecology Project, pers. comm. 2020).
 - o 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 (see "New status information" above)(Sarah Faegre, Rota Avian Behavior Ecology Project, pers. comm. 2020).
 - o Mariana crow mortality monitoring: From 2009 to 2019, transmitters were attached by RABEP to 115 Mariana crows that were tracked and monitored for the life of the battery. In all but one case the outcome was determined by either locating the carcass or re-sighting the live bird after battery failure (Sarah Faegre, Rota Avian Behavior Ecology Project, pers. comm. 2020).
 - Disease Investigations: Dr. Thierry Work at the USGS-Hawaii Field Station is leading an investigation (2010 to present) into the inflammatory syndrome called AEX, with a focus on identifying infectious disease. Drs. Carmel Witte and Caroline Moore at the San Diego Zoo Global are leading an epidemiological investigation (2018 to present) into AEX with a focus on landscape-level patterns in AEX and potential infectious and non-infectious causes for the syndrome (Sarah Faegre, Rota Avian Behavior Ecology Project, pers. comm. 2020).
 - Predator / herbivore monitoring and control – The UW Rota Island Feral Cat Removal Project began cat removal efforts on Rota in February 2012 (Ha et al. 2013). The UW removed 589 cats from areas in and around crow territories (Leo 2014). The Institute for Wildlife Studies took over cat control efforts on Rota from 2014-2016.
 - Strategic planning / Threats management planning – USFWS 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. 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. Priority actions identified in

the SDM exercise included predator control on Rota, and a phased approach to captive propagation (see details below in “Recommendations for Future Actions”). • Captive propagation for genetic storage and reintroduction – Captive care of sick or injured crows was conducted on an as-needed basis by RABEP captive care specialists from 2010-2014. From 2015 to present, the San Diego Zoo Global (SDZG) has led a captive rear-and-release program; care of other captive aga have also been transferred to SDZG care. As of August 2020, SDZG has reared 37 Mariana crows to independence. Twenty-three crows have been released and 14 are currently in captivity with an expected release date of December 2020. Of 23 crows released by SDZG in 2018 and 2019, two died, two are currently in rehabilitation for injuries, and 19 remain in the wild and are fully independent from supplemental food (Sarah Faegre, Rota Avian Behavior Ecology Project, pers. comm. 2020).

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.

USFWS. 2020. 5-YEAR REVIEW Short Form Summary Species Reviewed: *Corvus kubaryi* (Mariana crowāga). 11 pp.

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. 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)

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)
- 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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USFWS. 2016. Environmental Conservation Online System (ECOS) – Species Profile.
<http://ecos.fws.gov/ecp/>. Accessed July 2016

USFWS. 2014. Golden-cheeked warbler (*Setophaga chrysoparia*) 5-Year Review: Summary and Evaluation. Austin Ecological Services Field Office Austin, TX

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SPECIES ACCOUNT: *Drepanis (=Vestiaria) coccinea* (l'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). Kaua'i, Maui, Hawai'i (extant); Moloka'i (possibly extirpated); O'ahu (likely extirpated); Lāna'i (extirpated) (USFWS, 2021). Distribution: Kaua'i, Maui, Hawai'i (extant); Moloka'i (possibly extirpated); O'ahu (likely extirpated); Lāna'i (extirpated) (USFWS, 2022)

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

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)

Number of Populations:

9 (USFWS, 2022)

Population Size:

>600000 (USFWS, 2022)

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 existing regulatory 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 nectarivorous 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:

Recovery Priority Number = 11 (USFWS, 2022)

Delisting Criteria:

Not available - this species does not have a recovery plan.

Recovery Actions:

- Not available - this species does not have a recovery plan.
- 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).

References

USFWS 2016. Endangered and Threatened Wildlife and Plants Threatened Species Status for the liwi (*Drepanis coccinea*). 81 Federal Register 182. September 20, 2016. Pages 64414 - 64426

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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 taxonomy 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 Pahranaagat 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) Pahrnagat Management Unit— Pahrnagat 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).

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 assessed

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. Rangeland, 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).

- 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

Commonly-used Acronym: SHLA

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 coast (both Oregon and Washington) 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 Oregon coast, no documented breeding has occurred, but individuals have been observed during the breeding season in Clatsop County (USFWS 2020). 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 Pacific 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; 11/13/2013.

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).

Site Fidelity

Adult: High (USFWS 2020). Studies across the lark's range have found strong natal fidelity to nesting sites, which limits recruitment into new or unpopulated areas; 75 percent of streaked horned larks return each year to the place they were hatched or spent their first breeding season, whereas 25 percent of juvenile birds disperse to a different site (Pearson et al. 2008a, p. 11; Moore 2017a, p. 15; Wolf et al. 2017, p. 31; Wolf et al. 2020, p. 6).

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) Despite increases in abundance of local populations, a rangewide population estimate has not been reanalyzed since 2011. Therefore, we are unable to state conclusively that the rangewide population has increased based on survey data of local populations since larks were listed in 2013. (USFWS 2020).

Resiliency:

Resilient populations can withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), severe weather events or other changes to habitat conditions (environmental stochasticity), random fluctuations in genetic variation (genetic drift), or threats caused by anthropogenic activities. Resiliency can be evaluated using metrics such as population demographics (i.e. population size, birth and death rates, nesting success rates), and habitat parameters (i.e. the quality, quantity, and distribution of suitable habitats). To evaluate resiliency for each of the 42 local population units, we developed a condition category matrix to define high, moderate, low, and extirpated condition categories for the demographic and environmental factors influencing resiliency (Table 5). We then used this matrix to systematically evaluate each factor for each of the local population units. To maintain adequate resiliency, local populations of streaked horned larks need large open spaces with suitable habitat structure, and an appropriate disturbance regime sufficient to maintain habitat and support increased numbers of breeding birds. For our evaluation of current condition, we assessed information from peer-reviewed literature, as well as survey data and knowledge of anthropogenic practices. The size and stability of resilient local populations varies among regions, depending on overall abundance, connectivity between sites, the extent and quality of available habitat, and the timing and intensity of disturbance regimes. (USFWS, 2021). South Puget Lowlands: moderate to low resiliency Pacific Coast and Columbia River: low resiliency Willamette Valley: low to moderate resiliency

Representation:

Representation is sufficient genetic and ecological diversity to maintain adaptive capacity in a changing environment. Representation can be assessed as the number or percent of ecological settings across the range over which a species' recovery will occur. Generally, the more representation, or diversity, the species has, the more it can adapt to changes (natural or human-caused) in its environment. The habitat types occupied by local and regional populations of streaked horned larks have been thoroughly documented (Anderson and Pearson 2015, entire). The needs of the streaked horned lark to achieve representation are multiple local populations well distributed across its range in a broad variety of habitat types. Representation is appropriately addressed at the rangewide level. As noted earlier in this document, the streaked horned lark has been extirpated from the northernmost extent of its historical range in the northern Georgia Basin and north Puget Lowlands and from the Rogue and Umpqua Valleys in the south. These losses from the northernmost (i.e., cooler and wetter) and southernmost (i.e., warmer and drier) extremes of the lark's known historical range demonstrate a substantial loss of ecological diversity. Within their current range, larks are found on native prairies; military and civilian airfields; beaches, dunes, and sandy islands; restored native prairies; agricultural areas; and industrial sites. Occupied sites differ markedly within and among regions, which suggest that larks experience a broad range of ecological diversity. (USFWS, 2021) Rangewide: moderate to low representation.

Redundancy:

Redundancy is the ability to withstand catastrophic events, which is directly related to the number, distribution, and connectivity of resilient local populations. The needs of the streaked

horned lark to achieve adequate redundancy are multiple resilient populations in each region with the potential for movement among local and regional populations to allow recolonization following major stochastic events. Redundancy is appropriately addressed at the rangewide level. The draft Recovery Plan recommends that resilient local populations are distributed across a combination of lands managed intentionally for long-term lark conservation and lands managed for multiple-use objectives that provide short-term benefits to larks. At minimum, the draft Recovery Plan recommends that 38 sites are managed for long-term conservation: 8 sites in the South Puget Lowlands; 3 sites along the Pacific Coast; 6 sites in the Lower Columbia River; and 21 sites in the Willamette Valley. Currently, the four representational regions support 42 local populations representing species viability. Of the 42 local populations, only 8 are considered highly resilient and only 1 site (Sandy Island) is managed for streaked horned lark conservation. (USFWS, 2021) Rangewide: moderate to low redundancy.

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 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:

42 (USFWS, 2021) 3 regional populations: South Puget Lowlands - 8 local populations Pacific Coast and Columbia River - 24 local populations Willamette Valley - 10 local populations

Population Size:

1,170 to 1,610 individuals (USFWS, 2021) 1,170 - 1,610 individuals

Minimum Viable Population Size:

5,269 - 6,415 individuals

Population Narrative:

Currently, there are 42 local populations distributed across three distinct representative areas based on ecological uniqueness, each with a mix of high, moderate, and low resiliency. In general, the local populations with low condition have low abundance that has declined since 2013, and populations occur in locations that have less habitat availability and therefore limited capacity to support high numbers of birds. In addition, certain land management activities at these locations, such as construction and development or sand-borrow activities on the Columbia River would not support longterm resiliency even if population abundance stabilized and increased. Use of these sites is opportunistic based on habitat availability, and most of these sites are not anticipated to meaningfully contribute to subspecies viability or support high numbers of birds. (USFWS, 2021) The streaked horned lark has numerous, but mostly small (<10 breeding pairs) local populations that are well distributed across the South Puget Lowlands, Pacific Coast and Lower Columbia River, and the Willamette Valley regions. At the time of listing, local populations of streaked horned larks were smaller and there were fewer known sites compared to the number and size of local populations in 2019. However, it should be noted that monitoring efforts increased after larks were listed in 2013, increasing our knowledge on the status of occupied sites (Tables 1-3). In the South Puget Lowlands, the number of breeding pairs in the regional population increased due to increases in the local populations at the Gray Army and McChord Airfields, and the 91st Division Prairie, Range 76, likely in response to conservation measures implemented as part of section 7 consultations with JBLM. The number of occupied sites along the lower Columbia River has increased since the time of listing due to an increase in the availability of suitable habitat through the strategic placement of dredged materials. While the overall number of occupied sites represent a reduction from its historical range, of the 42 extant populations across the three regions, there are 8 in high condition, 15 in moderate condition, and 19 local populations in low condition that have unstable or declining trends and are at risk of disappearing (Table 12). Three sites that were occupied in years prior to the 2013 listing are currently considered extirpated. In summary, there are 42 local populations distributed across three distinct representative areas based on ecological uniqueness, each with a mix of high, moderate, and low resiliency. In general, the local populations with low condition have low abundance that has declined since 2013, and populations occur in locations that have less habitat availability and therefore limited capacity to support high numbers of birds. In addition, certain land management activities at these locations, such as construction and development or sand-borrow activities on the Columbia River would not support long-term resiliency even if population abundance stabilized and increased. Use of these sites is opportunistic based on habitat availability, and most of these sites are not anticipated to meaningfully contribute to subspecies viability or support high numbers of birds. The South Puget Lowlands region has an overall increasing population trend based on the 2013 to 2019 survey data. The region contains four local populations with high resiliency, one local population with moderate resiliency, and three local populations with low resiliency. Those local populations with low resiliency have small, declining populations and occur in areas where management activities have negative impacts on adult and juvenile birds, which currently limits resiliency. The Pacific Coast and Lower Columbia River region has an overall stable population trend based on

survey data from 2013 to 2019. There are two local populations in high condition due to abundance, movement between local populations, beneficial disturbance activities having low adverse effects to breeding birds, and suitable habitat. Nine local populations are in moderate condition due to low abundance and small site size which limits potential resiliency and contribution to regional viability. The remaining 13 local populations have low resiliency due to very low abundance with declining populations occurring in areas where habitat conditions are opportunistically available, such as Martin Bar or Austin Point, but where ongoing management activities do not support long-term, self-sustaining populations. While Leadbetter Point is managed to improve habitat quality for larks and reduce corvid predation, the local population has fluctuated in recent years and is currently considered unstable. While sites along the Pacific Coast have low numbers of breeding pairs, recent detections at previously unoccupied sites suggest the species could recolonize areas with suitable habitat. However, streaked horned larks have not recolonized new sites in the South Puget Lowlands region despite 20 years of prairie restoration and intensive monitoring, suggesting recolonization is site-specific and difficult to predict. Although the current abundance of local populations along the Pacific coast is low compared to other regional populations, it has been low for many years and we see no apparent declining trend in this regional population based on survey data between 2013 and 2019. The Willamette Valley region has an overall increasing population trend for 10 extant populations and supports two local population with high condition, Corvallis Municipal Airport and Baskett Slough NWR. There are five local populations in the Willamette Valley in moderate condition and three local populations in low condition. No breeding pairs were detected at one historical location, Salem Municipal Airport, during surveys from 2013 to 2019 and the site is assumed extirpated. The survey results report in Table 1 represent a small portion of the total number of streaked horned larks in the Willamette Valley due to lack of access on private lands, and there is no information to infer the condition of these populations. While habitat conditions in the Willamette Valley could support increased self-sustaining populations, on-going management activities at airports and agricultural areas have adverse effects on local populations. Combining these management actions with population trends between 2013 and 2019 and very little movement between sites reduces overall resiliency in the region. The draft Recovery Plan for the streaked horned lark (U.S. Fish and Wildlife Service 2019, entire) provides some thoughts on what adequate redundancy and representation for the subspecies entails. The plan recommends that 38 resilient sites be managed for long-term conservation: 8 sites in the South Puget Lowlands; 3 sites along the Pacific Coast and 6 sites in the Lower Columbia River; and 21 sites in the Willamette Valley. The current redundancy of streaked horned lark is characterized by 42 extant local populations across the range of the subspecies; 8 are considered high condition, 15 are ranked moderate, and 19 ranked low. There are at least two local populations ranked high in each regional population, suggesting relative good representation in varying habitats, including prairies, wetlands, coastal dunes, sandy islands, airports and road margins, and agricultural fields. Though the local populations on the Pacific coast add a measure of redundancy to the subspecies, streaked horned larks in the Pacific Coast and Lower Columbia River region use a form of replicated beach habitat on the dredge placement sites, so the exact contribution of the Pacific coast population to ecological and behavioral representation is uncertain. The rangewide distribution of 42 local populations confers some measure of protection against catastrophic events, particularly in the Willamette Valley where relatively large numbers of birds move about

in response to changing habitat conditions. Surveys detect low incidence of movement between local populations, and recolonization of restored sites in the South Puget Lowlands region has not occurred. However, recent detections of birds at sites previously unoccupied (i.e., Clatsop Spit) suggest individuals are actively moving between sites, adapting to new areas and potentially recolonizing areas with suitable habitat. Additional local populations in high and moderate condition throughout the range would benefit the overall level of redundancy and representation for the subspecies.

Threats and Stressors

Stressor: Habitat fragmentation, degradation, and loss

Exposure: Vegetation succession; encroachment of woody vegetation or grasses and invasive species; land use changes; crop conversion; and loss of natural disturbance processes.

Response: Loss of habitat.

Consequence: Decreased quantity and quality of suitable habitat to support breeding and wintering streaked horned larks, reduction in population viability.

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).

Stressor: Recreation

Exposure:

Response: Disturbance to adults; habitat degradation; mortality to eggs, nestlings, and fledglings.

Consequence: Reduced populations, habitat loss.

Narrative: Recreation at coastal sites can cause the degradation of streaked horned lark habitat, as well as disturbance to adults and juveniles, and direct mortality to eggs, nestlings, and fledglings. Activities such as the annual spring razor clam digs, dog walking, beachcombing, offroad vehicle use, camping, fishing, and horseback riding in coastal habitats may directly or indirectly increase predation (primarily by corvids), resulting in nest abandonment and nest failure for streaked horned larks (Pearson and Hopey 2005, pp. 19, 26, 29). Streaked horned larks nest in the same areas as western snowy plovers along the Washington coast, and it is highly likely that recreation has caused nest failures for larks at sites that have documented nest failure for plovers; both species are ground nesters and, therefore, similarly at risk of effects of recreation. During western snowy plover surveys conducted between 2006 and 2010 at coastal sites in Washington, human-caused nest failures were reported in 4 of the 5 years (Pearson et al. 2007, p. 16; Pearson et al. 2008b, p. 17; Pearson et al. 2009a, p. 18; Pearson et al. 2010, p. 16), and one of 16 monitored nests at Midway Beach on the Washington coast was crushed by a horse

in 2004 (Pearson and Hopey 2005, pp. 18–19). In 2002, JBLM began restricting recreational activity at the 13th Division Prairie to protect lark nesting sites; JBLM prohibited model airplane flying, dog walking, and vehicle traffic in the area used by streaked horned larks (Pearson and Hopey 2005, p. 29). JBLM continues to restrict recreational activities during the lark breeding season at the 13th Division Prairie, although enforcement, especially on weekends, is intermittent (Wolf et al. 2016, p. 43). In addition, the 2017 programmatic consultation JBLM entered into with the Service (U.S. Fish and Wildlife Service 2017) included recreation. The programmatic consultation has resulted in a marked increase in the breeding population of larks on JBLM from fewer than 100 pairs in 2013 (Wolf and Anderson 2014, p. 12), to over 120 pairs in 2019 (Wolf et al. 2020, p. 6).

Stressor: Aircraft Strikes

Exposure:

Response: Injury or mortality.

Consequence: Reduction in number of breeding adults, and surviving juveniles; population reduction.

Narrative: Individual lark in these local populations near runways are at increased risk of aircraft strikes and collisions. Horned lark strikes are frequently reported at military and civilian airports throughout the country, but because of the bird's small size, few strikes result in significant damage to aircraft (Dolbeer et al. 2011, p. 48; Air Force Safety Center 2012, p. 2). Juvenile males seem to be struck most often, perhaps because they are trying to establish new territories in unoccupied but risky areas on runway margins (Wolf et al. 2017, p. 31). With respect to streaked horned larks in particular, in the 5-year period from 2013 to 2017, McChord Airfield had seven confirmed strikes, and Gray Army Airfield recorded one confirmed streaked horned lark strike (Wolf in litt. 2018). Since January 2017, 16 adults have been killed by strikes on JBLM, including 10 adults and 2 juveniles killed by strikes at McChord Airfield in 2020 (Wolf in litt. 2020). The increased number of strikes in 2020 were a direct result of construction activities that redirected aircraft traffic to the northern half of the runway where lark density is highest and lark abundance was relatively high; this led to a higher than normal mortality rate from aircraft strikes. Aside from the 12 strikes in 2020, JBLM recorded a total of 12 strikes in the seven years between 2013 and 2019, for a rate of 1.7 strikes per year. While aircraft strikes do occur in several local populations at airports throughout the range of the species (particularly in the South Puget Lowlands), the rate appears relatively low and the vegetation management conducted by these airports also maintains replacement habitat that supports breeding pairs (Pearson et al. 2008a, p. 13; Camfield et al. 2011, p. 10; FAA 2020, entire).

Stressor: Aircraft Strikes (USFWS, 2021)

Exposure:

Response:

Consequence:

Narrative: Streaked horned larks are attracted to flat, open habitats around airports throughout their range. The streaked horned lark is also at risk from aircraft strikes and collisions that occur at airports. Death of individual larks caused by aircraft strikes is a threat to small or declining local

populations at airports, as the loss of even a single breeding individual can negatively influence the resiliency of local populations. (USFWS, 2021)

Stressor: Land Management Activities and Related Effects

Exposure: Vegetation management activities (i.e. mowing, agricultural practices, etc.); military training activities; and dredged material placement.

Response: Disturbance to adults; habitat degradation; mortality to eggs, nestlings, and fledglings.

Consequence: Reduced populations, habitat loss.

Narrative: Streaked horned larks evolved in a landscape of ephemeral habitat with regular historical disturbance regimes that maintained the large, open spaces with very early seral stage vegetation relied upon by the subspecies. Human activity led to the stabilization of these historical disturbance regimes, as well as the unintentional creation of “replacement” habitat for streaked horned larks that mimics their preferred large, open spaces. Replacement habitat occurs in a variety of settings across the range of the subspecies, including agricultural fields, at airports, and on dredge spoil islands. Open habitat is maintained in these areas by way of frequent human disturbance, including burning, mowing, cropping, chemical treatments (herbicide and pesticide application), or placement of dredged materials (Altman 1999, p. 19). Without regular large-scale, human-caused disturbance, the quantity of suitable habitat available to larks would decrease rapidly. These land management activities are key to providing and maintaining habitat for the streaked horned lark; without replacement habitat, the status of the subspecies would likely be much worse. However, when these same activities are conducted during the most active breeding season (mid-April to mid-June) for streaked horned larks, they have the potential to result in destruction of nests, crushing of eggs or nestlings, or flushing of fledglings or adults (Pearson and Hopey 2005, p. 17; Stinson 2005, p. 72). During the nesting seasons from 2002 to 2004, monitoring at Gray Army Airfield, McChord Airfield, and Olympia Airport in the South Puget Lowlands region documented nest failure at 8 percent of nests due to mowing over nests, forcing young to fledge early (Pearson and Hopey 2005, p. 18). Additionally, though dredge deposits can mimic sandy beach habitat typically used by larks, they have also been documented to destroy breeding sites and active nests (Pearson in litt. 2012a; Pearson et al. 2008a, p. 21; MacLaren 2000, p. 3; Pearson and Altman 2005, p. 10). In the Willamette Valley, some habitats in agricultural areas are consistently maintained and therefore available throughout the year (e.g., on the margins of gravel roads), while other patches of suitable habitat shift as areas such as large fields are mowed, harvested, sprayed, or burned. In 2017, the Willamette Valley NWR entered into a 4-year programmatic consultation with the Service for its farming and pesticide use program (U.S. Fish and Wildlife Service 2016b, entire). This programmatic consultation documents the Refuge program’s commitment to adapting its farming activities to improve the status of the streaked horned lark on the William L. Finley, Ankeny, and Baskett Slough units of the complex. Conservation measures include ensuring that farming activities minimize disturbance to larks, and that pesticides used in agricultural fields have a low risk of adverse effects to larks and their food sources. Airports implement hazardous wildlife management programs that include vegetation management around roads and runways, to discourage the presence of wildlife near the runways and thereby promote human safety for flights. Streaked horned lark are very attracted to the wide-open spaces created by vegetation management, and several airports in the range are now sites for local populations of the subspecies. In the South

Puget Lowlands, the streaked horned lark might have been extirpated if not for mowing at airports to maintain large areas of short grass (Stinson 2005, p. 70). Five of the eight streaked horned lark nesting sites in the South Puget Lowlands are located on or adjacent to airports and military airfields (Rogers 2000, p. 37; Pearson and Hopey 2005, p. 15). At least five breeding sites are found at airports in the Willamette Valley, including the largest known local population at Corvallis Municipal Airport (Moore 2008b, pp. 14–17). The Port of Olympia's Updated Master Plan includes recommendations to minimize impacts to larks at the airport by avoiding mowing during the breeding season; however, mowing still occurs during the breeding season (Port of Olympia/Olympia Regional Airport 2013, pp. 10–11) and the local population at the airport has fluctuated (both increased and decreased) in surveys from 2013 to 2019 (Wolf et al. 2020, p. 16). The overall count in 2019 of 27 breeding pairs was slightly lower than the count in 2013 (30), however, in 2019 there were six more breeding pairs than were counted in 2018. In 2017, the JBLM finalized a programmatic consultation with the Service that covered multiple activities affecting streaked horned lark including mowing (U.S. Fish and Wildlife Service 2017) (although mowing is allowed during the breeding season under emergency circumstances (Wolf et al. 2017, p. 34)). The consultation has resulted in a significant reduction in adverse effects to larks from mowing at military airfields. The breeding population of larks on JBLM increased from fewer than 100 pairs when the streaked horned lark was listed in 2013 (Wolf and Anderson 2014, p. 12), to over 120 pairs in 2019 (Wolf et al. 2020, p. 6). However, there are no conservation measures at several municipal airports in the Puget Lowlands region and none of the airports in the Willamette Valley region to reduce effects to streaked horned larks from operations and maintenance activities, including mowing.

Stressor: Loss of habitat (USFWS, 2020)

Exposure:

Response:

Consequence: Decreased quantity and quality of suitable habitat to support breeding and wintering streaked horned larks, reduction in population viability (USFWS, 2021).

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).

Stressor: Recreation (USFWS, 2020)

Exposure:

Response: Disturbance to adults; habitat degradation; mortality to eggs, nestlings, and fledglings (USFWS, 2020)

Consequence: Reduced populations, habitat loss.

Narrative: Recreation at coastal sites can cause the degradation of streaked horned lark habitat, as well as disturbance to adults and juveniles, and direct mortality to eggs, nestlings, and fledglings. Activities such as the annual spring razor clam digs, dog walking, beachcombing, offroad vehicle use, camping, fishing, and horseback riding in coastal habitats may directly or indirectly increase predation (primarily by corvids), resulting in nest abandonment and nest failure for streaked horned larks (Pearson and Hopey 2005, pp. 19, 26, 29). Streaked horned larks nest in the same areas as western snowy plovers along the Washington coast, and it is highly likely that recreation has caused nest failures for larks at sites that have documented nest failure for plovers; both species are ground nesters and, therefore, similarly at risk of effects of recreation. During western snowy plover surveys conducted between 2006 and 2010 at coastal sites in Washington, human-caused nest failures were reported in 4 of the 5 years (Pearson et al. 2007, p. 16; Pearson et al. 2008b, p. 17; Pearson et al. 2009a, p. 18; Pearson et al. 2010, p. 16), and one of 16 monitored nests at Midway Beach on the Washington coast was crushed by a horse in 2004 (Pearson and Hopey 2005, pp. 18–19). In 2002, JBLM began restricting recreational activity at the 13th Division Prairie to protect lark nesting sites; JBLM prohibited model airplane flying, dog walking, and vehicle traffic in the area used by streaked horned larks (Pearson and Hopey 2005, p. 29). JBLM continues to restrict recreational activities during the lark breeding season at the 13th Division Prairie, although enforcement, especially on weekends, is intermittent (Wolf et al. 2016, p. 43). In addition, the 2017 programmatic consultation JBLM entered into with the Service (U.S. Fish and Wildlife Service 2017) included recreation. The programmatic consultation has resulted in a marked increase in the breeding population of larks on JBLM from fewer than 100 pairs in 2013 (Wolf and Anderson 2014, p. 12), to over 120 pairs in 2019 (Wolf et al. 2020, p. 6) (USFWS, 2020).

Stressor: Aircraft Strikes (USFWS, 2020)

Exposure:

Response: Injury or mortality (USFWS, 2020)

Consequence: Reduction in number of breeding adults, and surviving juveniles; population reduction. (USFWS, 2020)

Narrative: Individual lark in these local populations near runways are at increased risk of aircraft strikes and collisions. Horned lark strikes are frequently reported at military and civilian airports throughout the country, but because of the bird's small size, few strikes result in significant damage to aircraft (Dolbeer et al. 2011, p. 48; Air Force Safety Center 2012, p. 2). Juvenile males seem to be struck most often, perhaps because they are trying to establish new territories in unoccupied but risky areas on runway margins (Wolf et al. 2017, p. 31). With respect to streaked horned larks in particular, in the 5-year period from 2013 to 2017, McChord Airfield had seven confirmed strikes, and Gray Army Airfield recorded one confirmed streaked horned lark strike (Wolf in litt. 2018). Since January 2017, 16 adults have been killed by strikes on JBLM, including 10 adults and 2 juveniles killed by strikes at McChord Airfield in 2020 (Wolf in litt. 2020). The increased number of strikes in 2020 were a direct result of construction activities that redirected aircraft traffic to the northern half of the runway where lark density is highest and lark abundance was relatively high; this led to a higher than normal mortality rate from aircraft strikes. Aside from the 12 strikes in 2020, JBLM recorded a total of 12 strikes in the seven years between 2013 and 2019, for a rate of 1.7 strikes per year. While aircraft strikes do occur in several local populations

at airports throughout the range of the species (particularly in the South Puget Lowlands), the rate appears relatively low and the vegetation management conducted by these airports also maintains replacement habitat that supports breeding pairs (Pearson et al. 2008a, p. 13; Camfield et al. 2011, p. 10; FAA 2020, entire) (USFWS, 2020)

Stressor: Land Management Activities and Related Effects (USFWS, 2020)

Exposure: Vegetation management activities (i.e. mowing, agricultural practices, etc.); military training activities; and dredged material placement (USFWS, 2020)

Response: Disturbance to adults; habitat degradation; mortality to eggs, nestlings, and fledglings (USFWS, 2020)

Consequence: Reduced populations, habitat loss (USFWS, 2020)

Narrative: Streaked horned larks evolved in a landscape of ephemeral habitat with regular historical disturbance regimes that maintained the large, open spaces with very early seral stage vegetation relied upon by the subspecies. Human activity led to the stabilization of these historical disturbance regimes, as well as the unintentional creation of “replacement” habitat for streaked horned larks that mimics their preferred large, open spaces. Replacement habitat occurs in a variety of settings across the range of the subspecies, including agricultural fields, at airports, and on dredge spoil islands. Open habitat is maintained in these areas by way of frequent human disturbance, including burning, mowing, cropping, chemical treatments (herbicide and pesticide application), or placement of dredged materials (Altman 1999, p. 19). Without regular large-scale, human-caused disturbance, the quantity of suitable habitat available to larks would decrease rapidly. These land management activities are key to providing and maintaining habitat for the streaked horned lark; without replacement habitat, the status of the subspecies would likely be much worse. However, when these same activities are conducted during the most active breeding season (mid-April to mid-June) for streaked horned larks, they have the potential to result in destruction of nests, crushing of eggs or nestlings, or flushing of fledglings or adults (Pearson and Hopey 2005, p. 17; Stinson 2005, p. 72). During the nesting seasons from 2002 to 2004, monitoring at Gray Army Airfield, McChord Airfield, and Olympia Airport in the South Puget Lowlands region documented nest failure at 8 percent of nests due to mowing over nests, forcing young to fledge early (Pearson and Hopey 2005, p. 18). Additionally, though dredge deposits can mimic sandy beach habitat typically used by larks, they have also been documented to destroy breeding sites and active nests (Pearson in litt. 2012a; Pearson et al. 2008a, p. 21; McLaren 2000, p. 3; Pearson and Altman 2005, p. 10). In the Willamette Valley, some habitats in agricultural areas are consistently maintained and therefore available throughout the year (e.g., on the margins of gravel roads), while other patches of suitable habitat shift as areas such as large fields are mowed, harvested, sprayed, or burned. In 2017, the Willamette Valley NWR entered into a 4-year programmatic consultation with the Service for its farming and pesticide use program (U.S. Fish and Wildlife Service 2016b, entire). This programmatic consultation documents the Refuge program’s commitment to adapting its farming activities to improve the status of the streaked horned lark on the William L. Finley, Ankeny, and Baskett Slough units of the complex. Conservation measures include ensuring that farming activities minimize disturbance to larks, and that pesticides used in agricultural fields have a low risk of adverse effects to larks and their food sources. Airports implement hazardous wildlife management programs that include vegetation management around roads and runways, to discourage the

presence of wildlife near the runways and thereby promote human safety for flights. Streaked horned lark are very attracted to the wide-open spaces created by vegetation management, and several airports in the range are now sites for local populations of the subspecies. In the South Puget Lowlands, the streaked horned lark might have been extirpated if not for mowing at airports to maintain large areas of short grass (Stinson 2005, p. 70). Five of the eight streaked horned lark nesting sites in the South Puget Lowlands are located on or adjacent to airports and military airfields (Rogers 2000, p. 37; Pearson and Hopey 2005, p. 15). At least five breeding sites are found at airports in the Willamette Valley, including the largest known local population at Corvallis Municipal Airport (Moore 2008b, pp. 14–17). The Port of Olympia's Updated Master Plan includes recommendations to minimize impacts to larks at the airport by avoiding mowing during the breeding season; however, mowing still occurs during the breeding season (Port of Olympia/Olympia Regional Airport 2013, pp. 10–11) and the local population at the airport has fluctuated (both increased and decreased) in surveys from 2013 to 2019 (Wolf et al. 2020, p. 16). The overall count in 2019 of 27 breeding pairs was slightly lower than the count in 2013 (30), however, in 2019 there were six more breeding pairs than were counted in 2018. In 2017, the JBLM finalized a programmatic consultation with the Service that covered multiple activities affecting streaked horned lark including mowing (U.S. Fish and Wildlife Service 2017) (although mowing is allowed during the breeding season under emergency circumstances (Wolf et al. 2017, p. 34)). The consultation has resulted in a significant reduction in adverse effects to larks from mowing at military airfields. The breeding population of larks on JBLM increased from fewer than 100 pairs when the streaked horned lark was listed in 2013 (Wolf and Anderson 2014, p. 12), to over 120 pairs in 2019 (Wolf et al. 2020, p. 6). However, there are no conservation measures at several municipal airports in the Puget Lowlands region and none of the airports in the Willamette Valley region to reduce effects to streaked horned larks from operations and maintenance activities, including mowing (USFWS, 2020).

Recovery

Reclassification Criteria:

Recovery Priority Number: 9C

Delisting Criteria:

Three self-sustaining regional populations of streaked horned larks within the south Puget Lowlands, Pacific Coast and lower Columbia River, and Willamette Valley regions that are of sufficient size to ensure long-term population viability; to rangewide population of 5,725 individuals. South Puget Lowland regional population: 700 individuals Pacific Coast and Columbia River regional population: 525 individuals Willamette Valley regional population: 4,500 individuals.

Protection of core sites with permanent or long-term conservation provisions that support appropriate characteristics of lark habitat and managed for conservation of larks.

Recovery Actions:

- Determine population status, trend, and current distribution.

- Conserve and enhance the three regional populations.
- Identify limiting factors and develop solutions for recovery.
- Promote outreach and cooperation with stakeholders and regional agencies.
- Develop and implement a post-delisting monitoring plan.

Conservation Measures and Best Management Practices:

- Since the streaked horned lark was listed in 2013, multiple entities have implemented a series of regulatory and voluntary conservation measures to offset negative impacts to larks and lark habitat, reducing the overall impact of threats and stressors influencing local populations. (USFWS, 2021)
- Development of a Habitat Conservation Plan (HCP) to permit the final phases of development of the Rivergate site was initiated by the Port of Portland in 2017 (Port of Portland 2017, p. 60); earlier phase of development occurred at Rivergate prior to the final listing of the species. As part of the 10(a)(1)(B) permit, the Port mitigated for the loss of habitat by securing a long-term easement on a 32-acre (13 ha) parcel at Sandy Island. Sandy Island is an occupied breeding site on the Columbia River about 30 miles (50 kilometers) north of the Rivergate industrial site and is designated as critical habitat for the streaked horned lark (Port of Portland 2017, p. 4). The HCP was developed to support the permit decision, outlining a 30-year protection and maintenance plan for Sandy Island (Port of Portland 2017, entire). The Port's commitment to manage the site and protect breeding streaked horned larks for the next 30 years helps to offset impacts to the regional population from the loss of available habitat at Rivergate. (USFWS, 2021)
- Conservation measures include the following: 1. Use largest spray booms practical for the job to minimize wheel track passes in treatment unit. Where possible use narrow tires and/or four-wheeled machines rather than floatation tires/three-wheeled machines to further reduce direct ground impacts resulting from treatment(s); 2. Limit ATV access for spot treatment to minimum necessary to facilitate the vegetation management objectives within the proposed project area; 3. Restrict prescribed burns to one-half of the known occupied breeding streaked horned lark habitat; 4. Raise mower decks to highest level to achieve desired biological outcomes and minimize ground level impacts; restrict individual mowing treatments to no more than 50 percent of project sites, while cumulative mowing during nesting season may equal 100 percent of project sites; 5. Stagger heavy equipment site access to allow occupied sites to complete breeding cycle un-impaired; minimize temporal impacts in relation to 120-day nesting period or shift implementation toward the tail end of the nesting season (Jul 15 to Aug 30); 6. Initiate activity at sites farther away from occupied lark habitats, and work toward occupied sites; 7. Avoid known nests by installing temporary fencing to create exclosures within larger grazing areas; 8. Avoid bare or sparsely vegetated areas during operations; 9. Minimize site entry and monitoring during nesting season, prioritizing access in non-streaked horned lark habitat; 10. Pedestrian spot herbicide application can minimize impacts by allowing for targeted treatment of undesirable vegetation while still allowing for concurrent ocular and aural site evaluations for streaked horned lark occupancy (i.e. no ATV engine noise, wheel tracks, etc.).

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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 pichincae* (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 femoralis pichincae* 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 or 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)

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 et 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 ruficularis*) 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)
- 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. Island Distribution: Found on Kauai, Niihau, Oahu, Lanai, Molokai, Maui and Hawaii. (USFWS, 2021c)

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 Opaekula, 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:

6 (USFWS, 2021c)

Population Size:

~1,500 (USFWS, 2021c)

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).

Recovery Actions:

- 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 'alae ke'oke'o 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • 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. • Predator / herbivore monitoring and control – Continue predator control and implement improved methods as they become available. • Invasive plant monitoring and control – Remove nonnative, invasive plants and improve altered wetland hydrology as appropriate. • Disease monitoring and control – Continue to monitor for avian botulism and if detected, implement actions to minimize the immediate threat. Research and develop new tools to prevent botulism related mortality. • 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 ‘ālae ke‘ōke‘ō as well as other endangered waterbirds. • 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, 2021b)
- New management actions: • Climate change degradation of habitat – Climate change is believed to pose a threat to this species. According to the Intergovernmental Panel on Climate Change, human activities have caused a 1degree Celsius (°C) (1.8 degrees Fahrenheit [°F]) increase in temperature above pre-industrial levels, and if the current rate of warming remains constant, we could reach an increase of 1.5°C (2.7 °F) by the year 2030 (IPCC 2018, A1, p. 6). Regional climate change models predict that the wet windward parts of the Hawaiian Islands may become wetter or remain stable in their seasonal rainfall, while the dry leeward sides would become drier (Timm et al. 2015, p. 92; Ghazal et al 2019, p. 2). Ghazal et al. (2019, entire) assessed the impacts of land use and climate changes on water balance components of the He‘eia coastal wetland on Oahu. Based on modeling it is believed that the applied scenarios may negatively affect groundwater recharge and baseflow that in turn adversely influence the groundwater sustainability of wetlands and the ecological functioning of coastal areas (Ghazal et al 2019, p. 14). Under future climate scenarios, rainfall variation was the determining factor most negatively impacting water balance components. Recharge and baseflow components had the highest sensitivity to the combined effects of land use and climate change, particularly during the dry season (Ghazal et al 2019, p. 1). The uncertainty analysis indicated that streamflow is projected to slightly rise by the middle of 21st century, but likely decline by 40 percent during the late 21st century (Ghazal et al 2019, p. 1). (USFWS, 2021b)

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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 (Stirnnemann 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

Population Growth Rate:

No information

Number of Populations:

No information

Population Size:

<100 (USFWS, 2021)

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

Samoa 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). The friendly ground-dove is a medium-sized dove native to the Samoan, Fijian and Tongan archipelagos and Wallis and Futuna Islands. The American Sāmoa population of the friendly ground-dove was listed as endangered and a Distinct Population Segment (DPS) under the Endangered Species Act in 2016. Historically and currently, the American Sāmoa DPS of the friendly ground-dove is only known to occur on the islands of Ofu and Olosega. Population trend information is unavailable, but the population has remained consistently small (< 100 individuals) since at least the late 1970s. (USFWS, 2021)

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:

1. Over a period of at least 10 years, tu'aimeo population data show a stable or increasing trend (i.e., finite rate of population increase, or λ , 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 250 individuals on at least 1 island (Ofu or Olosega). (USFWS, 2022)

2. Forest habitat on Ofu and Olosega is protected and managed such that the amount of habitat suitable for tu'aimeo is sufficient to sustain population targets identified in Downlisting Criterion 1. (USFWS, 2022)

3. Predator control programs on O Predator control programs on Ofu and Olosega are in effect with longterm commitments and are effectively managing predation mortality to the extent that population targets in Downlisting Criterion 1 are met. (USFWS, 2022)

Delisting Criteria:

1. Over a period of an additional 10 years, tu'aimeo population data show a stable or increasing trend (i.e., finite rate of population increase, or λ , 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. The average population throughout that time period is estimated to be at least 250 individuals on at least 2 islands within American Sāmoa (including Ofu, Olosega, or potentially Ta'ū or Tutuila).. (USFWS, 2022)

2. Forest habitat on Ofu and Olosega and any translocation localities is protected and managed such that the amount of habitat suitable for tu'aimeo is sufficient to sustain population targets identified in Delisting Criterion 1. (USFWS, 2022)

3. Predator control programs on Ofu, Olosega, and any translocation localities are in effect with longterm commitments and are effectively managing predation mortality to the extent that population targets in Delisting Criterion 1 are met. (USFWS, 2022)

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.
- 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.
- Implement a new mark and recapture study to obtain population and survival estimates.
- Continue ongoing rat-trapping projects on Ofu.
- Major recovery strategy elements include: • For all species: protection of native forest habitat; biosecurity measures to prevent transportation of nonnative predators and invasive plants among islands in American Sāmoa and introduction of new invasive species from outside the territory; and modification of American Sāmoa territorial law to allow eligibility for section 6 grant funds under the Act. • For pe'ape'a vai: protection of roost sites and

nearby forest from disturbance and habitat modification (particularly in the known remaining populations in Fiji); range-wide surveys to locate other extant populations; research on potential pesticide and disease impacts; and evaluating the feasibility of reestablishing populations through translocation or other approaches. • For ma'oma'o: predator control programs for rats and cats in Sāmoa (as well as any translocation localities in American Sāmoa); protection of diverse mature forest; and if feasible, translocation to reestablish populations in American Sāmoa. • For tu'aimeo: predator control programs for rats and cats on Ofu, Olosega, and any translocation localities; maintaining protected forest habitat; and if feasible, translocation to establish populations on other islands. • For Eua zebrina and Ostodes strigatus: comprehensive survey of American Sāmoa islands and islets for native snail and predator populations; translocation to predator-free islands and/or establishment of captive propagation programs; evaluating demography and predator-prey dynamics in existing populations; assessment of genetic and morphological diversity within and among islands; developing new predator control methods; and maintaining protected forest habitat. (USFWS, 2022)

Conservation Measures and Best Management Practices:

- RECOMMENDATIONS FOR FUTURE ACTIONS • Finalize the Draft Recovery Plan for Five Species from American Sāmoa • Identify and survey extant populations of moa and the habitats in which they occur to assess current distribution, abundance, and habitat use. • Survey historically occupied areas for any persisting populations. • Develop fine-scale climate models for the American Sāmoa DPS of friendly ground-dove to identify future suitable habitat based on existing and historical ranges and to determine potential future climate conditions. • Identify and prioritize areas necessary for recovery, including critical habitat, and delineate representative management units • Ensure long-term protection of management units. • Monitor management and use results to adapt management actions. • Develop and implement control programs for cats and rats, updating methods as new technology becomes available. • Control other threats to specific species as appropriate. • Monitor management and use results to adapt management actions. • Expand the distribution of existing wild populations and establish additional populations. • Utilize regulations and policy to support species recovery. (USFWS, 2021)

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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)

Number of Populations:

2 (USFWS, 1991)

Population Size:

287 (USFWS, 2015). ~285 (USFWS, 2019)

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). The most recent range-wide counts of the Mariana common moorhen estimated 133 birds on Saipan, 10 on Tinian, 3 on Rota, and 75 on Guam for a total of 221 in September 2018. It is likely that this is an underestimate as a more recent survey on Saipan during the dry season in May 2019 found 185 birds. It is likely the numbers on Guam may be larger as well, but surveys were not conducted. Therefore, the September count is the latest date when all islands were surveyed simultaneously (Steve Mullen, pers. comm.). Had the May 2019 data been able to be used, CNMI DFW estimates the total number may have been around 285 adult moorhens. (USFWS, 2020)

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 Witterman 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 λ , 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • 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. • 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, Rota, Tinian, and Saipan to monitor the status of the Mariana common moorhen throughout the Mariana Islands. • 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. • 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. • Research recommendation implementation – Keep abreast of research on improvements in predator control and implement improved methodology. • 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. • Human interaction monitoring and management – Minimize human disturbance at primary and secondary wetlands determined essential for recovery. • Habitat requirements research/Population viability monitoring and analysis – Research biological parameters needed to determine delisting criteria. • 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, 2020)
- New management actions: • Existing population management and restoration – In 2015, the DON placed ten nesting platforms at Fena Reservoir. A subset of the nesting platforms have been designed to include floating aquatic vegetation for cover (protection from predators) and to increase foraging opportunities. Moorhens have not been detected in the reservoir since 2013 so surveys have been discontinued. However, incidental sightings in the spillway were recorded during migratory bird monitoring in 2013-2015. (USFWS, 2020)

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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). Island Distribution: Found on Kauai and Oahu. Extirpated on Molokai, Maui and Hawaii. (USFWS, 2021c)

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:**

2 (USFWS, 2021c)

Population Size:

<400 (USFWS, 2021c)

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 filling 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*), Indian 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 harmless 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).
- 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 'ālae '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 'ālae '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)

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions:
 - Protect all core wetlands and at least 50 percent of supporting wetlands. Develop management plans for core and supporting wetlands.
 - Reintroduce the 'ālae '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. Directed analysis of the waterbird count data can be used to identify correlations, including use of specific wetlands, time of year, and state of the wetlands, that could improve management for the 'ālae 'ula and other endangered waterbirds.
 - Incorporate improved survey techniques for this species into the biannual statewide 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, 2021b)
- New management actions:
 - Climate change degradation of habitat – Climate change is believed to pose a threat to this species. According to the Intergovernmental Panel on Climate Change, human activities have caused a 1 degree Celsius (°C) (1.8 degrees Fahrenheit [°F]) increase in temperature above pre-industrial levels, and if the current rate of warming remains constant, we could reach an increase of 1.5°C (2.7 °F) by the year 2030 (IPCC 2018, A1, p. 6). Regional climate change models predict that the wet windward parts of the Hawaiian Islands may become wetter or remain stable in their seasonal rainfall, while the dry leeward sides would become drier (Timm et al. 2015, p. 92; Ghazal et al. 2019, p. 2). Ghazal et al. (2019, entire) assessed the impacts of land use and climate changes on water balance components of the He'eia coastal wetland on O'ahu. Based on modeling it is believed that the applied scenarios may negatively affect groundwater recharge and baseflow that in turn adversely influence the groundwater sustainability of wetlands and the ecological functioning of coastal areas (Ghazal et al. 2019, p. 14). Under future climate scenarios, rainfall variation was the determining factor most negatively impacting water balance components. Recharge and baseflow components had the highest sensitivity to the combined effects of land use and climate change, particularly during the dry season (Ghazal et al. 2019, p. 1). The uncertainty analysis indicated that

streamflow is projected to slightly rise by the middle of 21st century, but will likely decline by 40 percent during the late 21st century (Ghazal et al. 2019, p. 1). (USFWS, 2021b)

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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 following 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 constituent 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)

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 1981a, 1981b, 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)
- 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 southeastern 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. Interstate 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**Species Trends:**

Stable (USFWS, 2019)

Population Growth Rate:

Stable (USFWS, 1991)

Number of Populations:

1 (USFWS, 2019)

Population Size:

current estimate 174 birds: 67 males, 72 females, and 35 cranes of unknown sex (USFWS, 2024)

Population Narrative:

Species status: Stable. Estimates of the only known crane population that occurs on and near the Mississippi Sandhill Crane National Wildlife Refuge (Refuge) are generated annually from monitoring results. The current (March 2019) population estimate on the Refuge was 129 cranes (Hereford and Dedrickson 2019a). The number of chicks fledging on the Refuge has improved somewhat in recent years; however it is the consistent release of captive-bred and reared crane chicks that has provided population stability. An analysis of threats indicates several new post-listing threats have been identified and that the threats present at the time of listing are still present. (USFWS, 2019). Mississippi sandhill cranes are a monogamous long-lived subspecies with low annual reproductive potential and provide extended parent care. As an endemic subspecies, the Mississippi sandhill crane (*Grus canadensis pulla*) home range is limited to the 19,300 acre (ac) (7,810 ha) Refuge and the immediate surrounding area (Figure 1). The current estimate of the wild Mississippi sandhill crane population is 174 birds: 67 males, 72 females, and 35 cranes of unknown sex (Table 1) (Hereford 2024). This is the highest population estimate of the subspecies observed in the wild since 1993, when an estimate of 135 individuals followed robust releases of captive-reared birds (Gee and Hereford 1995). Currently, the Refuge population has exceeded the carrying capacity identified in the PHVA of 150 cranes, with a range of 130 to 170 birds (CBSG 1992). However, recruitment remains low and annual mortality remains high (Hereford 2024). Subspecies recovery may include expansion to additional areas of suitable habitat within the historical range of the subspecies and the development of a reintroduction strategy to determine the feasibility and means to reestablish a population at Grand Bay (USFWS, 2024)

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 (McIlhenny 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 birds 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 al., 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)

Stressor: Low recruitment (USFWS, 2024)

Exposure:

Response:

Consequence:

Narrative: As a long-lived bird with low productivity (two eggs per nest) and low natural recruitment (approximately 6.7%), recruitment to the Mississippi sandhill crane population has been primarily through population augmentation with captive-bred juveniles. Natural recruitment has continued to increase over the years, and accounts for just under 50% of the current population. Despite increases in natural recruitment, the lack of learned predator-defense behaviors remains the primary factor in the low natural recruitment in the population (see discussion under Factor C). An average annual sandhill crane recruitment rate of 15% is needed to achieve a stable population (Arnold et al. 2016) (USFWS, 2024).

Stressor: Climate Change (USFWS, 2024)

Exposure:

Response:

Consequence:

Narrative: Changing climatic conditions in the Southeast, including increasing drought, timing variations in seasonal precipitation, and heavy rain events (U.S. Environmental Protection Agency 2014; U.S. Global Change Research Program 2017), are expected to influence breeding behavior and impact crane recruitment. Extended droughts can lead to lower annual productivity and recruitment by reducing the quality and quantity of flooded and ponded sites used for nesting, thus increasing accessibility to predators (Hereford and Billodeaux 2010). Alterations in the seasonal timing of precipitation may result in flooded conditions appropriate for nesting occurring outside of the typical crane breeding season. Heavy downpours may flood active nests and require re-nesting. Although the crane has a prolonged nesting season and can re-nest, climate change may exacerbate the impact of other threats. The number of chicks fledged annually is negatively related to the annual number of extreme heat days (where daily high temperatures are $\geq 97^{\circ}\text{F}$) (Woolley et al. 2022). However, in 2023, despite 23 days categorized as extreme heat days, Mississippi sandhill cranes fledged 13 chicks in a historically long nesting season (February 8–September 22). The number of extreme heat days are expected to increase in the future and the impact of the effects of climate change are expected to increase in the future. As a result of climate change, wildfire severity and limitations on the use of prescribed fire continue to increase (Abatzoglou and Williams 2016; Williams et al. 2019; Burke et al. 2021). The application of prescribed fire is restricted to safe “burn windows”, or ranges of suitable weather and fuel conditions that facilitate manageable fire behavior. Increasing maximum temperatures and alterations in the seasonal timing of precipitation are expected to reduce burn windows, especially in the Southeast. Future climate projections indicate the percentage of suitable days for burning will decrease substantially during the summer months (Kupfer et al. 2020; Jonko et al. 2024). Compared to current conditions, suitable burn days are projected to decrease by 50% throughout the Southeast by 2051–2060 (Jonko et al. 2024). This decrease in projected burn days during the growing season, which accounts for a large percentage of burned area in the region (Nowell et al. 2018), presents a significant challenge to land managers’ ability to achieve ecological objectives (USFWS, 2024).

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)
- 1. Conduct a new PHVA using current data for the Refuge and for potential reintroduction at Grand Bay (USFWS, 2024).
- 2. Assess the genetic relationship of Mississippi sandhill cranes to other North American sandhill cranes and determine if restoring gene flow with other populations of cranes would be beneficial to Mississippi sandhill crane recovery (e.g., Florida sandhill crane) (USFWS, 2024).
- 3. Maximize quality and quantity of habitat on and near the Refuge by continuing to restore, improve, and maintain nesting, feeding, and roosting habitats. Control the spread of invasive plants onto the Refuge (USFWS, 2024).
- 4. Continue the captive propagation program. Determine the number of releases necessary to maintain a stable population and to create new populations elsewhere (USFWS, 2024).
- 5. Continue predator management and antipredator behavior training and possible translocation of cranes with antipredator behavior (USFWS, 2024).
- 6. Introduce Mississippi sandhill cranes onto Grand Bay and look for appropriate prairie/savanna habitat in other parts of Mississippi, Louisiana and Alabama that could potentially support additional Mississippi sandhill crane populations (USFWS, 2024).

Conservation Measures and Best Management Practices:

- **RECOMMENDATIONS FOR FUTURE ACTIONS** 1. Monitor the Mississippi sandhill crane population. Monitor mortality, survival, nesting, juvenile recruitment, and habitat use including movements and use of roosting, nesting, foraging, and loafing areas. Conduct a new PHVA using up-to-date data. 2. Assess the genetic relationship of Mississippi sandhill cranes to other North American sandhill cranes and determine if restoring gene flow with other populations of cranes would be beneficial to Mississippi sandhill crane recovery. 3. Increase natural recruitment in the wild population. Conduct predator management and study habitat variables associated with successful nesting territories. Explore the need and feasibility of using sterilized sandhill cranes from other populations outside Mississippi for cross-fostering Mississippi sandhill chicks at the Refuge in order to increase exposure of chicks to appropriate parenting skills. 4. Maximize the quality and quantity of habitat on and near the Refuge by continuing to restore, improve, and maintain nesting, feeding, and roosting habitats. Control the spread of invasive plants onto the Refuge and limit or negate crane contact with potential toxins. Explore ways to mitigate crane mortality due to increased development outside the refuge and increased density of roads. 5. Continue the captive propagation program. Determine the number of releases necessary to maintain a stable population and to create new populations elsewhere. 6. Introduce Mississippi sandhill cranes onto Grand Bay National Wildlife Refuge and

look for appropriate savanna habitat in Louisiana that could potentially support an additional Mississippi sandhill crane population. 7. Implement all other tasks identified in the recovery plan. 8. Revise the recovery plan as appropriate to address new threats and conservation needs. (USFWS, 2019)

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SPECIES ACCOUNT: *Hemignathus wilsoni* (= *H. munroi*) (?Akiapolaʻau (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 first 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 akiapolau 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 (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, 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions:
 - Surveys/inventories – Continued monitoring of ‘akiapōlā’au is important to determine species response to management actions and effects of climate change.
 - 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 including local control of mosquitoes at their breeding sites 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, including incompatible insect technique (Wolbachia - sterile male technique) and transgenic or genetically modified mosquitoes (LaPointe et al. 2009). 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 for disease control and their field application as a conservation strategy for Hawaiian forest birds.
 - Habitat and natural process management and restoration –
 - o We recommend 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. ‘Akiapōlā’au forage primarily on koa and utilize koa plantations for foraging (Pejchar et al. 2005). Acquisition and management of transmissionfree 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 Hawai‘i at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for ‘akiapōlā’au and other Hawaiian forest birds.
 - Captive propagation protocol development – Recovery of ‘akiapōlā’au may be achieved most effectively through in situ management techniques such as habitat management. However, captive propagation technology may need to be developed for ‘akiapōlā’au in case it is needed to help reestablish wild populations in the future. (USFWS, 2020)
- New management actions:
 - Surveys/inventories – Forest bird surveys were conducted on Hawai‘i from 2016- 2019 in areas within current and historical occurrence of ‘akiapōlā’au.
 - Disease control research – Scientists from the Hawai‘i Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and universities of Hawai‘i and Michigan are partnering with American Bird Conservancy, the Hawai‘i Department of Health, the Coordinating Group on Alien Pest Species, and the Nature Conservancy to adapt “Incompatible Insect Technique” to suppress reproduction in mosquitoes, *Culex quinquefasciatus*. *Culex quinquefasciatus*, or the southern house mosquito, is the carrier of avian malaria in Hawai‘i. Incompatible insect technique functions like birth control by making it impossible for male mosquitoes to produce viable offspring. Most mosquitoes carry a type of bacteria called Wolbachia in their system. Males and females must carry the same strain to reproduce. By giving labreared mosquitoes a different strain of Wolbachia, any eggs produced with wild mosquitoes would not hatch. (USFWS, 2020)

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SPECIES ACCOUNT: *Himantopus mexicanus knudseni* (Hawaiian stilt)

Species Taxonomic and Listing Information

Listing Status: Endangered; 10/13/1970; Pacific Region (R1) (USFWS, 2016)

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). Island Distribution: Found on Kauai, Hawaii, Molokai, Niihau, Lanai, Maui and Oahu. (USFWS, 2021c)

Critical Habitat Designated

Yes;

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 (USFWS, 2021c)

Population Size:

<2,000 (USFWS, 2021c)

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

Recovery Actions:

- 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.

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: The recovery strategy for ae'o centers on habitat protection and management, predator control, and mitigating impacts from climate change on all the main Hawaiian Islands.
- Core wetlands - Continue to protect (including securing from development) and manage core wetlands (delisting criterion objective of 100 percent) as described by USFWS (2011).
- Supporting wetlands - Continue to protect (including securing from development) and manage supporting wetlands (delisting criterion objective of 85 percent) as described by USFWS (2011).
- Continue to develop and implement management plans for core and supporting wetlands.
- Continue to eliminate or reduce and monitor predator populations in and around core and supporting wetlands.
- Continue standardized, biannual statewide surveys for ae'o and include wetlands designated as core and supporting wetlands for ae'o in the surveys for population index.
- Initiate a statewide banding effort to improve the ability to monitor the population structure.
- Monitor core and supporting wetlands for reproductive success, especially on Kaua'i, O'ahu, and Maui.
- Conduct population viability assessment periodically (every 5 years) to detect changes to the population.
- Coordinate management of core and supporting wetlands for ae'o with other agencies and organizations. Provide technical assistance to private landowners to develop wetland management plans that include predator control and botulism response.
- Climate change planning - Start prioritizing conservation actions that need to be taken in response to SLR for areas currently in the coastal plain (Kane and Fletcher 2013, p. 27).
- o Identify areas that may be impacted by marine and groundwater sources of flooding associated with SLR.
- o Identify areas naturally prone to flooding (e.g. depressions in topography, poor draining soils, low lying areas within the immediate vicinity of the coastline, etc.)
- o Identify coastal assets that fall within the erosion hazard zones.
- o Identify which effects from climate change may affect ae'o.
- o Identify and understand the biological tolerance of ae'o to the different effects from flooding and inundation that may impact all life stages of the species.
- Assess the availability of ae'o habitat in current core and supporting wetlands in

relation to projected trends in SLR and precipitation, • Review data on impacts to wetlands in Hawai'i from past tropical cyclones (e.g., Walaka), and identify the key threats to wetlands on Kaua'i, O'ahu, and Maui from SLR. • Start identifying upland habitat outside of the areas predicted to be impacted by SLR that may be suitable for restoration or creation of new wetlands and would provide ae'o habitat. • Continue to produce climate change models to predict SLR and assess key wetlands to protect/create in light of the analysis. • Revise Recovery Criterion 3 target for statewide ae'o population considering updated carrying capacity estimates when the PVA is finalized. New and ongoing research: • Hawai'i Wetland Joint Venture funded Kane (2014) and Kane and Fletcher (2013) to study flooding and inundation due to SLR at James Campbell NWR, Keālia NWR, and Kanahā Pond State Wildlife Sanctuary. Results of study included in this review. • Population Viability Analysis (PVA) was initiated for this species in 2017 (to update the findings of Engilis and Pratt [1993] and Reed et al. [1998]). Preliminary results (Reed and van Rees 2019) affirm that ae'o are conservationreliant species dependent on habitat management and predator control; final results are in preparation. • Harmon (in litt. 2018) is evaluating the impacts of flooding and depredation on ae'o nesting success and identified predators to assess the relationship of water level and depredation including: o Which potential predators contribute to nest failures? No results available at this time. o Does nest depredation decrease with increasing water levels? No results available at this time. o Does water depth influence predator type? No results available at this time. o Is nest initiation date correlated with water levels? No results available at this time. o Is the number of nest failures due to flooding higher in windward wetlands than in leeward wetlands? No results available at this time. o Does nest initiation date impact nesting success? Year 1 data shows nests laid early in the season have a higher success rate than those laid later in the season. o Results from the overall study suggests that availability of suitable nesting habitat continues to limit ae'o nesting (Price 2019, p 10). (USFWS, 2020)

References

USFWS 2016. Status of the Species and Critical Habitat: *Himantopus mexicanus knudseni* (Hawaiian stilt). 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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USFWS. 2020. 5-YEAR STATUS REVIEW Species Reviewed: Ae'o or Hawaiian stilt (*Himantopus mexicanus knudseni*). 26 pp.

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 crane, black crane. (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

No;

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)

Environmental Specificity

Adult: Narrow (inferred from USFWS, 2018a)

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 black rail 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 as 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 threats 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:

Stressor: Pesticides (USFWS, 2019)

Exposure:

Response:

Consequence:

Narrative: Widespread use of pesticides for mosquito control (USFWS 2019)

Recovery

Reclassification Criteria:

Recovery Priority Number: 3

Recovery Actions:

- 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)

Conservation Measures and Best Management Practices:

- Conservation Measures: 3.10.1 Migratory Bird Treaty Act The Migratory Bird Treaty Act of 1918 (16 U.S.C. 703 et seq.) is the Federal law providing specific protection for the eastern black rail due to its status as a migratory bird. The Migratory Bird Treaty Act (MBTA) prohibits the following actions, unless permitted by Federal regulation: to “pursue, hunt, take, capture, kill, attempt to take, capture or kill, possess, offer for sale, sell, offer to purchase, purchase, deliver for shipment, ship, cause to be shipped, deliver for transportation, transport, cause to be transported, carry, or cause to be carried by any means whatever, receive for shipment, transportation or carriage, or export, at any time, or in any manner, any migratory bird...or any part, nest, or egg of any such bird.” Through issuance of Migratory Bird Scientific Collecting permits, the Service ensures that best practices are implemented for the careful capture and handling of eastern black rails during banding operations and other research activities. The December 22, 2017 Solicitor’s Opinion, Opinion M37050, concludes that “consistent with the text, history, and purpose of the MBTA, the statute’s prohibitions on pursuing, hunting, taking, capturing, killing, or attempting to do the same apply only to affirmative actions that have as their purpose the taking or killing of migratory birds, their nests, or their eggs.” Therefore, take of an eastern black rail, its chicks, or its eggs that is incidental to another lawful activity does not violate the MBTA. 3.10.2 Coastal Management The Coastal Zone Management Act of 1972 (P.L. 92-583) (86 Stat. 1280; 16 U.S.C. 1451-1464) provides Federal funding to implement the states’ federally approved Coastal Zone Management Plans. All coastal states in the eastern black rail’s range have approved Coastal Zone Management Plans, which guide and regulate development and other activities within the designated coastal zone of each state (NOAA 2016, unpaginated). The Federal Consistency provision of the Coastal Zone Management Act requires Federal action agencies to ensure that the activities they fund or authorize are consistent, to the maximum extent practicable, with the enforceable policies of that state’s federally approved coastal management program (16 U.S.C. 1456). The Clean Water Act (CWA) and the Rivers and Harbors Act have sections (404 and 10, respectively) that contain provisions for the protection of jurisdictional wetlands from excavation and/or filling activities. The U.S. Army Corps of Engineers in conjunction with the U.S. Environmental Protection Agency administers permits that consider avoidance, minimization and compensation for projects affecting wetlands. Projects that cannot avoid impacts to wetlands must compensate their impacts through a restoration enhancement and/or preservation action for the equivalent functional loss. Mitigation banks are often used which tend to centralize compensation actions at a specific location for impacts in a considerably wider service area. Exact wetland types are not always restored or enhanced and there is considerable uncertainty that current mitigation practices would support the presence of black rails. The status of geographically isolated wetlands under the CWA has fluctuated with different court cases and rulings (Kirkman et al. 2000, pp. 553-554; Haukos and Smith 2003, pp. 582-586; Rains et al. 2016, entire). 3.10.3 Conservation Lands Suitable habitat for eastern black rail can be found within NWRs, National Parks and Seashores, state parks, preserves, wildlife management areas, and other conservation lands across the subspecies’ range. The National Wildlife Refuge System Improvement Act of 1997 (16 U.S.C. 668dd et seq.)

establishes the protection of biodiversity as the primary purpose of the NWR system; recreational and other uses of a NWR may only be approved if the Service finds such uses to be compatible with the purposes of that individual NWR and the purposes of the NWR system. Habitat for eastern black rails can also be found within National Parks and Seashores, which must balance visitation and recreation with the protection of natural resources like the eastern black rail and its habitat. The National Park Service Organic Act of 1916, as amended (39 Stat. 535, 16 U.S.C. 1), states that the National Park Service (NPS) “shall promote and regulate the use of [NPS units]...to conserve the scenery and the national and historical objects and the wildlife therein and to provide for the enjoyment of the same in such manner and by such means as will leave them unimpaired for the enjoyment of future generations.” In addition to the NPS Organic Act, the eastern black rail may benefit from a 2010 non-regulatory Memorandum of Understanding (MOU) between the NPS and the Service regarding migratory birds that was executed pursuant to Executive Order 13186; section F.4 of the MOU states that the NPS will identify and protect natural habitats of migratory bird species within park boundaries. Numerous conservation properties managed by State and non-governmental organizations also support habitat for eastern black rail. Protected lands such as Wildlife Management Areas, State Parks, State Natural Areas, and Preserves typically have rules that protect wildlife and prohibit the collection, destruction, or disturbance of plants and nongame animals. These lands are often managed for a suite of wildlife species while providing outdoor recreation opportunities to the public. Recent (2011 to 2017) eBird records of eastern black rails indicated a large number of these records occurred either on or within a kilometer of protected lands. This result may be a bias toward opportunities to detect the subspecies on public lands, may indicate that habitat suitable for the subspecies is more prevalent on protected lands, or a combination of the two. However, based on the available information, protected lands play an important role for the subspecies.

3.10.4 State Protections Black rail is listed as State Endangered in 7 states within the subspecies’ range: Delaware, Illinois, Indiana, Maryland, New Jersey, New York, and Virginia (Table 3-4). The species was formerly listed as endangered in Connecticut, but was considered extirpated during the last listing review based on extant data and subsequently delisted (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.). Protections are afforded to a species but vary by state when it is listed as either State Threatened or Endangered. In Delaware, the importation, transportation, possession or sale of any endangered species or parts of endangered species is prohibited (except under license or permit) (7 Del.C. § 601 - 605). Illinois statutes also include prohibitions on the possession, take, transport, selling and purchasing, or giving of a listed species, and allow incidental taking only upon approval of a conservation plan (520 I.L.C.S. 10/1 – 11). Indiana statutes prohibit any form of possession of listed species, including taking, transporting, purchasing or selling except by permit (I.C. 14-2234-1 to 12). Listed species may be removed, captured, or destroyed in Indiana only if it is shown by good cause that the species is causing property damage or is a danger to human health (I.C. 14-22-34-1 to 12). Similar prohibitions on the possession of a listed species in any form, except by permit or license, are in effect in Maryland (MD Code, Natural Resources, § 10-2A-01 - 09), New Jersey (NJSA 23:2A-1 to 23:2A-1:15), New York (N.Y. Env’tl. Conserv. Law § 11-0535; 6 NY NYCRR 182.1 - .16), and Virginia (Va. Code Ann. §§ 29.1-563 – 570). Violations of the statutes typically result in a misdemeanor, including fines, and forfeiture of the species or parts of the species and the equipment used to take the species. Some States also have provisions for nongame wildlife and habitat preservation programs (e.g., 7 Del.C. § 201 – 204; MD Code, Natural Resources, § 1-705). For example, in Maryland, the State Chesapeake Bay and Endangered Species Fund (MD Code, Natural Resources, § 1-705) provides funds to promote the conservation, propagation, and habitat protection of nongame, threatened, or endangered species. Black rail is listed as a Species in Need of Conservation in Kansas and requires

conservation measures to attempt to keep the species from becoming a State Threatened or Endangered species (Kansas Department of Wildlife, Parks and Tourism 2018, unpaginated). Black rail also is listed as Special Concern in North Carolina and requires monitoring (North Carolina Wildlife Resources Commission 2014, p. 6). The species is identified as a Species of Greatest Conservation Need in many State Wildlife Action Plans (USGS 2017, unpaginated). According to Natural Heritage Programs, black rail is ranked as possibly extirpated in the District of Columbia and in Indiana (NatureServe 2017, unpaginated) (USFWS, 2018).

- In some locations, loss of salt marsh associated with conversion to open water due to sea level rise is being offset to some extent by salt marshes becoming established in areas where salt water intrusion occurs also due to sea level rise or in areas where marsh accretion rates keep pace with sea level rise (Kirwin et al. 2016, pp. 255-256). Although this does not mean such shifts could continue indefinitely (i.e., into the longer term), it does illustrate a possible outcome in the nearterm in some areas, depending on a variety of relevant local conditions. An example of this habitat shift is described for the Chesapeake Bay (Schieder et al. 2018, entire). In addition, possible landward migration of salt marshes on the U.S. Gulf Coast has been described, along with potential barriers to such migration (Enwright et al. 2016, pp. 311-314; Kirwin et al. 2016, p. 258). (USFWS, 2019)

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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 thereafter, 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, Kahohe 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 above, 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 'iliahī (*Santalum paniculatum*) 'akoko (*Euphorbia olowaluana*), and pilo (*Coprosma montana*). Important understory shrubs include 'a'ali'i (*Dodonaea viscosa*), pukiawe, na'ena 'e (*Dubautia arborea*), and 'akala.

Dispersal/Migration***Population Information and Trends*****Population Trends:**

Declining

Number of Populations:

1 core population (USFWS, 2020)

Population Size:

Estimated pop. of 1,051 in 2018 (USFWS, 2020)

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 $17\% \pm 3.5$ 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 Hawai'i. 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 mosquitoes 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 Hawai'i.

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 Kaua'i where it is now only periodic (Benning et al. 2002). Disease prevalence and the prevalence of mosquitos are increasing across the Alaka'i (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 Kaua'i 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).

Stressor: Drought (USFWS, 2020)

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). Drought conditions on Mauna Kea as of July 28, 2020 fall into the D1 category, or

moderate drought intensity, based on the U.S. Drought Monitor (Heim 2020). Drought leads to tree death and also increases fire risk. (USFWS, 2020)

Stressor: Pests (USFWS, 2020)

Exposure:

Response:

Consequence:

Narrative: *Myoporum sandwicense* (naio) is an important tree species in the Mauna Kea dry forests, and is especially prevalent in the 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 the island of Hawai'i 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, 2020)

Recovery

Recovery Actions:

- **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 Hawai'i. 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 Hawai'i (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 LaPointe 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions:
 - Continue population surveys and monitoring to determine palila response to management actions and the effects of climate change.
 - Habitat protection and restoration
 - o Increase frequency and improve efficacy of aerial hunting to remove all mouflon sheep from palila critical habitat.
 - o When ungulates are removed from critical habitat, increased habitat management should occur in palila core habitat, including grass control and forest restoration. When ungulates are removed from critical habitat, increased habitat management should occur in palila core habitat, including grass control and forest restoration.
 - o Continue funding for the MKFRP for forest restoration, fence maintenance, and all other aspects of the MKFRP program.
 - o Continue enhancement of habitat outside the currently occupied range of palila, including Pu'u Mali Restoration Area, Lupea on the western slope of Mauna Loa, and Kīpuka 'Alala in the saddle between Mauna Kea and Mauna Loa, where new populations could be established.
 - Research
 - o Investigate methods to reduce or control invasive grass cover on Mauna Kea. Examine experimental approaches to restore *Sophora chrysophylla* in heavily degraded areas and improve *S. chrysophylla* tree vigor and density by applying fertilizer, giving water, and/or removing competing weeds in the less affected *S. chrysophylla* forest habitats.
 - o Identify a mycologist to collaborate on *Armillaria* (fungus affecting the roots of *S. chrysophylla*) for root diagnostics; will need a plan and a research proposal.
 - o Identify survey and research opportunities for *Cydia* caterpillars to determine overall function and abundance as an important food source for palila.
 - 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 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 development of modified mosquitoes for disease control and their field application as a conservation strategy for Hawaiian forest birds.
 - Predator monitoring and control
 - Continue and expand predator control (particularly for cats) in all areas where palila breed, including on adjacent lands (Pōhakuloa Training Area).
 - Determine the feasibility of captive propagation for reintroduction and genetic storage / reintroduction / translocation. Continue care for the palila in captivity and develop a release or translocation strategy.
 - Fire monitoring and control
 - Implement fire risk reduction measures by establishing green fuel breaks and improving existing roadway fire breaks; improve fire detection and response by stationing fire response resources (such as water trucks and fire spotters) on the west slope of Mauna Kea in key habitat; and conduct other improvements where necessary to allow a rapid and effective ground and aerial response to fire. Establish partnership with Parker Ranch and the possibility of placing dip tanks along fencelines between Ka'ohe and Pu'u Mali.
 - Weed monitoring and control
 - Continue funding the MKFRP for weed control, including *Delairea odorata* (cape ivy), *Ulex europaeus* (gorse), *Cenchrus setaceum* (fountain grass), *Senecio madagascariensis* (fire weed), and *Passiflora mollissima* (banana poka) and any newly identified invasive plants. (USFWS, 2020)
- New and on-going management actions:
 - In an effort to establish a second population of palila at the Pu'u Mali Restoration Area on the north slope of Mauna Kea, a total of eight captive birds were released in 2019. Prior to release, preparations included building a new release aviary and rebuilding previously established release aviaries, controlling introduced mammalian predators, and assessing

Sophora chrysophylla (māmane) flowers and seedpods in and around the release area. Palila were also prepared for release by being paired at KBCC and MBCC, before being transferred to the Pu'u Mali Restoration Area, where they were temporarily held in release aviaries to allow for acclimation. The palila dispersed widely after release and most died from predation or disappeared within one week. However, one of the palila pairs settled near the release site and the birds were observed foraging and interacting together for nearly three months after release. Unfortunately, the female then died, appearing to be depredated by a raptor, either 'io (*Buteo solitarius*) or pueo (*Asio flammeus sandwichensis*). The male palila was observed foraging at the feeders for a short period after the female disappeared before he then disappeared as well (last observed on September 26, 2019).

- The Palila Hui, a group of biologists from state, federal, and non-profit entities began a demography study in 2020. The objectives were to: (1) determine nest survival (or nest success) rates and adult fecundity, and identify major causes of nest failure, (2) determine adult and juvenile survival rates, adult sex ratio, habitat use, dispersal and juvenile recruitment rate to estimate spatial abundance, (3) determine the disease prevalence in the wild palila population, (4) measure nest site characteristics and compare with historical data), and (5) quantify avian mammalian predator prevalence within core breeding habitat (Palila Demography Plan unpublished 2020). The Hawai'i Division of Forestry and Wildlife (DOFAW), Natural Area Reserves (NAR), and the Mauna Kea Forest Restoration Project (MKFRP) banded a total of 26 palila in 2020 and observed four palila nests (NARS pers. comm. 2020).
- Habitat restoration and management – The MKFRP conducts weed control, forest restoration, forest monitoring, fence monitoring and maintenance, community outreach, volunteer trips, and ungulate control at Ka'ohe and Pu'u Mali Restoration Areas and in the core palila habitat within Mauna Kea Forest Reserve. From 2015 to 2019, an average of 15,000 to 20,000 plants have been outplanted per year by volunteer groups (approximately 200-300 volunteers per year). There is a 70% overall success rate of outplantings (MKFRP pers. comm. 2019).
- Predator control – The MKFRP and DOFAW continue to conduct predator trapping on the west (Ka'ohe) and north (Pu'u Mali) slopes of Mauna Kea. In August of 2018, a total of 210 traps were placed in a grid system at Pu'u Mali and 20 cats, 11 mongoose, and 6 rats were captured. At Ka'ohe, a total of 250 traps captured 11 cats, 8 mongoose, and 8 rats in 2018 (MKFRP pers. comm. 2019).
- Ungulate control (sheep) – DOFAW conducts quarterly control efforts for mouflon sheep (*Ovis orientalis orientalis*) on Mauna Kea, mostly focused on the core palila area. The number of sheep remaining on Mauna Kea is estimated at between 100 to 200 individuals. A total of 25-27 mouflon sheep have been radio-collared on the mountain since February 2019. Currently, three to four of these collared sheep are together which supports the low population estimate. Mauna Kea is also open yearround for hunting and hunters removed 38 animals over a six-month period in 2019 (DOFAW pers. comm. 2019).
- Ungulate control (pigs) – Pigs (*Sus scrofa*) have been controlled in Ka'ohe Restoration Area with 36 pigs caught in 2018 and 60 pigs in 2019 (MKFRP pers. comm. 2019).
- Fencing – To date, there are 62.5 miles (100 kilometers) of fencing around palila critical habitat and around the Ka'ohe and Pu'u Mali restoration areas. Currently, 5.9 miles (9.5 kilometers) are left to be contracted and replaced using Capital Improvement Program funding (DOFAW pers. comm. 2019). The MKFRP currently maintains these fences on Mauna Kea (MKFRP pers. comm. 2019).
- Fire management – Approximately 16 miles (26 kilometers) of fire/fuel breaks are in place at Ka'ohe, which are maintained by DOFAW.
- Habitat Assessment – To assess *Sophora chrysophylla* flowers and seed pods, phenology surveys have been conducted on a quarterly basis at Pu'u Mali and at Ka'ohe since 2019. Data analysis for this project has not been completed.
- Surveys – Annual palila surveys are coordinated by MKFRP and DOFAW staff in January or February of each year to monitor the range and abundance of palila. (USFWS, 2020)

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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 'Akeke'e is a small (10-12 g) insectivorous Hawaiian honeycreeper endemic to Kaua'i. 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 Hawai'i 'Akepa (*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). 'Akeke'e are most often observed in pairs or family groups.

Current Range

The 'Akeke'e 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 'Akeke'e at the time of listing. 'Akeke'e 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. Kauai (USFWS, 2021c) Numbering between 208 and 1,037 adults (Paxton et al. 2022b, p. 9), the 'akeke'e's range has been restricted to 58 square kilometers (km²) (22.4 square miles [mi²]) with an area of 11.10 km² (4.3 mi²) of suitable nesting habitat remaining (USFWS, 2022).

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 flynnii*. 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 flynnii*, 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 species-specific 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: *Broussaia*, *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: 'Akeke'e forage for insects, insect larvae, and spiders on the outer branches and leaves of 'ohi'a 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 'Akeke'e 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 'ohi'a 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 'Akeke'e is likely similar to that of the closely related, and well-studied, Hawai'i 'Akepa (*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 $(11.1 \pm 2.3 \text{ m Standard Deviation [SD]})$. Nesting success, calculated using program MARK, was $0.71 \pm 0.17 \text{ Standard Error (SE)}$. 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 tameiameia* (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, KFBRR unpubl. data) (USFWS, 2017). This federally endangered Hawaiian honeycreeper is an insectivorous nonmigratory forest interior bird endemic to Kaua'i. The 'akeke'e occurs on the Alaka'i Plateau above 1,000 meters (3,281 feet) in wet native montane forests dominated by *Metrosideros polymorpha* ('ōhi'a lehua), *Acacia koa* (koa), *Cheirodendron trigynum* ('ōlapa), *Cheirodendron* spp. (lapalapa), and *Syzygium sandwicensis* ('ōhi'a ha) (USFWS, 2022)

Dispersal/Migration

Population Information and Trends

Population Trends:

Declining (USFWS, 2022)

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).

Number of Populations:

1 (USFWS, 2021c)

Population Size:

~208 (USFWS, 2022)

Population Narrative:

The first quantitative information on the population size and distribution of the 'Akeke'e was based on extensive surveys conducted from 1968-1973, which yielded an island-wide population estimate of $5,066 \pm 840$ birds (Service 1983). Most individuals were found in the Alaka'i Plateau area and the Koke'e area west of the Alaka'i at elevations from 800-1,370 m. In 1981, the number of 'Akeke'e estimated to occur in a 25 km² area of the southeastern Alaka'i was $1,700 \pm 300$, with higher densities in the higher, more remote regions of the eastern Alaka'i Plateau and lower densities toward the west in the Koke'e region (Scott et al. 1986). In 1968-1973, the 'Akeke'e population in this same area was estimated to be 600 ± 200 birds (Service 1983). The

estimated population was $7,839 \pm 704$ birds in 2000, $5,669 \pm 1,003$ birds in 2005, and $3,111 \pm 591$ birds 2008 (DOFAW and USGS, unpubl. data). The most current estimate for the 'Akeke'e population is ca. 750 birds (DOFAW unpubl. data). The geographic range occupied by 'Akeke'e 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). The current wild population of 'akeke'e is estimated to be as low as 208 adults (Paxton et al. 2022b, p. 9) and declining. If the population trend continues on its trajectory, extinction is predicted to occur as soon as 2023 (Paxton et al. 2022b, p. 9). From 2000 to 2018, the range of 'akeke'e diminished 60 percent (Paxton et al. 2022b, p. 3). The current estimated range is 58 square kilometers (km²) (22.4 square miles [mi²]) with an area of 11.1 km² (4.3 mi²) of suitable nesting habitat remaining (USFWS, 2022)

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 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: 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 'Akikiki 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 Hawai'i.

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 Kaua'i 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 'Akikiki and the 'Akeke'e 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 *Melinis 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 polymorpha*) 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 Sincok'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 (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).

Recovery Priority Number: 2

Recovery Actions:

- 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 Hawai'i. 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 Hawai'i (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 LaPointe 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 Hawai'i 'Amakihi (*Hemignathus virens*) and the O'ahu 'Amakihi (*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 landscape-level 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 akeke 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 akeke 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).

Conservation Measures and Best Management Practices:

- **Recommendations for Future Actions:**
 - **Avian malaria and avian pox mosquito vector control** - Decrease the threat of avian disease.
 - o Foster the ability of native birds to tolerate or develop resistance to avian pox and avian malaria.
 - o Implement landscape level control of the southern house mosquito vector by using existing and developing technologies such as Wolbachia to control populations and bio-pesticides to treat larvae.
 - o Continue to investigate novel technologies to confront mosquito vectors and mosquito-borne pathogens in the Hawaiian Islands.
 - **Biosecurity** - Implement a statewide interagency biosecurity plan to prevent Rapid 'Ōhi'a Death and other detrimental non-native species from spreading on Kaua'i. 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 Hawai'i.
 - 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.
 - **Captive propagation protocol development** - Develop methods to hold cryogenic germplasm for 'akeke'e.
 - **Reintroduction / translocation** - Develop captive propagation and translocation thresholds, timetables, budgets, and plans for 'akeke'e.
 - **Population viability monitoring and analysis** - Conduct population and metapopulation viability analyses.
 - **Population biology research** - Continue local demographic sampling of 'akeke'e to better understand species life history traits and factors effecting population size and distribution.
 - **Habitat Protection and Management** - Habitat protection and management should continue to occur in areas in which 'akeke'e 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. • Predator Control - A need exists to develop, test, register, and apply toxicants for control of feral cats (*Felis catus*) and introduced rodents in remote forested habitat. Prevention of additional introductions of exotic plants, insects, reptiles, mammals (especially the mongoose [*Herpestes auropunctatus*]) and alien birds that may act as predators on, or competitors with, native birds is necessary. • Surveys / inventories - Systematically survey all forest bird habitat on Kaua'i at least once every five years to determine changes in distribution and population size of all native and nonnative forest birds (USFWS, 2022).

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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 ventrally. 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)

Number of Populations:

5 (USFWS, 2020)

Population Size:

estimated 16,248 (95% CI 10,074 - 25,198) (USFWS, 2020)

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).

Stressor: Climate change destruction or degradation of habitat (USFWS, 2020)

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; 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 Hawai'i, 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., ICAP 2010; IPCC 2013), would result in 100 years in a nearly 100 percent decrease in the land area 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 Hawai'i 'ākepa as predicted, it would likely contribute to the extinction of this species over time. (USFWS, 2020)

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 (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, 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • Surveys/inventories – Continued monitoring of Hawai'i 'ākepa is important to determine species response to management actions and effects of climate change. • 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 including local control of mosquitoes at their breeding sites 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, including incompatible insect technique (Wolbachia - sterile male technique) and transgenic or genetically modified mosquitoes (LaPointe et al. 2009). 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. • Habitat and natural process management and restoration – o We recommend 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 birds 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 Hawai'i at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for Hawai'i 'ākepa and other Hawaiian forest birds. (USFWS, 2020)
- New management actions: • Surveys/inventories – Forest bird surveys were conducted on Hawai'i from 2016- 2019 in areas with current and historical occurrence of Hawai'i 'ākepa. • Disease control research – Scientists from the Hawai'i Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and universities of Hawai'i and Michigan are partnering with American Bird Conservancy, the Hawai'i Department of Health, the Coordinating Group on Alien Pest Species, and the Nature Conservancy to adapt "Incompatible Insect Technique" to suppress reproduction in mosquitoes, *Culex quinquefasciatus*. *Culex quinquefasciatus*, or the southern house mosquito, is the carrier of avian malaria in Hawai'i. Incompatible insect technique functions like birth control by making it impossible for male mosquitoes to produce viable offspring. Most mosquitoes carry a type of bacteria called Wolbachia in their system. Males and females must carry the same strain to reproduce. By giving labreared mosquitoes a different strain of Wolbachia, any eggs produced with wild mosquitoes would not hatch. (USFWS, 2020)

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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

Adult: 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

Adult: 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

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 interdiction 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions:
 - Regularly survey and monitor the species using the methods described in Amidon et al. 2011 to assess population status and trends.
 - Threats – predator control research – Continue efforts to develop and refine brown treesnake control techniques to support large-scale control and/or eradication efforts. 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.
 - Threats – herbivore control research – remove ungulates from the islands with larger Micronesian megapode populations, including Aguiguan, Alamagan, and Pagan.
 - Threats – predator control research – Prioritize islands most in need of predator control, implement predator control and utilize improved methods as they become available.
 - Habitat and natural process management and restoration – Determine how to improve the management of the islands with the largest Micronesian megapode populations, especially those set aside as conservation areas. For example, consider rodent removal from Sarigan.
 - o Develop and implement plans to monitor Micronesian megapode populations on all islands on a regular basis.
 - Population biology research – Conduct essential research on the ecology and biology of the Micronesian megapode in the Mariana Islands. Determine if Micronesian megapodes can be supported and re-introduced to islands they have been extirpated from, for example, Rota and Tinian.
 - o Conduct a population viability analysis (PVA) to determine the minimum viable population number by island needed for recovery, and
 - o Conduct surveys every year for at least 10 years to determine actual status of the species.
 - Invasive plant monitoring and control – Restore native forest and conduct forest restoration programs.
 - Update the recovery plan (USFWS 1998). Use recent survey data to reevaluate and revise down- and delisting criteria as appropriate.
 - There are past records of poaching, which may not be an issue currently, but may become a concern if people move permanently back to northern islands utilized by megapodes. (USFWS, 2020)
- New management actions:
 - Predator monitoring and control – Efforts continue on Guam to control the brown treesnake at ports of entry and on military lands. In recent years, acetaminophen has been used as a toxicant to control snakes within a 55-hectare (136-acre) fenced area on Anderson Air Force Base (AAFB), Guam. In addition, a brown treesnake strategic plan was finalized in 2015. The megapode was historically found on Guam, so efforts to reduce predators could potentially allow for reintroduction of the species.
 - 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. Typhoons 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). Improved modeling of the impacts of climate change will help decision makers determine which populations of the megapode will be impacted the most and inform management decision.
 - Invasive Plant Management- The Service has received funding from the U.S. Navy as mitigation for the bombing of FDM to conduct an invasive plant control and native habitat restoration project on Aguiguan. The project is expected to begin in 2020. The creation of additional native forest habitat on Aguiguan will increase breeding, feeding, and sheltering habitat on the island for the megapode.
 - Ungulate Management- CNMI DFW is currently evaluating the feasibility of ungulate control on Alamagan. The removal of ungulates on Alamagan would decrease the threat of nest failure by trampling or rooting by pigs and other ungulates as well as reduce grazing pressure and aid in the regeneration of forest habitat. (USFWS, 2020)

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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., omar (Myadestes obscurus) and puaiohi or small Kauai thrush (Myadestes 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

Adult: 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:

Unknown (Presumed Extinct)

Species Trends:

Unknown; last confirmed sighting in 1980 (USFWS, 2015); Unknown (Presumed Extinct)

Number of Populations:

0 - 2 (USFWS, 2023)

Population Size:

Unknown (Presumed Extinct) (USFWS, 2023)

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 Moloka'i in 2010 in areas with historical occurrence of oloma'o (R. Camp, U.S. Geological Survey, pers. comm. 2015). Oloma'o were not detected during these surveys. • In response to the reported sighting in May, 2005 of an oloma'o near 'Ōhi'alele just below Pu'u Ali'i Natural Area Reserve (Pu'u Ali'i NAR) (Ken Wood, e-mail communication with Fern Duvall, 2005), biologists John Vetter and Kristy Swinnerton spent two to three days in Pu'u Ali'i NAR, shortly after the reported sighting. Using playback recordings for oloma'o they covered the Pu'u Ali'i NAR well, but no oloma'o were detected (John Vetter, USFWS, pers. comm., 2018). • During a four-day Oloku'i Plateau biological survey in 2015 there were several sightings of oloma'o near 'Ōhi'alele in The Nature Conservancy Pelekunu Preserve by a Hawai'i 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 oloma'o on Moloka'i. In 2008, only 120 variable circular-plot surveys had been conducted on Moloka'i in areas where oloma'o 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 oloma'o 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). We believe the status of the oloma'ō is "unknown," based on conclusion of the Hawai'i Rare Bird Search 1994-1996 that the species could still be potentially extant (Reynolds and Snetsinger, 2001, pp. 141-142), the low survey effort for oloma'ō after this (see Table 1), and the recent unconfirmed sightings of oloma'ō in 2005, 2015 and audio detection of an "unknown bird" that sounded "thrush-like" in 2021. 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). The large area of the Olokui Plateau, an area of 656 hectares (1,616 acres) that was not surveyed during the Hawaii Rare Bird Search, and the many remote areas within this that are only rarely visited by qualified observers, increase the potential that a small population of oloma'ō could still exist on Moloka'i (USFWS, 2023).

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 oloma'ō 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'ō 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 (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, 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).

Recovery Priority Number: 5

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 oloma'o 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 oloma'o be conducted on Moloka'i using similar methodologies as those employed during the Hawai'i 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions:
 - Surveys/inventories o One of the most important recovery actions for the oloma’o is to search areas of forest habitat where the species occurred historically (USFWS 2006, p. 3-17) intensively and systematically. 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 oloma’o be conducted on Moloka’i using similar methodologies as those employed during the Hawai’i 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.
 - 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, pp 406-409). Recent progress has been made with the development of sterile male and genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing soon (LaPointe et al. 2009, pp. 415-417). Landscape-scale mosquito control is planned on Maui and Kaua'i in the near future. We encourage continued research in the fields of sterile insect techniques and genomic technologies for disease control and their field application as a conservation strategy for Hawaiian forest birds and application on a landscape-scale to reduce threat of avian disease in native forests on Moloka'i. • Habitat and natural process management and restoration – oloma'o benefit from habitat protection including fencing, ungulate removal, weed control, and habitat restoration that assist other native Hawaiian forest birds on Moloka'i (USFWS, 2023).

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USFWS. 2023 5-YEAR REVIEW Short Form Summary. Species Reviewed: Oloma`o or Moloka`i Thrush (*Myadestes lanaiensis rutha*). Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawaii. 7 pp.

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). Island Distribution: Kauai (USFWS, 2021c)

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 forage 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 Alaka'i Plateau (Scott et al. 1986, Snetsinger et al. 1999). Puaiohi use wet native montane forest dominated by 'ohi'a, 'olapa, lapalapa (*C. platyphyllum*), 'ohia ha (*Syzygium sandwicensis*), kawa'u, and kolea, with a diverse understory of native plants including 'ohelo 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 (USFWS, 2023)

Population Size:

~494 (USFWS, 2023)

Additional Population-level Information:

Since 2009, the overall trend of puaiohi within its restricted range in the Alaka'i 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 Kawaikōi, but density declines with elevation (Snetsinger et al. 1999, Crampton et al., 2017). The upper reaches of the Halehaha and Halepā'ākai 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 Kawaikōi / Kauaikinānā (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 Koai'e 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 Alaka'i 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 Alaka'i 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; KFBPR unpubl. data), which likely reflects locating additional birds versus an increase in the population. Since 2009, the overall trend of puaiohi within its restricted range in the Alaka'i 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 (4,942 acres) and 75% of the population occurs in 10 km² (2,471 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 Kawaikōi, but density declines with elevation (Snetsinger et al. 1999; Crampton et al. 2017). The upper reaches of the Halehaha and Halepā'ākai 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; Crampton et al. 2017) and lower Kawaikōi/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 (USFWS 2018). Surveys in March 2000 and spring 2012 confirmed the existence of a small population along an upper tributary of the Koai'e Stream, although its size and extent are unknown (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, 2023).

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. 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 Hawai'i.

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 Kaua'i 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 Kaua'i 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

Reclassification Criteria:

Recovery Priority Number: 2

Recovery Actions:

- 2018 Management action a) Ungulate Control — The Kaua'i Watershed Alliance constructed a fence in 2011 to protect the southeastern Alaka'i 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 Halepā'ākai, was completed in 2016, and ungulate and rat control is ongoing in this unit. Fences around the Drinking Glass and Koai'e 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 Alaka'i 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 Halepā'ākai, 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 Kaua'i 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 nest 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 Kawaikōi 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 Hawai'i 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 Kawaikōi drainage 13.8% of captive birds have bred, while in the higher density Halepā'ākai drainage only 1.4% have bred (KFBRP, unpubl. data). However, even in the Kawaikōi, 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 than 1 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 Hawai'i 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 Halepā'ākai (KFBRP, unpubl. data). (USFWS, 2018).
- 2018 Management action e) Occupancy Surveys — Kaua'i 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 *Hedygium 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 Kawaikōi. 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 'Ōhi'a Death and other detrimental non-native species from becoming established on Kaua'i (Hawai'i 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 Hawai'i 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 Hawai'i 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).
- Life history and demographic studies of the Puaiohi were conducted from 1996 to 2000 by the USGS and have been ongoing since by the Kaua'i Forest Bird Recovery Project (KFBRP) under the direction of DOFAW. Invasive alien plants are controlled in the Alaka'i and Koke'e areas by TNC and the Koke'e Resource Conservation Program. In 2010, the Kaua'i Watershed Alliance (KWA) completed fencing to protect 810 ha of Puaiohi habitat in the southeastern Alaka'i 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 Kaua'i Ecosystem was prepared in 2010 for the Puaiohi. The outline covers all federally listed species on Kaua'i, 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 Alaka'i (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 KFBPR 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 Hawai'i. 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 Hawai'i (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 LaPointe 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions:
 - Surveys/inventories — Continued monitoring of puaiohi is important to determine species' response to management actions and effects of climate change.
 - Habitat management and restoration —
 - o Continue habitat management in areas where the species currently exists (USFWS 2006).
 - o Invasive plants such as *Hedygium gardnerianum* (Himalayan 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, Koai'e and Kawaikōi. Continued weed control, fencing, and ungulate removal are recommended for these areas.
 - Predator/herbivore control —
 - o Control rodents over a larger area. Rodent control programs should be continued and expanded by whatever methods are available. Currently, KFBPR has plans to increase the density of traps in existing grids to increase rodent suppression and improve puaiohi survival. However, given ongoing issues with trap failures that remain unaddressed by the manufacturer, trapping is not as cost effective as initially thought. Aerial or hand broadcast of rodenticide inside fenced habitat should be considered and evaluated.
 - o Evaluating the response of puaiohi to rodent control has been the subject of a 2020- 2023 study, which has suggested modifications to trap protocols that will be the subject of a subsequent study in an adaptive management approach.
 - o Continue cat trapping near high density puaiohi nesting areas and evaluate its effectiveness.
 - o Prevent 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.
 - Biosecurity — Implement a statewide interagency biosecurity plan to prevent Rapid 'Ōhi'a Death and other detrimental non-native species from becoming established on Kaua'i. 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 Hawai'i.
 - 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.
- Disease control research — 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. 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. A current focus for conservation in Hawai'i is the development of mass rearing 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 (IIT). Capacity is being developed for the mass rearing and release of *Wolbachia* infected *C. quinquefasciatus*. However, management can be modified to incorporate more efficient technologies for mass rearing and release as they are developed and approved. • Translocation – A recent paper analyzed the potential for translocation of puaiohi to high-elevation areas on other islands (Fantle-Lepczk et al. 2020). This analysis could be expanded and implemented if appropriate to establish new populations of puaiohi (USFWS, 2023).

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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

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).

Recovery Priority Number: 5C

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.
- 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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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)

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 unable 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 Caribbean (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.
- 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: *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 loreal 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)

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 (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, 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).
- 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).

Conservation Measures and Best Management Practices:

- **Recommendations for Future Actions:**
 - **Surveys/inventories** – Continued monitoring of ‘alawī is important to determine species response to management actions and effects of climate change.
 - **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 including local control of mosquitoes at their breeding sites 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, including incompatible insect technique (Wolbachia - sterile male technique) and transgenic or genetically modified mosquitoes (LaPointe et al. 2009). 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.
 - **Habitat and natural process management and restoration** –
 - o We recommend 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. 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 Hawai'i at high elevations adjacent to protected refugia and managing these areas for forest growth to provide suitable habitat for 'alawī and other Hawaiian forest birds. • Captive propagation protocol development – Recovery of 'alawī may be achieved most effectively through in situ management techniques such as habitat management. However, captive propagation technology may need to be developed for 'alawī in case it is needed to help reestablish wild populations in the future. (USFWS, 2020)

- New management actions: • Surveys/inventories – Forest bird surveys were conducted on Hawai'i from 2016- 2019 in areas with current and historical occurrence of 'alawī. • Disease control research – Scientists from the Hawai'i Department of Land and Natural Resources, the U.S. Fish and Wildlife Service, and universities of Hawai'i and Michigan are partnering with American Bird Conservancy, the Hawai'i Department of Health, the Coordinating Group on Alien Pest Species, and the Nature Conservancy to adapt "Incompatible Insect Technique" to suppress reproduction in mosquitoes, *Culex quinquefasciatus*. *Culex quinquefasciatus*, or the southern house mosquito, is the carrier of avian malaria in Hawai'i. Incompatible insect technique functions like birth control by making it impossible for male mosquitoes to produce viable offspring. Most mosquitoes carry a type of bacteria called Wolbachia in their system. Males and females must carry the same strain to reproduce. By giving labreared mosquitoes a different strain of Wolbachia, any eggs produced with wild mosquitoes would not hatch. (USFWS, 2020)

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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 hermland 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 hermland 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 dielirectum*, *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*, *Isodendron 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 dielirectum*, *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*, *Isodendron 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 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 dielirectum*, *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*, *Isodendron 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 dielirectum*, *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*, *Isodendron 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*, *Isodendron 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*, *Isodendron 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*, *Isodendron 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 campylothea* ssp. *pentamera*, *B. campylothea* 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 are 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 Puehuhunui 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*, *Isodendron pyriform*, *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. *waihoi*ensis, *Cyanea copelandii* ssp. *haleakala*ensis, *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. *waihoi*ensis, *Cyanea copelandii* ssp. *haleakala*ensis, *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*, *Isodendron 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*, *Isodendron 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 pyriformis*, *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 dielirectum*, *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 wiebkii*, *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 wiebkii*, *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 dielirectum*, *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 hermland 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:

population estimate of 'ākohekohe is 1768 + 315 birds (95% CI) (USFWS, 2023)

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). 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). status information: • The most recent population estimate of 'ākohekohe is 1768 + 315 birds (95% CI) (Judge et al. 2021, p. 121) from east Maui forest-bird surveys conducted in 2017 using the variable circular plot survey methodology (Scott et al. 1986). Variable circular plots are used generally to survey forest birds in Hawai'i, but according to Camp et al. (2009) this is not an appropriate method for all species and provides poor estimates for extremely rare birds (USFWS, 2023).

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).

Stressor: Climate change (USFWS, 2023)

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, p. 559; Banko and Banko 2009, pp. 52-53). 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, *Plasmodium relictum*, occurs, potentially reducing the remaining suitable habitat for these species (Atkinson and LaPointe 2009, p. 53; Atkinson et al. 2014, p. 2426). In Hawai'i, the threshold temperature for transmission of avian malaria has been estimated to be 55 degrees Fahrenheit (13 degrees Celsius), whereas peak *P. relictum* prevalence in wild mosquitoes occurs in mid-elevation forest where the mean ambient summer temperature is 64 degrees Fahrenheit (17 degrees Celsius) (Benning et al. 2002, p. 14247). Benning et al. (2002, p. 14247) used GIS simulation to show that an increase in temperature of 3.6 degrees Fahrenheit (2 degrees Celsius), which is within the range predicted by most climate models, would result for Hanawā Natural Area Reserve on east Maui in a reduction in forest with a low risk of malarial infection by half in 100 years. Fortini et al. (2015, p. 9) predict for current climate change that `ākohekohe will lose 92% of its range by 2080-2100 due to intrusion of mosquitoes and increased disease prevalence (USFWS, 2023).

Recovery

Recovery Actions:

- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: The recovery strategy for ‘ākohekohe centers on protection, restoration, and management of native high elevation forests on east Maui (Haleakalā), west Maui, and east Moloka‘i. • Surveys/inventories — Continued monitoring of ‘ākohekohe is important to determine species response to management actions and climate change and population status. • Habitat management and restoration — Continue habitat management in areas where the species currently exists. Invasive plants such as *Hedychium gardnerianum* (Himalayan ginger), strawberry guava (*Psidium cattleianum*), and *Sphaeropteris cooperi* (Australian tree fern) and non-native ungulates are degrading ‘ākohekohe habitat. Continue control of introduced invasive plants and exclusion/removal of ungulates that spread seeds of invasive plants. • Ungulate monitoring and control — Continue ungulate control. ‘Ākohekohe are currently restricted to the windward forests of east Maui from Waikamoi to Manawainui Valley. Waikamoi Preserve, managed by The Nature Conservancy of Hawai‘i (TNC) is completely enclosed by ungulate exclusion fencing, and in cooperation with the East Maui Watershed Partnership (EMWP), TNC and EMWP have reduced ungulate populations within fenced areas to near zero in 12,000 acres of TNC and adjacent State Forest lands (TNC 2018, p. 10). Hanawā Natural Area Reserve, further east is completely fenced with ongoing ungulate control. Ungulate removal is ongoing and new fence construction and repairs to existing fencing are planned on the east slope of Haleakalā volcano within Haleakalā National Park. However, it is important that fencing and ungulate control be conducted in all areas on east Maui where populations of ‘ākohekohe exist. • Predator monitoring and control — Control of small mammalian predators is needed throughout the species’ range. Currently, intensive control of rats (*Rattus* spp.) and introduced mammalian predators [cats (*Felis catus*) and mongoose (*Herpestes auropunctatus*)] is underway in different portions of the species’ range. • 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.

- **Biosecurity** — Implement a statewide interagency biosecurity plan to prevent Rapid 'Ōhi'a Death and other detrimental non-native species from becoming established on Maui. 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 Hawai'i. 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.
- **Disease monitoring and control** — Identification of resistance or tolerance to avian diseases within the population is an important recovery strategy. Disease control using traditional and new methods is critical.
 - o Studies to examine potential genetic resistance by 'ākohekohe to avian disease have not been conducted but are important to identify any potential resistance or tolerance to avian disease.
 - o Control of mosquitoes and their breeding sites is needed using traditional methods including application of *Bacillus thuringiensis israelensis* (Bti), a bacterial larvicide, whenever feasible, and ungulate exclusion and removal that reduces mosquito breeding sites.
 - o 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.
 - o 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 2023). Continued support for this program is critical to prevent West Nile virus and other avian diseases from entering the State of Hawai'i.
 - o Landscape-scale mosquito control — Over the last 5-years there has been substantial movement toward development and implementation of landscape-scale control of the introduced southern house mosquito (*Culex quinquefasciatus*) that transmits avian disease to Hawaiian forest birds. In 2022 an Environmental Assessment (EA) was published for broad-scale mosquito control in conservation areas on east Maui using the Incompatible Insect Technique (ITT) (HALE 2022, entire) and preparations have begun for first use of IIT on east Maui using male *C. quinquefasciatus* mosquitoes treated with *Wolbachia*. *Wolbachia* is a naturally occurring bacteria which is present in over half of all insect species worldwide (<https://www.birdsnotmosquitoes.org/wolbachia>). Researchers have found that *Wolbachia* plays an important role in insect reproduction, because it can function like birth control. The bacteria is already present in many insects in Hawai'i, including some mosquito species. IIT works because male mosquitoes with one strain of *Wolbachia* can only reproduce with females with the same strain of *Wolbachia*. Conversely, males with one strain of *Wolbachia* cannot produce viable offspring with females with a different strain of *Wolbachia*, or females without *Wolbachia*. In a laboratory setting, researchers can expose mosquitoes to a different strain of *Wolbachia* and then rear large numbers of them. The mosquitoes are then separated by sex and only male mosquitoes are released into the wild. Once released, the lab-raised male mosquitoes mate with wild female mosquitoes and those females lay eggs that never hatch. When such releases are completed consecutively, mosquito populations decrease because new generations are not produced in the wild.
- **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, p. 2-143). However, plans are underway to bring a few individuals into captivity to determine how well individuals adapt when removed from the wild (USFWS, 2023).

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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 many 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)

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). Summary Species Status Information: • The O`ahu creeper was federally listed as endangered on October 13, 1970 (USFWS 2010). • The last sighting of the O`ahu creeper in which physical evidence was gathered was in 1968 (Roberts et al. 2010). • 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). No O`ahu creepers have been confirmed in any Christmas Bird Counts since. • Roberts et al (2010) estimated the chance that a species is extinct in a given year, subsequent to the last accepted sighting. When only sightings with physical evidence were used, the authors determined the year 2009 as the upper 95% confidence bound for species extinction. If all independent expert opinion sightings were included, however, the expected year of O`ahu creeper extinction was 1989 when using 95% confidence. This approach for establishing extinction probability is problematic when applied to extremely rare species such as O`ahu creeper that are potentially distributed over a large area because absence of observation records may be the result of inadequate survey effort. (USFWS, 2019)

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).

Stressor: Rapid Ohia Death

Exposure:

Response:

Consequence:

Narrative: (ROD) is a new threat to the O`ahu creeper and other species that utilize *M. polymorpha* or `ōhi`a trees. `Ōhi`a is the dominant tree in the Ko`olau forests. The preferred habitat of the O`ahu creeper is thought to be mid-elevation koa/`ōhi`a (*Acacia koa*/*Metrosideros polymorpha*) forests in valleys or on sideridges at elevations from 300 to 600 meters (1,000 to 2,000 feet) (Shallenberger and Pratt 1978).

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 (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, 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • 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 last well-documented observation of the O'ahu creeper was in 1985, 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, we recommend 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, we recommend 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. • 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). Recent progress has been made with the development of sterile male and genetically modified mosquitoes for disease control. Several of these techniques have achieved proof-of-principle in laboratory studies, while other insect techniques, including self-sustaining technologies to achieve long-term transmission control are anticipated to advance to field testing in the near future (LaPointe et al. 2009). We encourage continued research in the fields of

genomic technologies for disease control and their field application as a conservation strategy for Hawaiian forest birds. • Habitat and natural process management and restoration – Oʻahu creeper will benefit from habitat restoration to assist other native Hawaiian forest birds on Oʻahu. (USFWS, 2019)

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USFWS. 2019. 5-YEAR

SPECIES ACCOUNT: *Picoides borealis* (Red-cockaded woodpecker)

Species Taxonomic and Listing Information

Listing Status: Endangered; October 13, 1970; Southeast region (R4) (USFWS 2006)

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 reneest. 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:

Current Population Resilience Resiliency describes the ability of populations to withstand deterministic and low-level stochastic events (arising from random factors). Highly resilient populations are better able to withstand disturbances such as random fluctuations in birth rates (demographic stochasticity), annual variation in rainfall (environmental stochasticity), or the effects of anthropogenic activities. We measured resiliency at the population level for this assessment, primarily by evaluating the current population size as number of active clusters and secondarily by the associated past growth rate. Populations are located on properties owned by a variety of agencies and private entities including but not limited to the Department of Defense, U.S. Forest Service, state wildlife and natural resource agencies, Department of Energy, state forest service, U.S. Fish and Wildlife Service, and a variety of private landowners. The data used to calculate number of current active clusters and population growth rates came from a variety of sources, and in some cases we had to make some assumptions depending on the data resolution. The breadth of data sources and the corresponding decisions made based on the data resolution are detailed below. Values for current numbers of active clusters were derived from the most recent estimates we were able to obtain. In most cases, these estimates were available from the Service's Annual RCW Property Data Report database and represented the total number of active clusters during the 2016 breeding season. When possible, we obtained updated numbers for the 2017 breeding season from GIS files or other sources. For a few populations, we were not able to obtain population size estimates as recent as 2016, so we used

the most current population size we were able to obtain. No current population size estimates are older than the 2013 breeding season. To calculate growth rates for a given demographic population we obtained past time series abundance data for annual number of active clusters for as long as possible, not to precede 1998. We did not seek or use data prior 1998 for several reasons. Abundance and spatial data are not available prior to 1998 for most demographically delineated populations. The best available data for most populations is for 1998 and afterwards concurrent with the implementation of the Service's Annual RCW Property Data Report database. Also, as discussed in previous sections, the management paradigm for RCWs changed dramatically in the late 1990s (e.g. cavity management, recruitment clusters) to sustain and increase populations, and we wanted to capture the results of this new and more effective management. It is important to note that much of our abundance data is limited to a property level. Thus, if a property has multiple current demographic populations, we often lacked a past and spatially explicit time series for those individual demographic populations. In these cases, we calculated a "property level" population growth rate, and applied it to all of the demographic populations occurring on that property. Currently, there are at least 124 demographic populations across the range of the RCW (Table 3). Although we have not categorized overall resilience, we have categorized two important parameters related to population resiliency: current population size and associated population growth rate. Population size categories are as follows: very low (<30 active clusters); low (30-99 active clusters); moderate (100-249 active clusters); high (250-499 active clusters); and very high (>500 active clusters). This categorization is based largely on modeling of the dynamics of idealized RCW populations by Walters et al. (2002b) as validated by Schiegg et al. (2005) and Walters et al. (2011). Walters et al. (2002b) employed a spatially-explicit, individual-based RCW model that incorporated demographic and environmental stochasticity, and thus is appropriate for assessing resilience. In subsequent applications, the demographic effects of inbreeding depression on population size and persistence were added (Daniels et al. 2000, Schiegg et al. 2006) based on empirical RCW data of inbreeding effects. In their analysis, populations were modeled with unlimited, high quality foraging and nesting habitat, with sufficient and well distributed old pines for natural cavity excavation, but were not subject to management techniques designed to stimulate population growth (e.g., recruitment clusters and cavity management). Population growth was limited to pioneering and budding with natural cavity excavation. Population growth, persistence, risks of extirpation and other output of these model simulations provides a template to identify inherent population resilience against results of the relative success or failure of management for this conservation-reliant species. Under these model and simulation conditions, populations of 25 (our very low category) and 50 (low) active clusters always declined in response to spatial aggregation, density of groups, and inbreeding depression. Simulated populations of 250 (high) and 500 (very high) were stable on average regardless of spatial aggregation and density at comparative densities to the spatially delineated demographic SSA populations, although the smaller populations near 250 in this sizeclass could have a declining growth rate slightly less than 1.0. Populations of 100 to 250 groups were stable at high levels of aggregation and density, but declining at lower levels. Thus our moderate category captures the range within which stability was dependent on spatial aggregation and density of groups. We used 30 active clusters rather than 25 as our boundary between the very low and low categories because 30 is a threshold for differences in management in the species' Recovery Plan (USFWS 2003), particularly for RCW

translocation management benefits, as well as a threshold for differences in population behavior observed in our global model analysis. When we had at least 5 years of past abundance data we estimated a population growth rate by comparing the initial population size to the final population size and calculating the rate of growth required to produce the observed change in population size. Thus the figures we present are constant growth rates. Based on these rates we categorized populations as decreasing ($\lambda < 1$), increasing ($\lambda > 1.02$) or stable ($\lambda = 1.00-1.02$). Our primary categorization of current resilience is based on population size. We use population growth rate as a secondary factor to indicate relative resilience of populations within each of the five resilience categories (see below). Of the 124 populations analyzed, we classified the resilience of 3 populations as very high; 3 as high; 10 as moderate; 37 as low; and 71 as very low (Table 3). In any category, management has been essential to restore and sustain foraging habitat with prescribed fire, silviculture and other treatments, and provide sufficient cavities. (USFWS, 2019)

Representation:

Representation provides the ability of a species to adapt to changing environmental conditions. As described in Chapter 3, representation for this species is assessed primarily on life history variation and ecological diversity among ecoregions. This approach is based ecoregions that represented recovery units in the RCW Recovery plan (USFWS 2003). Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations, their resiliency, and their distribution and connectivity, redundancy increases the probability that the species has a margin of safety to withstand or recover from catastrophic events (such as a rare destructive natural event or episode involving many populations). We report redundancy for RCWs as the total number and resilience of demographic populations and their distribution within and among representative units. The historical range of the RCW included the entire historical range of longleaf pine ecosystems, but the RCWs also inhabited open shortleaf, slash, loblolly, and Virginia pine forests, especially in the Ozark-Ouachita Highlands and the southern tip of the Appalachian Highlands (Costa and Walker 1995). Occasional occurrences were noted for New Jersey (Hausman 1928), Pennsylvania (Gentry 1877), Maryland (Meanly 1943), and Ohio (Dawson and Jones 1903). Historic distribution data in Figure 25 consists of county level information based on published sources (Jackson 1971; Hooper et al. 1980; Costa and Walker 1995) and interviews with various RCW experts. County historical records are contemporary data, most from the 1900s, and do not represent pre-settlement conditions when RCWs were more abundant and probably more widely distributed. Based on these data, RCWs no longer occur in 7 ecoregions where their occurrence in suitable woodland likely was on the edge the historic range: Ozarks, Central Mixed Grass Prairies, Interior Low Province, Cross Timbers and Southern Mixed Grass Prairies, North Atlantic Coast, Central Appalachian Forest, and Southern Blue Ridge (Figure 24). RCWs have been extirpated from these ecoregions for some time, and they are not considered relevant to recovery (USFWS 2003). The remaining 13 ecoregions still contain RCWs. (USFWS, 2019)

Redundancy:

Representation provides the ability of a species to adapt to changing environmental conditions. As described in Chapter 3, representation for this species is assessed primarily on life history

variation and ecological diversity among ecoregions. This approach is based ecoregions that represented recovery units in the RCW Recovery plan (USFWS 2003). Redundancy describes the ability of a species to withstand catastrophic events. Measured by the number of populations, their resiliency, and their distribution and connectivity, redundancy increases the probability that the species has a margin of safety to withstand or recover from catastrophic events (such as a rare destructive natural event or episode involving many populations). We report redundancy for RCWs as the total number and resilience of demographic populations and their distribution within and among representative units. The historical range of the RCW included the entire historical range of longleaf pine ecosystems, but the RCWs also inhabited open shortleaf, slash, loblolly, and Virginia pine forests, especially in the Ozark-Ouachita Highlands and the southern tip of the Appalachian Highlands (Costa and Walker 1995). Occasional occurrences were noted for New Jersey (Hausman 1928), Pennsylvania (Gentry 1877), Maryland (Meanly 1943), and Ohio (Dawson and Jones 1903). Historic distribution data in Figure 25 consists of county level information based on published sources (Jackson 1971; Hooper et al. 1980; Costa and Walker 1995) and interviews with various RCW experts. County historical records are contemporary data, most from the 1900s, and do not represent pre-settlement conditions when RCWs were more abundant and probably more widely distributed. Based on these data, RCWs no longer occur in 7 ecoregions where their occurrence in suitable woodland likely was on the edge the historic range: Ozarks, Central Mixed Grass Prairies, Interior Low Province, Cross Timbers and Southern Mixed Grass Prairies, North Atlantic Coast, Central Appalachian Forest, and Southern Blue Ridge (Figure 24). RCWs have been extirpated from these ecoregions for some time, and they are not considered relevant to recovery (USFWS 2003). The remaining 13 ecoregions still contain RCWs. (USFWS, 2019)

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).
- 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 *Melospiza crissalis*, changing the Inyo California towhee's scientific name to *Melospiza 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 wash from Ruby 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 circle 1/8 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 lying 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 R42E and proceeding downstream along the streambed to the eastern boundary of Section 13. The above includes portions of Sections 11, 12, 13, and 14, T24S R42E.

(10) Circles with 1/8 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 streambed and 1/8 mile on either side of Mountain Springs Canyon commencing from the southern border of Section 8 and continuing along the streambed to the point at which Mountain Springs Canyon Wash intersects the eastern boundary 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 occur

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 of 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 (*Oreortyx 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:**

Declining (USFWS, 2024)

Species Trends:

Increasing (NatureServe 2015)

Population Growth Rate:

Stable

Number of Populations:

One

Population Size:

400-450 (USFWS, 2024)

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). Several years of extended drought between 2012 and 2022 (Figure 7) have coincided with an estimated population decline of approximately 40 to 50 percent (Figure 5, Figure 6). LaBerteaux (2015d, p. iii) reported that the population decline observed during 2015 surveys of 11 study sites mainly occurred from 2012 through 2013 (LaBerteaux 2014, p. iii). The decline was attributed to factors associated with prolonged drought, degradation of habitats by feral equines, and possibly human disturbances (LaBerteaux 2015d, p. iii; LaBerteaux 2015d, p. iii). In 2015, LaBerteaux (2015d, p. iii) suggested that the average winter rainfall and subsequent high food abundance enabled towhees at NAWS China Lake to successfully raise young and, in some cases, produce a second clutch. Since 2019, decreased abundance and occupancy, compared to 1998–2011 surveys, has been attributed to habitat impacts from long-term drought (LaBerteaux 2019, p. 39; Atwell, LLC 2020, pp. i, 11; LaBerteaux 2021b, pp. 38, 40; McCreedy 2022b, p. S2; McCreedy 2022c, p. S-1). During the 2012–2022 drought, LaBerteaux observed drastic differences in towhee abundance among sites. For example, the change in total numbers of adults between 2007 and 2021 ranged from no change to an 87.5 percent decrease depending on the survey area (LaBerteaux 2021b, p. 41). LaBerteaux recommended that results of “limited survey efforts” should not be used to extrapolate across the entire range of the subspecies because of the high variability of occupancy across the range and consideration that a large portion of previously occupied sites (104 sites, 39 percent) has not been surveyed since before 2012 (Figure 3), (LaBerteaux 2021b, pp. 40–41). As a result, LaBerteaux has not provided a rangewide population estimate in her reports since 2011. However, in 2022, McCreedy (2022b, p. S-2) estimated the rangewide population using a similar extrapolation method that

LaBerteaux previously used. Based on the survey of 76 sites on BLM and CDFW lands, he estimated the total population of towhees at 400–450 adults in 2022 (Figure 5) (McCreedy 2022b, p. S-2). Acknowledging LaBerteaux's caution, this estimate suggests a potential increase in abundance since 2021, when McCreedy (2022c, p. S-2) noted extremely dry habitat conditions at BLM survey sites and suggested that the towhee population may be less than 400 individuals (USFWS, 2024).

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 (*Phragmites 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.

Recovery Priority Number: 15

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:

- **RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS** The recovery actions listed below are recommendations to be initiated over the next 5 years. These will help guide continuing recovery of the Inyo California towhee by providing information to better manage nesting sites. Conservation of the towhee is dependent on continued cooperation with our partners to minimize impacts from current threats and aid in recovery. 1. Monitor habitat and status of Inyo California towhees. a. Work with partners to develop a systematic approach to conduct rangewide surveys of towhee abundance, habitat condition, and threats. b. Investigate whether aerial or satellite imagery or spectral data can be used to efficiently monitor annual habitat conditions across the range. 2. Protect and manage habitat. a. Continue to work with BLM, DoD, and the State to remove feral equines from the towhee's range to achieve management goals of zero burros and no more than 168 feral horses. b. Work with State and Federal partners, including law enforcement, to improve early detection of unauthorized grow operations, deter future cannabis grow activities, and improve remediation and restoration of existing and past grow operations. c. Work with partners to protect riparian areas with fencing when necessary and maintain existing fences. d. Patrol recreational use of sensitive towhee habitats. If prudent, install signs and conduct outreach to reduce impacts from recreational activities. e. Work with partners to monitor and control, or eliminate, invasive nonnative plants in towhee habitat, especially nonnative annual grasses (USFWS, 2024).

Additional Threshold Information:

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References

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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 (Poliophtilinae) 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 Geronimo 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 (*Poliophtila 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 fasciculatum*), lemonadeberry (*Rhus integrifolia*), California encelia (*Encelia californica*), pricklypear and cholla cactus (*Opuntia* spp.), and various species of Haploppus. 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).

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 convert. 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).
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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)

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)

Recovery Actions:

- 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.

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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 Wet-Maui, 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 Wet-Maui, 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 Wet-Maui, 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 Mesic-Maui, 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 dielirectum*, *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*, *Isodendron 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 dielirectum*, *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*, *Isodendron 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 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 dielirectum*, *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*, *Isodendron pyriformis*, *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 dielirectum*, *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*, *Isodendron pyriformis*, *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 dielirectum*, *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*, *Isodendron 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 dielirectum*, *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*, *Isodendron 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 dielirectum*, *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*, *Isodendron pyriformis*, *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 ferrispilosa*, *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 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 Puehuhunui 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*, *Isodendron pyriform*, *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 herbl 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 herbl 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*, *Isodendron pyriformis*, *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 herbl 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*, *Isodendron 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*, *Isodendron 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 hermland 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 arnotianus* 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 Kiwiku 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 'ohi'a 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 'ohi'a, 'olapa (Cheirodendron trigynum), kolea (Myrsine lessertiana), and kawa'u (Ilex anomala), with a diverse understory of native plants including 'akala (Rubus hawaiensis), 'ohelo (Vaccinium calycinum), 'alani (Melicope spp.), pukiawe (Styphelia tameiameia), 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 Trends:

Declining (USFWS, 2023)

Population Size:

157 +- 67 birds (USFWS, 2023)

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 reproductive 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 only 10 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). The most recent population estimate of kiwikiu is 157 ± 67 birds (95% CI) (Judge et al. 2021, p. 121) from east Maui forest-bird surveys conducted in 2017 using the variable circular plot survey methodology (Scott et al. 1986). Variable circular plots are generally used to survey forest birds in Hawai'i, but according to Camp et al. (2009) this is not an appropriate method for all species and provides poor estimates for extremely rare birds. • Judge et al. (2021, p. 120) calculated a 41% contraction in the kiwikiu range compared to range estimates reported by Camp et al. (2009) from east Maui forest-bird surveys conducted from 1980 through 2001. Current kiwikiu range is estimated 2,992 hectares (ha) (7,393 acres (ac)) (Judge et al. 2021, p. 121). There is strong evidence for decline in kiwikiu abundance within Haleakalā National Park since the 1980s (Brink 2020, pp. 21, 28) (USFWS, 2023).

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.

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 Kiwiku 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 'Akikiki 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 Hawai'i.

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 Kiwiku'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 Kiwiku (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 Kaua'i where it is now only periodic (Benning et al. 2002). Disease prevalence and the prevalence of mosquitos are increasing across the Alaka'i (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 Kaua'i 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

Reclassification Criteria:

Recovery Priority Number: 1

Recovery Actions:

- **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 Hawai'i. 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 Hawai'i (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). Hanawā 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 kiwīkiu 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 kiwīkiu 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 Hanawā Natural Area Reserve, Waikamoi Preserve, and Kahikinui's Nakula Natural Area Reserve. An important component of kiwīkiu 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 kiwīkiu 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 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 kiwikiu in these areas. The U.S. Geological Survey, National Wildlife Health Center, Honolulu Field Station, collaborates with USFWS and the 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 Hawai'i (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 Hawai'i. Captive propagation was deemed unsuccessful due to low reproductive 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 Moloka'i. 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 MFBPR 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: The recovery strategy for the kiwikiu centers on protection, restoration, and management of native high elevation forests on east Maui (Haleakalā), west Maui (Mauna Kahalawai), and east Moloka'i. • Surveys/inventories — Continued monitoring of kiwikiu is important to determine species response to management actions and effects of climate change and population status. Due to the difficulty in using VCP transects to monitor the population, territory mapping in high density areas and mark-recapture are potentially more preferred methods. • Habitat management and restoration — Continue habitat management in areas where the species currently exists. Invasive plants such as *Hedygium gardnerianum* (Himalayan ginger), strawberry guava (*Psidium cattleianum*), and *Sphaeropteris cooperi* (Australian tree fern) and non-native ungulates are degrading kiwikiu habitat. Continue control of introduced invasive plants and exclusion/removal of ungulates that spread seeds of invasive plants. • Ungulate monitoring and control — Continue ungulate control. Kiwikiu are currently restricted to the windward forests of east Maui from Waikamoi to Manawainui Valley. Waikamoi Preserve, managed by The Nature Conservancy of Hawai'i (TNC) is completely enclosed by ungulate exclusion fencing and in cooperation with the East Maui Watershed Partnership (EMWP), TNC and EMWP have reduced ungulate populations within fenced areas to near zero in 12,000 acres of TNC and adjacent State

Forest lands (TNC 2018, p. 10). Hanawā Natural Area Reserve, further east is completely fenced with ongoing ungulate control. Ungulate removal is ongoing and new fence construction and repairs to existing fencing are planned on the east slope of Haleakalā volcano within Haleakalā National Park. However, it is important that fencing and ungulate control be conducted in all areas on east Maui where populations of 'kiwīkiu exist.

- Predator monitoring and control — Control of small mammalian predators is needed throughout the species' range. Currently, intensive control of rats (*Rattus* spp.) and introduced mammalian predators [cats (*Felis catus*) and mongoose (*Herpestes auro-punctatus*)] is underway in different parts of the species' range.
- Predator control research — An important component of kiwīkiu 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.
- Biosecurity — Implement a statewide interagency biosecurity plan to prevent Rapid 'Ōhi'a Death and other detrimental non-native species from becoming established on Maui. 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 Hawai'i.
 - 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.
- Disease monitoring and control — Identification of resistance or tolerance to avian diseases within the population is an important recovery strategy. Disease control using traditional and new methods is also critical.
 - o Studies to examine potential genetic resistance by kiwīkiu to avian disease have not been conducted but are important to identify any potential resistance or tolerance to avian disease. However, during the translocation attempt in 2019, a number of individuals were determined to be positive for malaria (MFBRP unpubl. data). Additional research on this question is ongoing.
 - o Control of mosquitoes and their breeding sites is needed using traditional methods including application of *Bacillus thuringiensis israelensis* (Bti), a bacterial larvicide, whenever feasible, and ungulate exclusion and removal that reduces mosquito breeding sites.
 - o Much of the potential kiwīkiu 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 kiwīkiu in these areas.
 - o 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 2023). Continued support for this program is critical to prevent West Nile virus and other avian diseases from entering the State of Hawai'i.
 - o Landscape-scale mosquito control — Over the last 5 years there has been substantial movement toward development and implementation of landscape-scale control of the introduced southern house mosquito (*Culex quinquefasciatus*) that transmits avian disease to Hawaiian forest birds. In 2022 an Environmental Assessment (EA) was published for broadscale mosquito control in conservation areas on east Maui using the Incompatible Insect Technique (IIT) (HALE 2022, entire) and preparations have begun for first use of IIT on east Maui using male *C. quinquefasciatus* mosquitoes treated with *Wolbachia*. *Wolbachia* is a naturally occurring bacteria which is present in over half of all insect species worldwide (<https://www.birdsnotmosquitoes.org/wolbachia>). Researchers have found that *Wolbachia* plays an important role in insect reproduction, because it can function like birth control. The bacteria is already present in many insects in Hawai'i, including some mosquito species. IIT works because male mosquitoes with one strain of *Wolbachia* can only reproduce with females with

the same strain of Wolbachia. Conversely, males with one strain of Wolbachia cannot produce viable offspring with females with a different strain of Wolbachia, or females without Wolbachia. In a laboratory setting, researchers can expose mosquitoes to a different strain of Wolbachia and then rear large numbers of them. The mosquitoes are then separated by sex and only male mosquitoes are released into the wild. Once released, the lab-raised male mosquitoes mate with wild female mosquitoes and those females lay eggs that never hatch. When such releases are completed consecutively, mosquito populations decrease because new generations are not produced in the wild. • Captive propagation protocol development — Research on captive breeding for the kiwikiu was initiated in 1997 and most of the individuals were released in 2019. Two individuals that are unreleasable continue to reside at the Maui Bird Conservation Center. Plans are underway to restart the captive program in 2023 (USFWS, 2023).

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USFWS. 2023. 5-YEAR REVIEW Short Form Summary Species Reviewed: Kiwikiu or Maui parrotbill (*Pseudonestor xanthophrys*). Region 1/Pacific Islands Fish and Wildlife Office (PIFWO), Honolulu, Hawai'i. 9 pages.

SPECIES ACCOUNT: *Psittirostra psittacea* (ʻOʻu (honeycreeper))

Species Taxonomic and Listing Information

Listing Status: Endangered; 03/11/1967; Pacific Region (R1) (USFWS, 2016). Recommended for delisting due to extinction (USFWS, 2021c)

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 ʻoʻu 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). ʻOʻu were found historically on the islands of Hawaiʻi, Maui, Molokaʻi, Lanaʻi, Oʻahu, and Kauaʻi, 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). Possibly found on Kauai and Hawaii, extirpated elsewhere, likely extinct (USFWS, 2021c).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

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). Recommended for extinction (USFWS, 2021c)

Number of Populations:

0 - 3 (NatureServe, 2015)

Population Size:

0 - 50 individuals (NatureServe, 2015). Likely extinct (USFWS, 2021c)

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 (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, 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).
- 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: *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).

Population Growth Rate:

Slow

Number of Populations:

19 (USFWS, 2020)

Population Size:

308 pairs (USFWS, 2020).

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:

The initial survey in 1980 estimated 203 pairs across 11 marsh sites. Since then the population has fluctuated between a low of 142 pairs in 1985 to a high of 656 pairs in 2016 (Figure 4; Zembal et al. 2017, p. 13; Appendix B). However, the high count in 2016 was not evenly distributed, as two marshes, Upper Newport Bay and Tijuana Slough NWR, accounted for 50.2 percent of the total population (Zembal, Hoffman, and Konecny 2016, p. 8). Since 2016, the numbers of light-footed Ridgway's rail pairs have been in decline, dropping from 656 pairs to 308 in 2019 (Zembal et al. 2020, p. 13), with a majority of losses occurring from the populations residing at those two marshes. In addition, the 2019 survey reports that only three of the marsh areas surveyed contained more than 30 pairs each (a minimum number over time for delisting; see section III), as opposed to five in 2018 and six in 2015 (Zembal et al. 2020, p. 13; Appendix B). The recent population decline is thought to result from a combination of stochastic factors across occupied areas. (USFWS, 2020). In 2019 Light-footed Ridgway's rails were reported at 19 locations from Ventura to San Diego Counties. This is a constriction from the historical range, which was previously as far north as Santa Barbara County. Of these 19 occurrences, only 6 have had more than 20 pairs when averaged over 5 years; 2 of which have not received augmentation from the captive breeding program in that time. Additionally, the status and distribution of light-footed Ridgway's rail in Baja California, Mexico remains largely unknown. (USFWS, 2020)

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 catus*), 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)

Downlisting Recovery Criteria The Service will consider downlisting the light-footed Ridgway's rail to threatened when all of the following criteria are met: Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range A1: Coastal marsh areas utilized by light-footed Ridgway's rail 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 yearround. 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 minimum of 4,000 ha (9,884 acres) to provide redundancy and the ability to withstand catastrophic events. A3: Water is maintained within both occupied and sufficient suitable, unoccupied habitat 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. A4: The status and distribution of light-footed Ridgway's rails in Mexico is understood and suitable habitat has been sufficiently conserved and protected from land use changes such as agriculture, and desalination plants. These protections include upland habitat to allow for marsh retreat in response to sea level rise. Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes There are no known current threats under this factor; therefore, no criteria are necessary. Factor C: Disease or Predation 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. Factor D: Inadequacy of Existing Regulatory Mechanisms No known threats exist under this factor; therefore, no criteria are necessary. Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence E1: At least 800 breeding pairs can be detected, rangewide in the United States, for a minimum of 5 years to increase subspecies' resilience (or as indicated through population modeling to support resiliency of the species). 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. E2: Light-footed Ridgway's rail are distributed across sites in each of the U.S. counties historically occupied (Santa Barbara, Ventura, Los Angeles, Orange, and San Diego) and Baja California, Mexico 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. E3: An outreach program is implemented in coordination with Federal and State agencies, partners and communities to educate the public about the plight of, and conservation efforts for, light-footed Ridgway's rail. (USFWS, 2019)

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).

Delisting Recovery Criteria The Service will consider the light-footed Ridgway's rail for delisting when the criteria for downlisting light-footed Ridgway's rail are met along with the following additions: Factor A: Present or Threatened Destruction, Modification, or Curtailment of Habitat or Range A5: Occupied and sufficient suitable, unoccupied 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 and meet demographic goals. A6: 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. A7: Occupied habitat, sufficient suitable unoccupied habitat, and adjacent upland habitat in Mexico is adequately conserved and protected from future land use changes to support resiliency of the rail and increase redundancy. Factor B: Overutilization for Commercial, Recreational, Scientific, or Educational Purposes There are no known threats under this factor; therefore, no criteria are necessary. Factor C: Disease or Predation No further threats to the subspecies due to disease or predation are currently known beyond what is stated above. Therefore, no further criteria are necessary. Factor D: Inadequacy of Existing Regulatory Mechanisms No known threats exist under this factor; therefore, no criteria are necessary. Factor E: Other Natural or Manmade Factors Affecting Its Continued Existence 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. 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, 2019)

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:

- RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS 1. Work with partners to help conserve and manage occupied light-footed Ridgway's rail habitat. Existing occupied habitat should be managed to maintain and, where possible, increase the carrying capacity of each marsh. Management of habitat may include removing exotic vegetation, improving water quality control, implementing predator control, increasing tidal influences to marshes that have been closed off, preventing siltation, controlling pollutants, maintaining and restoring freshwater inputs, etc. 2. Identify opportunities through the Service's Partners for Fish and Wildlife and Coastal Programs to promote conservation and restoration of light-footed Ridgway's rail coastal and inland freshwater habitats. Both coastal saltwater and inland freshwater marshes (especially at historical or anecdotal locations) which include potential habitat but are not currently occupied by light-footed Ridgway's rails should be examined to determine if restoration may increase the value of the habitat for the species, and perhaps extend their range. 3. Protection of light-footed Ridgway's rail occupied marshes in Mexico. It is believed that a large population of light-footed Ridgway's rails reside in marshes in Mexico. Therefore, the survival of these populations will greatly affect the survival of the

species as a whole. Working with the Mexican government and local groups, marshes in Mexico should be surveyed to determine the status of the light-footed Ridgway's rail and be protected from development and/or habitat degradation. 4. Continue captive propagation program for the light-footed Ridgway's rail and monitor success. This effort is believed to be effectively augmenting subpopulations within marshes, increasing resiliency to withstand stochastic events. However, captive propagation should not be considered a long-term management solution and efforts should be taken to look at a long-term plan to ensure that wild populations are self-sustaining. Projects promoting and monitoring the program should be implemented so that it may be modified to meet these goals. 5. Finalize light-footed Ridgway's rail survey protocol and continue monitoring of occupied and potential habitat. A standardized survey protocol should be developed and finalized so that data can be collected and compared from new and existing areas. Systematic censuses should continue throughout occupied and potentially occupied habitat to track recovery of the light-footed Ridgway's rail. This data should be robust enough to enable estimates of occupancy and relative abundance through time. Monitoring of populations in Mexico should be initiated to gain knowledge of population numbers throughout the species' entire range. 6. Research potential movement and dispersal capabilities of the light-footed Ridgway's rail between populations to gain a better understanding of the population structure and connectivity. Knowledge gaps regarding the light-footed Ridgway's rails movements and dispersal are still largely unknown. Understanding these population dynamics can help to encourage recolonization of restored habitat, manage for genetic diversity, and provide insight into the geographic limits of the subspecies into Baja California, Mexico. A thorough understanding of these dynamics will assist us in supporting the subspecies resiliency and representation. (USFWS, 2020)

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 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 Collins 1992). 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:

Decline

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 Creek-Richardson'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 Petaluma 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, spread 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.

Conservation Measures and Best Management Practices:

- **RECOMMENDATIONS FOR FUTURE ACTIONS:** Since the time when the 2013 5-Year Review was completed, the Recovery Plan has been finalized. The Recovery Plan identifies short- and long-term components of the recovery strategy. In addition to the Recovery Plan strategies and recommendations for future actions from the 2013 5-Year Review, the following actions are recommended over the next five years: 1) Develop a California clapper rail range-wide, long-term, population monitoring plan and program. This effort would be designed to specifically address needs for evaluating the status and distribution and recovery progress of the species relative to the Recovery Plan. It will include standardized protocols for monitoring, data collection, reporting, and analysis. 2) Develop standardized California clapper rail habitat assessment and modeling protocol. Habitat assessment and modeling protocol is necessary to evaluate the suitability of habitat, estimate the extent and configuration of current habitat, and project the extent and configuration of habitat into the future. The protocol would be used in estimating rail and habitat status and distribution and measuring progress toward recovery criteria. 3) Develop tidal marsh restoration

guidelines, with emphasis on the Recovery Plan focal species, including California clapper rail. The proposed tidal marsh restoration guidelines would update and expand upon the Design Guidelines for Tidal Wetland Restoration in San Francisco Bay (Philip Williams & Associates, Ltd. and Faber 2004). The effort should: (A) access and analyze focal species, vegetation, and topographic survey data from tidal marsh restorations and natural marshes; (B) evaluate the performance of multiple habitat and system/function measures and restoration design elements for the focal species; (C) prescribe tidal marsh restoration features and values that will best benefit the focal species into the future; (D) recommend monitoring data collection and reporting protocol and standards for evaluating the same habitat benefits to the focal species; and (E) work with all partners, including land managers, tidal marsh experts, and other interested parties (USFWS, 2020)

References

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USFWS. 2013. California clapper rail (*Rallus longirostris obsoletus*) 5-Year Review: Summary and Evaluation, U.S. Fish and Wildlife Service, Sacramento Fish and Wildlife Office, Sacramento, CA, April 2013, 61 p.

USFWS. 2020. 5-YEAR REVIEW California clapper rail (*Rallus longirostris obsoletus*). 33 pp.

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**

Adult: 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

Adult: 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, Sinaloa, 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)

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 seleniferous 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).
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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

Adult: 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. Currently, the Guam rail is only found in the wild as an experimental population on Rota and as a population covered under a Safe Harbor Agreement on Cocos. Recovery population goals have not been met, but the population is at full

capacity in captivity (Table 1). In addition, the Guam rail has not yet been reestablished on Guam. Because population goals have not been met throughout its range, no new populations on Guam have been established and the species is still threatened by human disturbance, predation, and other factors (Table 2); the Guam rail remains in danger of extinction. (USFWS, 2020)

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 snake 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.
- 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.

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: Recovery implementation for the Guam rail should include the following:
 - Captive propagation for genetic storage and reintroduction – Continue efforts to maintain an active captive propagation and reintroduction program.
 - o Develop methods for translocating Guam rails including fight or flight response to snakes as has been shown to work with other species.
 - Predator / herbivory monitoring and control
 - Continue efforts to develop and refine brown treesnake control techniques and support small-scale and large-scale control and/or

eradication efforts on Guam. • Implement large-scale feral cat control and/or eradication. • Population viability monitoring and analysis – Continue population and demographic monitoring on Cocos Island and Rota. • Site / area / habitat protection – Permanently secure and manage new fenced areas on Guam and Rota and immediately surrounding buffer habitat • Reintroduction / translocation o Consider alternative sites for establishing other populations. o Develop reintroduction plan for Guam rails on Guam and set aside and protect recovery areas for Guam rails on Guam. • Develop expandable enclosure systems that can adapt and expand as snakes are eradicated from enclosures and new lands are acquired. • Revise recovery objectives and criteria – Revise recovery plan.(USFWS, 2020)

- New management actions: • Predator/herbivore monitoring and control – Efforts continue on Guam to control the brown treesnake at ports of entry and on military lands. Recently, acetaminophen was used as a toxicant to control snakes within a 55-hectare (136-acre) fenced area on Anderson Air Force Base (AAFB), Guam. • Monitor lizards and rodents are monitored and controlled on Cocos Island to support the establishment and expansion of the experimental rail population on the island. • Brown treesnake removal and biosecurity also occurs in the port town of Merizo, where boats to Cocos leave to prevent incursion of the island. • Cats- Rota: Limited feral cat control was conducted for Aga on Rota, which also benefitted the experimental Guam rail population on the island from 2015 to 2017 with five, eight, and fifty-six cats removed in these three years, respectively. • Radio transmitter tracking – Birds on Cocos have been radio-tracked to determine home range, nesting, and survival. o A male that was killed in 2017 on Cocos was part of the initial cohort released on the island. The rail would have been approximately seven years old, making it the oldest Guam rail recorded in the wild. o In FY 2017, radio-tracking of Guam rails increased from one point per day to three-point triangulation completed twice a day. The increase in points taken per day will improve understanding of habitat use. Guam rail were tracked daily for location and activity five days a week. If a mortality signal was heard, the transmitter/bird was tracked to retrieve/locate radio and/or bird. If nesting was suspected due to continued use of specific area or intermittent mortality signals, the area was checked to locate nest. o During FY 2017 six birds were trapped, banded and fitted with radio transmitters for tracking. Those six plus two others from FY 2016 were tracked daily for status and location. o At the beginning of FY 2019, one Guam rail was being tracked on Cocos Island. Two birds were recaptured and transmitters placed on them, however, by April 2019, all transmitters had failed. No additional birds were tracked. Sixteen Guam rail were trapped on Cocos Island during FY 2019; the birds were banded, blood sampled, weighed, and released. Six birds trapped were recaptures and ten were new captures. Almost all of the birds trapped, except for the two that had transmitters placed on them were below the recommended weight for transmitters. o Analysis of home range, habitat requirements, and activity patterns on Cocos Island is ongoing. The preliminary data tells us that captive bred rails are viable and capable of reproductive success in the wild. It is also showing that males have a slightly wider home range 6.15 ha to females' 5.66 ha. Further analysis is needed to determine how home range sizes change as the Guam rail population increases and during breeding. • Outreach to local schools to bring awareness of the problem brown treesnake cause the Guam rail have been initiated with community participation (DAWR 2018) • The Department of the Navy and the U.S. Fish and Wildlife Service have signed a Memorandum of Understanding for Guam Region-Wide Conservation of Forest Resources under the Readiness and Environmental Protection Integration Program. • An MOA between DAWR & CNMI DFW to hire a biologist to work on Rota to complete the Guam rail presence/absence survey and respond to incidental Guam rail sightings has not been completed. The MOA to hire a biologist to work on Rota will be completed in FY 2020 (DAWR 2020). (USFWS, 2020)

References

USFWS 2016. Status of the Species and Critical Habitat: *Gallirallus owstoni* (Guam rail). U.S. Fish and Wildlife Service 2600 SE 98TH Ave., Suite 100. Portland, OR 97266. Provided to FESTF from Chris Mullens 9/30/2016.

USFWS 2016. Status of the Species and Critical Habitat: *Gallirallus owstoni* (Guam rail). U.S. Fish and Wildlife Service 2600 SE 98TH Ave., Suite 100. Portland, OR 97266. Provided to FESTF from Chris Mullens 9/30/2016. USFWS. 2020. 5-YEAR REVIEW Short Form Summary Species Reviewed: Guam rail

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USFWS. 2018. Draft Amendment to the Native Forest Birds of Guam and Rota of the Commonwealth of the Northern Mariana Islands Recovery Plan. USFWS, Pacific Region. November 2018. 6 pp.

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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

Yes; 7/30/2020.

Legal Description

We, the U.S. Fish and Wildlife Service (Service), designate critical habitat for the elfin-woods warbler (*Setophaga angelae*) under the Endangered Species Act of 1973, as amended (Act). In total, approximately 27,488 acres (11,125 hectares) in the Maricao, San Germán, Sabana Grande, Yauco, Río Grande, Canoánas, Las Piedras, Naguabo, Ceiba, Cayey, San Lorenzo, Guayama, and Patillas municipalities in Puerto Rico fall within the boundaries of the critical habitat designation. The effect of this regulation is to extend the Act's protections to the elfin-woods warbler's critical habitat. (USFWS, 2020)

Critical Habitat Designation

Unit 1: Maricao; Maricao, San Germán, Sabana Grande, and Yauco Municipalities, Puerto Rico. (i) General description: Unit 1 consists of 12,978 ac (5,252 ha). Approximately 8,861 ac (3,586 ha) are owned by the Commonwealth and managed by the Puerto Rico Department of Natural and Environmental Resources, and 4,117 ac (1,666 ha) are in private ownership. The unit is located north of State Road PR-2, south of State Road PR-105, and approximately 105 kilometers 65 mi (105 km) west of the International Airport Luis Muñoz Marín. Unit 2: El Yunque; Río Grande, Canóvanas, Las Piedras, Naguabo, and Ceiba Municipalities, Puerto Rico. (i) General description: Unit 2 consists of 11,430 ac (4,626 ha) of federally owned land managed by the U.S. Forest Service (El Yunque National Forest). The unit is located within El Yunque National Forest, east of State Road PR-186, north of State Road PR-31, and approximately 24 km (15 mi) east of the International Airport Luis Muñoz Marín. Unit 3: Carite; Cayey, San Lorenzo, Guayama, and Patillas Municipalities, Puerto Rico. (i) General description: Unit 3 consists of 3,080 ac (1,247 ha) of lands owned by the Commonwealth and managed by the Puerto Rico Department of Natural and Environmental Resources. The unit is located within the Carite Commonwealth Forest west of State Road PR-7740 and State Road PR-184 that run within the Carite Commonwealth Forest, and approximately 23 mi (37 km) south of the International Airport Luis Muñoz Marín. (USFWS, 2020)

Primary Constituent Elements/Physical or Biological Features

(1) Critical habitat units are depicted for Puerto Rico, on the maps in this entry. (2) Within these areas, the physical or biological features essential to the conservation of the elfin-woods warbler consist of the following components: (i) Wet and rain montane forest types: (A) Podocarpus forest at elevations between 600 and 900 meters (m) (1,968 and 2,952 feet (ft)) with continuous closed canopy of 20 m (66 ft) in height, dominated by *Podocarpus coriaceus* trees with well-developed understory. (B) Dwarf forest at elevations above 900 m (2,952 ft) with a single story of trees between 1 and 6 m (3 and 19 ft) in height, with an understory of mosses, epiphytes, and liverworts. (C) Palo Colorado forest at elevations between 600 and 900 m (1,968 and 2,952 ft) with a closed canopy of approximately 20 m (66 ft) and an understory dominated by grasses, ferns, bromeliads, and sedges. (ii) Forested habitat areas that contain: (A) Active shade-grown coffee plantations or forested agricultural lands that are above 300 m in elevation and dominated primarily by native vegetation; or (B) Abandoned coffee plantations or agricultural lands (i.e., agricultural practices were discontinued) with native forest cover and a closed canopy found

above 300 m in elevation. (iii) Forested habitat (at elevations between 300 and 850 m (984 and 2,788 ft)) not contained within the habitats described in paragraphs (2)(i) and (ii) of this entry: (A) Exposed ridge woodland forest found in valleys, slopes, and shallow soils with a more or less continuous canopy at elevations ranging from 550 to 750 m (1,804 to 2,460 ft); (B) Timber plantation forest at elevations ranging from 630 to 850 m (2,066 to 2,788 ft); or (C) Secondary forests dominated by native tree species with a closed canopy of approximately 20–30 m (66–100 ft) in height at elevations ranging from 300 to 750 m (984 to 2,460 ft). (3) 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 July 30, 2020. (USFWS, 2020)

Special Management Considerations or Protections

When designating critical habitat, we assess whether the specific areas within the geographical area occupied by the species at the time of listing contain features that are essential to the conservation of the species and may require special management considerations or protection. The Maricao unit contains privately owned agricultural lands in which various activities may affect one or more of the PBFs. The features of this unit essential to the conservation of the elfinwoods warbler may require special management considerations or protection to reduce the following threats: Loss, fragmentation, and degradation of habitat due to unsustainable agricultural practices; hurricanes; and human-induced fires. The features of the El Yunque unit may require special management considerations or protection to reduce threats or potential threats from hurricanes and human-induced fires, which may be exacerbated by the effects of climate change. Management activities that could ameliorate these threats or potential threats include but are not limited to the following: The 2014 candidate conservation agreement (CCA) signed by the Service, U.S. Forest Service, and Puerto Rico Department of Natural and Environmental Resources (PRDNER) to implement conservation practices for the benefit of the elfin-woods warbler and its habitat in EYNF and MCF (USFWS 2014); implementation of conservation agreements with private landowners to restore habitat and minimize habitat disturbance and fragmentation; and development and implementation of management plans for other protected lands where the species is found. (USFWS, 2020)

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-Vázquez (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: Territorial

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-Vázquez (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 information

Dispersal/Migration Narrative

Adult: Based on surveys conducted in 1989 and 1990, Arroyo-Vázquez (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

Population Growth Rate:

Low

Number of Populations:

2

Population Size:

~1,800+ adults (USFWS, 2022)

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 Puerto 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). Details of past estimates of elfin-woods warblers is provided in the final listing rule (Service 2016a). Based on the past studies in MCF1, in 2010 BirdLife International estimated the overall (island-wide) elfin-woods warbler population in Puerto Rico to be at least 1,800 mature individuals (Arendt et al. 2013). No formal assessment of the total number of individuals is available to determine if this estimate was correct or has changed in the last 12 years. Studies described below indicate potential declines in occupancy which is concerning (USFWS, 2022).

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.

Recovery Priority Number: 14

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.
- 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).

Conservation Measures and Best Management Practices:

- RECOMMENDATIONS FOR FUTURE ACTIVITIES • Establish additional Partner and Fish Wildlife agreements, in cooperation with Natural Resources Conservation Service with landowners near Maricao Commonwealth Forest and El Yunque National Forest to protect and enhance existing and potential elfin-woods warbler habitat. • Promote conservation actions and sustainable practices of existing agriculture lands in areas where the warbler occurs near the Maricao Commonwealth Forest. • Implement habitat restoration projects in coordination with NRCS, USFS and PR DNER to provide effective corridors for the elfin-woods warbler dispersal throughout the central mountains of Puerto Rico to help expand the current distribution of the species. • Develop and implement a program to inform the public on the importance to protect the elfin-woods warbler and its habitat. • Promote planting native trees to provide shade to coffee trees and control or removal of invasive non-native plant species that may be modifying suitable habitat for the elfinwoods warbler. • Monitor success of recovery actions and use results to adapt management actions. • Promote the development of a human-induced fire prevention plan for the areas occupied by the species in Maricao. • Promote research that forecast the elfin-woods warbler's vulnerability and response to climate change (USFWS, 2022).

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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

Today, California least tern nesting is confined to 29 nesting areas that total approximately 487 hectares (ha) (1,204 acres (ac)) of habitat along the California coast. The total acreage of nesting habitat is higher than the previous number reported in the 2014 Species Report (USFWS 2014) due to the use of a more quantitative assessment rather than an expansion of nesting habitat. The number of California least tern pairs nesting at each nesting area is highly variable. For example, in 2016, the number of pairs estimated nesting at sites in California ranged from 1 (e.g., Sacramento Bufferlands, Pittsburg Power Plant) to 804 (e.g., Santa Margarita River–North Beach South) (Frost 2016, Appendix B-3). In 2016, the majority (approximately 85 percent) of California least tern breeding pairs were concentrated in southern California within the coastal Counties of Ventura, Los Angeles, Orange, and San Diego (Frost 2016, p. 11; Figure 2), and almost half of the birds in San Diego County nested within lands owned and managed by Marine Corps Base (MCB) Camp Pendleton. (USFWS, 2020)

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

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 or 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 Growth Rate:**

Stable

Number of Populations:

One

Population Size:

~8,900 (USFWS, 2020)

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:

Historically, the California least tern was considered abundant along the California coast. At the time of listing, the California least tern was known to nest at 15 sites in the United States, from San Mateo County to San Diego County, California. Shortly after listing it was estimated that only 256 pairs remained. Since listing, the minimum number of pairs steadily increased to over 7,100 pairs in 2009. In 2016, fledglings were observed at 21 nesting areas, and the breeding population estimated at 3989 pairs (Frost 2017). Preliminary estimates of 4095 pairs in 2017 were reported at 29 nesting areas (Sin 2019, pers. comm.). Surveys of the Pacific coast of the Baja California Peninsula documented 300 nesting pairs at eight nesting areas in 2018. The primary threats at the time of listing were development of nesting sites, disturbance, off-road vehicle use, and predation. Many of these threats are ongoing, but existing conservation measures have helped to reduce impacts. Despite these efforts, the California least tern remains a conservation-reliant species (Scott et al. 2010). (USFWS, 2020)

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 preyed 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.

Conservation Measures and Best Management Practices:

- **RECOMMENDATIONS FOR ACTIONS OVER THE NEXT 5 YEARS** The actions listed below are recommendations to be completed over the next 5 years. These will help guide continuing recovery of the California least tern by providing information to better manage nesting sites. Conservation of the California least tern is dependent on continued cooperation with our partners to minimize impacts from current threats and aid in future restoration. 1. Continue to coordinate with CDFW, San Diego State University, and other partners to conduct analysis of existing least tern data, to determine trends; create reliable, accurate population models that identify demographic requirements for a stable population; quantify long-term trends; and direct future management priorities to determine population and breeding colony stability. 2. Work with the DOD (the Navy, the Marine Corps, and Air Force), CDFW, California Department of Parks and Recreation, and other partners to continue current successful site management that minimizes impacts of encroaching vegetation, predation, and human disturbance. Investigate innovative techniques of site management and monitoring to reduce costs and better protect the species. 3. Continue food availability studies already started by monitors or initiate new studies on the impact that shifting food resources have on survival, productivity, and colony dynamics of the California least tern. 4. Partner with Mexican nongovernmental organizations, scientists, and Federal agencies on potential recovery and management actions at nesting sites in Mexico. 5. Update the California least tern recovery plan and recovery criteria with current science, population data, and biology. Utilize threats-based analysis to develop recovery goals. 6. Continue efforts to identify the wintering range of the California least tern and the threats that impact the species on its wintering grounds and migration route. 7. Develop banding protocol to create unified data collection rangewide. Continue banding and recapture studies to determine age structure, survival, and movement. 8. Develop standardized monitoring protocols and on-line data portal to facilitate synthesis, analysis, and sharing of data. 9. Enter into long-term agreements that will assure continued protection and management of California least tern nest sites. (USFWS, 2020)
- We are recommending the following actions prior to reconsidering the status of the subspecies: 1. Analyze existing California least tern data to develop a population model that estimates the population demographics necessary for population and breeding colony stability. 2. Continue to work with our partners regarding ongoing site management activities to minimize impacts of predation, encroaching vegetation, and human disturbance. 3. Investigate the impact of shifting food resources on survival, productivity, and colony dynamics of the California least tern, and explore potential for new nesting areas that address any anticipated changes in nesting distribution driven by shifting food resources. 4. Update the California least tern recovery plan and recovery criteria with current science, population data, and biology. Utilize threats-based criteria and analysis to develop updated recovery objectives supported by population modeling. 5. Analyze genetic samples to better understand the current distribution of California least terns and other subspecies in Mexico. (USFWS, 2020)

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SPECIES ACCOUNT: *Strix occidentalis caurina* (Northern spotted owl)

Species Taxonomic and Listing Information

Commonly-used Acronym: STOC; NSO; SPOW

Listing Status: Threatened; June 26, 1990 (55 FR 26114). Endangered status determined to be warranted but precluded; December 15, 2020 (85 FR 81144)

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 tufts, 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*). 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 northern spotted owl is smaller than the historical range from British Columbia south to California as the northern spotted owl is extirpated or very uncommon in certain areas such as southwestern Washington and British Columbia (USFWS 2019). ton, 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). In California the range extends 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, Quinalt, 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 180,855 ac (73,189 ha) 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-fir-tanoak 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 north-to-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 north-south 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–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.

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 K LW-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.

K LW-3. The K LW-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 K LW-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.

K LW-4. The K LW-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 KLV-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. KLV-5. The KLV-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 KLV-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. KLV-6. The KLV-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 KLV-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. KLV-7. The KLV-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 KLV-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. KLV-8. The KLV-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 KLV-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. KLV-9. The KLV-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 KLV-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 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 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 north-south

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-to-medium 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 (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 2019). 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). I cannot strike out the above nor put my addition below in red: The northern spotted owl is territorial; home-range sizes vary geographically, generally increasing from south to north, which is likely a response to differences in habitat quality including structural complexity of forest conditions and availability of prey (USFWS 2011, p. G-2).

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. Of 11 long-term demographic monitoring areas, all are in decline: six areas at the rate of 6 to 9 percent annually, and five areas at 2 to 5 percent annually (Franklin et al. 2021, p. 1).

Species Trends:

Declining (USFWS 2019). The rate of realized population change for northern spotted owls in demographic study areas in Washington, as well as the Coast Range and Klamath study areas in Oregon, showed declines of 75 percent or more between 1995 and 2017. Other Oregon study areas showed declines of over 60 percent over the same time period. In California, declines ranged from more than 60 percent over the same time period, to 30 percent at Hoopa between 1995 and 2013, to exclude the period when barred owl removal was conducted at Hoopa (Franklin et al. 2021, p. 13)

Resiliency:

Low

Representation:

Low

Redundancy:

Moderate

Population Growth Rate:

Declining: the average annual rate of population change from 1995 through 2017 was -5.3 percent and the rate of decline is increasing (Franklin et al. 2021, p. 13-16)

Number of Populations:

There are 12 physiographic provinces, based on recognized landscape subdivisions exhibiting different physical and environmental features (USFWS 2011b).

Population Size:

Current estimates of the rangewide northern spotted owl population are not available. As of July 1, 1994, there were 5,431 known site-centers of spotted owl pairs or resident singles (USFWS 1995, p. 9495); this number represents cumulative number of locations, not a population estimate. The actual number of currently occupied spotted owl locations across the range is unknown because many areas remain un-surveyed (USDI FWS 2011a, p. A-2). Many of the historical sites are not likely occupied due to displacement by barred owls, timber harvest, or severe fires since 1994; it is also possible that some new sites may have been added.

Resistance to Disease:

Unknown; at this time, no avian diseases or parasitic infections are significantly affecting spotted owls. (USFWS 2011b).

Adaptability:

Low

Additional Population-level Information:

The northern spotted owl is extirpated or uncommon in certain areas such as southwestern Washington and British Columbia (USFWS 2019, p. 13).

Population Narrative:

Northern spotted owl populations show a trend of decline. The average annual rate of population change from 1995 through 2017 was -5.3 percent and the rate of decline is increasing (Franklin et al. 2021, p. 13-16). There are 12 physiographic provinces, based on recognized landscape subdivisions exhibiting different physical and environmental features (USFWS 2011). Currently, there are three extant wild populations, in California, Oregon, and Washington. The exact number within these populations is unknown. Current estimates of the rangewide northern spotted owl population are not available. As of July 1, 1994, there were 5,431 known site-centers of spotted owl pairs or resident singles (USFWS 1995, p. 9495); this number represents cumulative number of locations, not a population estimate. The actual number of currently occupied spotted owl locations across the range is unknown because many areas remain un-surveyed (USDI FWS 2011a, p. A-2). Many of the historical sites are not likely occupied due to displacement by barred owls, timber harvest, or severe fires since 1994; it is also possible that some new sites may have been added. At this time, no avian diseases or parasitic infections are significantly affecting spotted owls. The northern spotted owl is extirpated or uncommon in certain areas such as southwestern Washington and British Columbia (USFWS 2019, p. 13).

Threats and Stressors

Stressor: Habitat loss and fragmentation

Exposure: Wildfire, timber harvest, forest thinning and 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. Reductions in prey availability, causing a decrease in fitness. Reductions in habitat connectivity reduces the ability of individuals to fill territorial vacancies. Dispersal is important in providing adequate gene flow across the range of the subspecies and in maintaining stable populations (USFWS 2019, p. 20). Reductions in both habitat and prey can increase competitive pressure from barred owls (Wiens et al. 2014, p. 1)

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 foraging, dispersal, and reproduction (USFWS 2015). Wildfires have now surpassed timber harvest in causing habitat loss on Federal lands (Davis et al. 2016, p. 22).

Stressor: Increased interspecies competition for habitat and resources with the barred owl (*Strix varia*)

Exposure: Competition for both prey and habitat resources. Barred owls have also been documented to physically attack spotted owls (Pearson and Livezey 2003, p. 274).

Response: Reduced site occupancy, fecundity, reproduction, apparent survival, and detectability.

Consequence: Death of individuals and greatly reduced populations. Reduced detectability in northern spotted owls could impact management decisions to reduce suitable habitat in an area the subspecies is not believed to be present.

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). The presence of barred owls compound the effects of reduced old growth forest in northern spotted owl core habitat areas, increasing local extirpation of territories (Dugger et al. 2011, pp. 2463-2467).

Stressor: Disturbance from humans/equipment

Exposure: Heavy machinery and helicopter use, outdoor recreation, and hunting.

Response: Human presence, noise from heavy machinery, and smoke can cause a disruption of breeding, feeding, or sheltering behavior such that it creates the potential for injury to individuals (USFWS 2003, entire). Rotor wash from helicopters can blow birds out of nests and cause disruption due the potential for flying debris and shaking of trees located directly under a hovering helicopter.

Consequence: Loss of individuals, especially young; reduced reproduction.

Narrative: Noise, smoke, and human presence in proximity of northern spotted owls can cause a disruption of breeding, feeding, or sheltering behavior such that it creates the potential for injury to individuals (USFWS 2003, entire). Rotor wash from helicopters can blow birds out of nests and cause disruption due the potential for flying debris and shaking of trees located directly under a hovering helicopter. Disturbance can impact the survival and reproduction of individual northern spotted owls but is not a threat at the population scale in the way that habitat loss and barred owls threaten the continued existence of the subspecies.

Stressor: Loss of genetic variation

Exposure: Critically small populations; Geographic isolation due to large gaps in habitat.

Response: Increased inbreeding depression and decreased adaptive potential.

Consequence: Population bottleneck.

Narrative: Small effective population size, such as those observed in Washington, are highly susceptible to loss of genetic variation and fitness due to genetic drift and other factors (Frankham 1996, entire; Frankham et al. 2014, entire). Reductions in habitat connectivity reduces the ability of individuals to fill territorial vacancies. Dispersal between areas of suitable nesting habitat is important in providing adequate gene flow across the range of the subspecies and in maintaining stable populations (USFWS 2019, p. 20). 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).

Stressor: Climate Change

Exposure: Changes in forest species composition; reduction in low elevation forest habitat; increased frequency and severity of wildfires; reduction in prey species; colder wetter winters in some portions of range, warmer in southern portions; drier summers (Glenn et al. 2010, p. 2551; Mote et al. 2014, p. 489)

Response: Loss of habitat, reduction in prey species, survival of young

Consequence: Reduced annual survival, recruitment, and population growth rates

Narrative: Climate change is expected to impact forest types, altering northern spotted owl habitat that could lead to shifts or declines in populations. The range of regionally dominant Douglas-fir is projected to contract in Coastal Washington and Oregon, and in some areas of the Cascades in Washington and northern Oregon (Littell et al. 2013, p. 113). Potential changes in temperature and precipitation have important implications for the northern spotted owl. Predicted wetter weather during the winter and nesting season may reduce reproduction and survival during the breeding season due to declines or decreased activity in small mammal populations, so that less food is available during reproduction when metabolic demands are high (Glenn et al. 2011, p. 1290-1291). Cold, wet nesting seasons predicted for Washington and Oregon may increase mortality of nestlings due to chilling, thereby reducing the number of young fledged per pair per year (Franklin et al. 2000, pp. 577, 582; Glenn et al. 2011, p. 1288). The threats of habitat loss and competition with barred owls are exacerbated by changes in forest ecosystem processes and dynamics, including patterns of wildfires, insect outbreaks, and disease, which are occurring at faster rates due to climate change (77 FR p. 71879).

Recovery

Reclassification Criteria:

Reclassification criteria have not been established for this species.

Recovery Priority Number: 6C

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).
 - 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).

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).
- Maintain northern spotted owl habitat regardless of current occupancy. This would help the species in the face of the effects of climate change (Glenn et al. 2011, p. 1292), as well as help allow for recolonization by spotted owls if barred owl populations can be reduced, and allow for connectivity among areas still occupied by spotted owls (Franklin et al. 2021, p. 18).

Additional Threshold Information:

- Unable to enter Table 1 included in FWS edits
- Unable to enter Table 1 included in FWS edits

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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, mixed-coniferous 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 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–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 Mountaineer, 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 mixed conifer, 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.

Population Growth Rate:

Unknown

Number of Populations:

5 AU's (USFWS, 2023)

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. The Recovery Plan (USFWS 2012) subdivided the owl's range within the U.S. into five Ecological Management Units (EMUs): Colorado Plateau (CP), Southern Rocky Mountains (SRM), Upper Gila Mountains (UGM), Basin and Range-East (BRE), and Basin and Range-West (BRW), which we provide current information on below (Figure 1). The

Recovery Plan also identified five EMUs in Mexico; however, we will not discuss these EMUs specifically in this document, but rather more broadly based upon the information we have (USFWS, 2023).

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

Reclassification Criteria:

Recovery Priority Number: 9C

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).

Conservation Measures and Best Management Practices:

- **RECOMMENDATIONS FOR FUTURE ACTIONS** We will work with our partners to implement the following recommended actions during the next five-year review period: • We will continue to work with the Forest Service, National Park Service, Bureau of Land Management, states, tribes, and other partners to develop and implement forest management actions (e.g., thinning, prescribed fire) that reduce the risk of high-intensity, landscape-level wildland fire that can degrade or remove owl nest/roost habitat. In development of these actions, we need to ensure that the actions follow the Recovery Plan, to the best of managers' abilities. Current information indicates that the implementation of the Recovery Plan management recommendations for mechanical thinning and burning in PAC and recovery habitat will meet recovery and forest management objectives. We advise that agencies continue to follow those recommendations when conducting these activities in owl PACs and recovery habitat. • We recommend revising the desired conditions in the Sacramento Mountains on the Lincoln National Forest (BRE EMU) to emphasize canopy cover and some attribute measuring the large tree component (Ganey et al. 2016). We also recommend repeating the Ganey et al. (2016) assessment (or other method as appropriate) in other EMUs to determine how well the desired conditions for those areas in the Recovery Plan describe nesting habitat for the owl (USFWS 2012). This information would improve our ability to conserve the key habitat components of owl habitat, particularly nest/roost habitat, which is a limiting factor for the owl (USFWS 2012). • We recommend working with our partners to improve our ability to identify and monitor the status of owl PAC and recovery habitat, particularly in Colorado within the SRM EMU and Utah within the CP EMU. The use of the Living Map using data beyond that from NFS lands in Arizona and New Mexico will better inform where to conduct surveys, progress towards recovery, and allow us to monitor habitat trends through time. • We recommend working with our partners to collect new information regarding the effects of climate change on the owl, the abundance and distribution of the owl and its prey, and the owl's space requirements (e.g., nest core area, foraging habitat needs), particularly within different habitat types and EMUs (e.g., forested habitat within the UGM EMU versus sky islands in the BRW EMU). • We recommend working with the Recovery Team and our partners to develop a strategy for modifying the existing population trend monitoring method (USFWS 2012, Appendix E) or developing a new methodology, potentially using acoustic recording devices to detect owls to improve our ability to monitor owls in canyon as well as forest habitat (USFWS, 2023).

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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.
- • 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.

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • Continue captive propagation efforts to increase the population size by expanding facility capacity. • Continue efforts to develop and refine BTS control techniques on a landscape scale and apply across sihek habitat. • Continue and expand ungulate control and the creation of ungulate free areas across habitat. • Translocate sihek to 'learning' sites prior to reintroduction to Guam. • Restore native forests through Invasive plant monitoring and control. (USFWS, 2020)
- New management actions: • Reintroduction/translocation Planning for release of sihek from captivity is ongoing. There have been three stakeholder planning workshops which identified objectives of sihek conservation translocation and different alternative scenarios for translocations; determining how to increase captive population size, looking at disease risks around translocations and logistics of trial releases to small 'learning' sites; and addressing cultural values around sihek releases and potential economic impacts (Trask, ZSL, pers. Comm. 2020). A translocation plan for releases to small 'learning' sites is currently being created. This plan, as well as experience and knowledge gained from these initial learning site releases, will inform the translocation plan for releases to establishment sites (Trask, ZSL, pers. Comm. 2020). • Population viability analysis (PVA) The impact of breeding depression was estimated and incorporated in the captive population PVA to simulate different management scenarios and releases into the wild. The suggested inbreeding depression reinforces the need to increase the captive population size to reduce the rate of increase in inbreeding and loss of genetic diversity into the future. An increased population size would also support releases into the wild without impacting the viability of the population. • Conservation of habitat The Department of Defense and the U.S. Fish and Wildlife Service (FWS) have entered into two agreements to protect and/or manage habitat for sihek and other federally listed species on Guam. A 2020 Memorandum of Understanding between Joint Region Marianas and the FWS outlined a mutual understanding regarding the intentions and future considerations of a Department of Defense Readiness and Environmental Protection Integration Initiative to address conservation of upland vegetation communities for the sihek as well as other federally listed species on Guam. In 2015 a Memorandum of Agreement between the Department of the Navy and the FWS designated 5,234 acres (2,118 ha) of habitat for the recovery and survival of the sihek in Northern Guam in response to loss of habitat described in the 2015 Marine Corps Relocation Biological Opinion (USFWS 2015a,b). The Department of the Navy began implementation of a 1,000 acre (405 ha) forest enhancement project to offset the loss of recovery habitat for the sihek and other species due to activities described in the 2017 reinitiation of the 2015 Biological Opinion on the Department of the Navy's relocation of U.S. Marine Corps from Okinawa to Guam and Associated Activities on Guam (USFWS 2017). The project will be fully enclosed by an ungulate exclusion fence with ungulate control, invasive plants will be removed and vegetation found in native limestone habitats will be outplanted. (USFWS, 2020)

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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).

USFWS. 2020. 5-YEAR REVIEW Short Form Summary Species Reviewed: *Halcyon cinnamomina* *cinnamomina* (Sihek, Guam Micronesian kingfisher). 7 pp.

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).

Stressor: Known impediments to population growth

Exposure:

Response:

Consequence:

Narrative: Although tremendous gains in information needed to guide Attwater's prairie-chicken recovery have occurred since the last status review, populations remain extremely vulnerable to extirpation in large part due to their small size. Known impediments to population growth, and in turn to species persistence, include (1) impacts of red imported fire ants on invertebrates required as food for chicks, (2) stochastic weather events, (3) and continued loss and fragmentation of habitat from woody species encroachment and urban expansion. The long-term consequences associated with the extreme population bottleneck experienced by this species, especially with regard to population genetics, are unknown. Availability of suitable grassland habitat will ultimately limit recovery progress, but the ubiquitous presence of fire ants within existing grasslands is a much more immediate threat. Research suggests that progress toward recovery will only occur if significant resources are available to manage fire ants at the landscape scale required to support Attwater's prairie-chicken populations. Until then, this subspecies will remain in imminent danger of extinction. Therefore, no change in status is warranted or recommended. (USFWS, 2021)

Recovery

Recovery Actions:

- 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.

Conservation Measures and Best Management Practices:

- **RECOMMENDATIONS FOR FUTURE ACTIONS** Future actions should include continued focus on captive propagation, release efforts to supplement existing populations, and the establishment of new populations where quality habitat exists (recovery plan objectives 2 and 3). This requires continued work to restore and maintain a network of large, high quality prairie habitats within the historic range of the Attwater's prairiechicken (recovery plan objective 1). Fire ant management must be an integral part of the restoration and maintenance of habitat quality. Research is needed to optimize fire ant management with regard to retreatment intervals and selection of areas for treatment (recovery plan task 3.7). Support for existing captive rearing facilities is essential to provide source stock for the continued expansion of wild populations, and to serve as a hedge against extinction until viable populations are established in the wild (recovery plan objective 2). (USFWS, 2021)

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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 under section 7 of the Act for activities that are funded, authorized, or carried out by a Federal agency.

Critical Habitat Designation

The Service is designating 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, W $\frac{1}{2}$, and 12, all except NE $\frac{1}{4}$. 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. 5 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 corner of T. 5 N., R. 26 W., partially unsurveyed sec. 20; thence west to the northeast corner 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 NE $\frac{1}{4}$; and thence north to the southeast corner of T. 5 N., R. 27 W., 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 below the 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. 6 W.; 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 of the 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 of the 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 S., R. 7 W.

4. Coyote Creek. San Diego County. T. 9 S., R. 5 E.: secs. 22, N $\frac{1}{2}$ S E $\frac{1}{4}$; and 23, SW $\frac{1}{4}$.

5. Santa Margarita River, San Diego County. T. 9 S., R. 3 W.: secs. 4, all lands below the 600-foot contour; 5 SE $\frac{1}{4}$; 7; and 8. In T. 9 S., R. 4 W., Sec. 12 E $\frac{1}{2}$; 13 NE $\frac{1}{4}$.

6. San Luis Rey River, San Diego County. T. 11 S., R. 5 W.: secs. 13, S $\frac{1}{2}$ NE $\frac{1}{4}$, SE $\frac{1}{4}$ NW $\frac{1}{4}$, SW $\frac{1}{4}$; 14, SE $\frac{1}{4}$ SW $\frac{1}{4}$, S $\frac{1}{2}$ SE $\frac{1}{4}$; and 23, NW $\frac{1}{4}$. T. 11 S., R. 4 W.: secs. 3, all land north of Murray Road; 4, E $\frac{1}{2}$ NE $\frac{1}{4}$, E $\frac{1}{2}$ SE $\frac{1}{4}$ SW $\frac{1}{4}$ W $\frac{1}{2}$ NE $\frac{1}{4}$ SE $\frac{1}{4}$ E $\frac{1}{2}$ NW $\frac{1}{4}$ SE $\frac{1}{4}$, SW $\frac{1}{4}$ SE $\frac{1}{4}$; 7, N $\frac{1}{2}$ NE $\frac{1}{4}$ NE $\frac{1}{4}$, NW $\frac{1}{4}$ NE $\frac{1}{4}$, E $\frac{1}{2}$ W $\frac{1}{2}$. SW $\frac{1}{4}$ SW $\frac{1}{4}$; 8, N $\frac{1}{2}$ NE $\frac{1}{4}$, N $\frac{1}{2}$ N $\frac{1}{2}$ NW $\frac{1}{4}$; 9, N $\frac{1}{2}$ SNW $\frac{1}{4}$; and 18, NW $\frac{1}{4}$. T. 10 S., R. 4 W.: sec. 34, S $\frac{1}{2}$ SW $\frac{1}{4}$. Surveyed and unsurveyed portions according to the following metes and bounds; bordered on the north by a line commencing at the intersection of North River Road and the surveyed eastern section line of sec. 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 the eastern 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 its junction 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 the junction 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. 10S., 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 and northeasterly 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 of sec. 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 east approximately 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 the eastern-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 along said 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 Aqueduct on the north side of the San 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 116°58'014"W longitude immediately north of the confluence of Sweetwater 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 116°58'014"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 of said 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, S½SE¼/4SE¼/4; and 35, S½SW¼, SW¼/4SW¼/4SE¼. T. 19 S., R. 2 W.; secs. 1, W½SW¼NW¾: 2, S½NE¼NE¼, NW¼NE¼, N½SE¼/4NE¼/4, N½NE¼NW¾, 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 coastal sage 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) increases in 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).

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).
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Additional Threshold Information:

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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 nasa 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 nasa 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 nasa 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 nasa 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 *Tarennia 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). 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). Zarones et al. (2013) documented greater abundance of Rota white-eyes in wetter forests with more dense foliage and higher stem density. Some studies suggest that changes in the distribution of the Rota white-eye may be due to a decrease in suitable habitat as a result of changes in forest structure (Amidon 2000; Zarones et al. 2013). (USFWS, 2020)

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Not available

Population Information and Trends

Population Trends:

~90% decline since 1982 (USFWS, 2007)

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 Rota white-eye 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 (aka, *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 catus*); 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, nasa Luta population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Λ , 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, nasa Luta population data show a stable or increasing trend (i.e., finite rate of annual population increase, or Λ , 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).
- 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).

Conservation Measures and Best Management Practices:

- Recommendations for Future Actions: • Population viability monitoring and analysis – Continue population monitoring to establish greater confidence in abundance estimates • Predator / herbivory monitoring and control – Continue and expand brown treesnake interdiction on Rota • Population biology research o Continue and expand threat assessments for the Rota white-eye to determine mortality factors o Continue and expand research into population dynamics to provide information on nest success and survival. • Habitat and natural process management and restoration – Restore and protect native forest habitat throughout the historic range of the Rota white-eye. (USFWS, 2020)

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