Appendix C: Animals

Reptiles

SPECIES ACCOUNT: *Ameiva polops* (St. Croix ground lizard)

Species Taxonomic and Listing Information

Listing Status: Endangered; July 5, 1977

Physical Description

The St. Croix ground lizard (Ameiva polops) is a small species of Ameiva (snout-vent-length 35-77 mm). According to Dodd (1980), this species has a light brown middorsal stripe, bordered by wide dark brown or black stripes below which are narrow parallel stripes of brown, black and white. Continuing on to the tail are the middorsal stripe, bordering stripes and the narrow white stripes. The tail also has alternating rings of blue and black. The top of the head is uniform brown. Chin, throat, chest, sides of the snout and undersides of the forelegs are deep pinkish-red. The belly is a light gray with lateral bluish markings (USFWS, 1984).

Taxonomy

Taxonomic characteristics which distinguish this species from other Ameiva include: 10 (12) longitudinal rows of ventral scales, 33-39 femoral pores, dorsal caudal scales in oblique rows, enlarged median gular scales, and 2 parallel rows of preanal scales (USFWS, 1984).

Historical Range

The St. Croix ground lizard historic distribution included St. Croix, Green Cay, Protestant Cay, and presumably Buck Island (USFWS 1984). At the time of listing, the species was only known from Protestant Cay and Green Cay NWR. The last report of the species in the main island of St. Croix was in 1968 (USFWS 1984) (USFWS, 2013).

Current Range

The distribution of the species has presently expanded as a result of successful translocation efforts. Currently, the species is known from Protestant Cay, Green Cay National Wildlife Refuge, Ruth Cay and Buck Island Reef NM (Figure 1). Green Cay and Protestant Cay are designated critical habitat for the species (USFWS, 2013).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 9/22/1977.

Legal Description

On September 22, 1977, the Director, U.S. Fish and Wildlife Service issued a rulemaking which determined critical habitat for the St. Croix ground lizard (Ameiva polops) pursuant to Section 7 of the Endangered Species Act Of 1973 (42 FR 47840 - 47845). In accordance with section 7, all Federal agencies will be required to insure that actions authorized, funded, or carried out by them do not adversely affect these Critical Habitats.

Critical Habitat Designation

Critical habitat for the St. Croix ground lizard is designated in the U.S. Virgin Islands.

Protestant Cay, roughly defined by the coordinates 64o42'15''N. and 17o45'7.5''W.

Green Cay, roughly define by the coordinates 67o37'30'' N. and 17o46'15'' W.

Primary Constituent Elements/Physical or Biological Features

Not available

Special Management Considerations or Protections

Not available

Life History

Feeding Narrative

Adult: Ameiva polops was noted by Wiley (in prep.) to actively prowl, root and dig for prey. In 1936, Beatty (Grant, 1937) dissected a number of Ameiva and found them to have eaten the amphipods which were abundant along the beach. Philibosian and Ruibal (1971) reported that the hermit crab (Coenobita clypeatus) was a prey item for the animals introduces to Buck Island. Wiley (in prep.) observed that the smaller ground lizards foraging among the tidal wrack took grammarian amphipods flushed form the seagrass, that small white moths were taken from under the forest litter, and that A. polops was frequently observed foraging out of site under the litter or in shallow holes dug by the lizard (USFWS, 1984).

Reproduction Narrative

Adult: No information found

Tolerance Ranges/Thresholds

Adult: Low (inferred from USFWS, 1984)

Site Fidelity

Adult: High (inferred from USFWS, 1984)

Habitat Narrative

Adult: The St. Croix ground lizard is currently utilizing coastal dry forest vegetation on four offshore islands of St. Croix, USVI (U.S. Virgin Islands). Green Cay NWR is a 5.17 ha (ca. 14.1 acres) islet located in Chenay Bay about 150 m offshore the northeastern coast of St. Croix (McNair and Lombard 2004). McNair and Lombard (2004) provide general descriptions of the habitat of the St. Croix ground lizard in the three most obvious topographical and vegetative features on Green Cay (North, South, and Beach). The north area is comprised primarily of a shrub-grassland association; the south area is primarily open and closed dry and mesic forest with some shrubgrassland association; and the beach area (southern tip, and some margins of the east, west and north coast) has some trees like buttonwood (Conocarpus erectus), manchineel (Hippomane mancinella), sea grape (Coccoloba uvifera) and sea side maho (Thespesia populnea). Lizards were more abundant in forested areas in the southern half of the cay, but scarcer than expected on beaches, especially treeless areas. This is consistent with what Wiley (1984) and Meier et al. (1993) found. Wiley (1984) notes that the most important habitat components selected by the lizard were, suitable substrate for burrowing, presence of leaf or tidal litter, and areas which offered both canopied and exposed sections for thermoregulation. Meier et al. (1993) states tree density is the habitat factor most closely-related to distribution of the St. Croix ground lizard, being observed more frequently where trees were present (USFWS, 2013). Low tolerance range and high site fidelity are based on the species specific habitat needs and low number of populations.

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 1984)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS, 1984)

Dispersal

Adult: Low (USFWS, 2013)

Immigration/Emigration

Adult: No (USFWS, 2013)

Dispersal/Migration Narrative

Adult: High mobility is inferred based on species taxonomy. Species is non-migratory and has low dispersal and does not immigrate/emigrate because it is limited to relatively small islands (USFWS, 2013).

Population Information and Trends

Population Trends:

Decreasing (USFWS, 2013)

Resiliency:

Low (inferred from USFWS, 2013)

Representation:

Low (inferred from USFWS, 2013)

Redundancy:

Low (inferred from USFWS, 2013)

Number of Populations:

Four (USFWS, 2013)

Population Size:

600 to 2,000 total population estimate (USFWS, 2013)

Population Narrative:

USFWS (2013) notes that all but one population appears to be declining. In addition, this document notes that there are 4 known populations totaling an estimated 600 to 2,000 individuals.Low resiliency, redundancy and representation are inferred based on low population numbers and restricted habitat as well as low number of individuals.

Threats and Stressors

Stressor: Introduced mongoose (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: There is circumstantial evidence that correlates the decline of A. polops with the proliferation of the small Indian mongoose (USFWS, 1984).

Stressor: beautification' measures (USFWS, 1984)
Exposure:
Response:
Consequence:
Narrative: Modification of understory such as constant raking, removal of undergrowth and other 'beautification' projects around resorts and other developments may have contributed to the decline of the ground lizard (USFWS, 1984).

Recovery

Reclassification Criteria:
The recovery plan (USFWS, 1984) is outdated as it only lists criteria for reclassification but not delisting (USFWS, 2013).

The RP establishes that this species could be considered for reclassification from endangered to threatened when: 1. The existing population at Green Cay is protected. 2. The continued existence of the population on Protestant Cay is·ensured. 3. A self-sustaining population (500 or more individuals) is established on Buck Island. 4. Adequate population dispersion is obtained (USFWS, 2019).

Delisting Criteria:
The SCGL will be considered for delisting when the following criteria are met: 1. Establish two (2) additional populations that show a stable or increasing trend, evidenced by natural recruitment and multiple age classes (addresses Factor C, and E). 2. Existing three (4) populations on Buck Island, Protestant Cay, Ruth Cay, and Green Cay show a stable or increasing trend, evidenced by natural recruitment and multiple age classes (addresses Factor A, C, and E). 3. Threats have been addressed and/or managed to the extent that the species will remain viable into the foreseeable future (addresses Factor A, and C) (USFWS, 2019).

Conservation Measures and Best Management Practices:
- Evaluate success of translocation efforts to Bick Island and continue translocation if necessary to establish a self-sustainable population (USFWS, 2013).
- Initiate and/or continue rat and mongoose monitoring and control/eradication programs (USFWS, 2013).
- Initiate and/or continue habitat enhancement practices including invasive plant species removal and planting of native coastal vegetation (USFWS, 2013).
- Plan for a reverse translocation of lizards from Ruth to Protestant Cay as suggested by Hurtado et al. (2012), and assess other possible reverse translocations (USFWS, 2013).

- Protect Ruth Cay in perpetuity (USFWS, 2013).
- Assess climate change and sea level rise on lizard population and habitat (USFWS, 2013).
- Explore other possible reintroduction sites and/or translocations for the long-term survival of the species (USFWS, 2013).
- Update recovery plan and revise downlisting/delisting criteria (USFWS, 2013).

References

U.S. Fish and Wildlife Service. 1984. St. Croix Ground Lizard Recovery Plan, U.S. Fish and Wildlife Service, Atlanta, Georgia. 26 pp

U.S. Fish and Wildlife Service. 2013. St. Croix Ground Lizard (Ameiva polops) 5-Year Review: Summary and Evaluation U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boqueron, Puerto Rico.

U.S. Fish and Wildlife Service. 1977. Endangered and Threatened Wildlife and Plants. Correction and Augmentation of Published Rulemaking. Final rule. 42 FR 47840 - 47845 (September 22, 1977).

U.S. Fish and Wildlife Service. 2019. Amendment 1 to the Recovery Plan for the endangered St. Croix ground lizard (Ameiva polops).

USFWS. 2013. St. Croix Ground Lizard (Ameiva polops)

5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 19 pp.

SPECIES ACCOUNT: *Anolis roosevelti* (Culebra Island giant anole)

Species Taxonomic and Listing Information

Listing Status: Endangered; August 22, 1977; Southeast Region (R4)

Physical Description

The Culebra Island 'Giant' anole, Anolis roosevelti, a rather large brownish-gray lizard growing about 160 mm snout-vent-length (USFWs, 1982).

Taxonomy

Despite the lack of any significant series of specimens, Major Grant was quite certain that the specimen he possessed represented a new taxon. The type description contains a comparison of this new species with both A. cuvieri for the mainland of Puerto Rico and A. ricordi from the Island of Hispaniola. It is evident from this comparison that the new species possesses characteristics of both of these species of giant anoles, but that it is distinct from either (USFWS, 1982).

Historical Range

Culebra Island (USFWS, 1982).

Current Range

Culebra Island (USFWS, 2014).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 7/21/1977.

Legal Description

On July 21, 1977, the U.S. Fish and Wildlife Service designated critical habitat for Anolis roosevelti (Culebra Island giant anole) under the Endangered Species Act of 1973, as amended (42 FR 37371 - 37373).

Critical Habitat Designation

Critical habitat for the Culebra Island giant anole is designated in an area on Culebra Island outlined on the map depicted in the final rule.

Primary Constituent Elements/Physical or Biological Features

Not available

Special Management Considerations or Protections

The areas (exclusive of existing manmade structures or settlements which are not necessary to the normal needs or survival of the species) are Critical Habitat for the Species indicated. Pursuant to Section 7 of the Act, all Federal agencies must insure that actions authorized, funded, or carried out by them do not result-in the destruction or adverse modifkation of these areas.

Life History

Feeding Narrative

Adult: Unknown. Species has not been seen since 1932 and is only known from two preserved specimens (USFWS, 2014).Anectodal: Ficus fruit (USFWS, 1982)

Reproduction Narrative

Adult: Unknown. Species has not been seen since 1932 and is only known from two preserved specimens (USFWS, 2014).

Habitat Narrative

Adult: Anecdotal reports indicate this species may be arboreal and is found in Ficus and gumbo-limbo forests (USFWS, 1982).

Dispersal/Migration

Dispersal/Migration Narrative

Adult: Unknown. Species has not been seen since 1932 and is only known from two preserved specimens (USFWS, 2014).

Population Information and Trends

Population Trends:

Not available

Population Narrative:

Unknown. Species has not been seen since 1932 and is only known from two preserved specimens (USFWS, 2014).

Threats and Stressors

Stressor: Habitat destruction or modification (USFWS, 2014)
Exposure:
Response:
Consequence:
Narrative: Deforestation for residential and tourist development projects is considered an imminent threat to its survival. However, this threat is considered low in scale as most habitat is under protected status (USFWS, 2014).

Stressor: Catastrophic events and human-induced fires (2014)
Exposure:
Response:
Consequence:
Narrative: Catastrophic natural events such as hurricanes, may dramatic ally affect forest species composition and structure, felling large trees and creating numerous canopy gaps. Furthermore, fire is not a natural component of subtropical dry forest in Puerto Rico and Virgin Islands. Hence, species found in this type of habitats are not fire adapted, so human-induced fires constitute a threat the Culebra giant anole and its habitat (USFWS, 2014).

Recovery

Reclassification Criteria:
Confirm species existence (USFWS, 2014)

Recovery Actions:

- If existent, the Culebra giant anole and its habitat may be threatened by modification, and manmade and natural catastrophic events. Therefore, as proposed by some researchers, more intensive and comprehensive surveys should be conducted to verify the status of the species (USFWS, 2014).

References

U.S. Fish and Wildlife Service. 1982. Giant Anole Recovery Plan, U.S. Fish and Wildlife Service, Atlanta, Georgia. 19 pp

U.S. Fish and Wildlife Service. 2014. Culebra Island Giant Anole (Anolis roosevelti) 5-Year Review: Summary and Evaluation U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boqueron, Puerto Rico.

U.S. Fish and Wildlife Service. 1977. Endangered and Threatened Wildlife and Plants

Final Endangered Status and Critical Habitat for the giant Anole. Final rule. 42 FR 37371 - 37373 (July 21, 1977).

USFWS. 2014. Culebra Island Giant Anole (Anolis roosevelti)

5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service, Southeast Region, Caribbean Ecological Services Field Office, Boquerón, Puerto Rico. 21 pp.

SPECIES ACCOUNT: *Caretta caretta* (Loggerhead sea turtle (N Pacific Ocean DPS))

Species Taxonomic and Listing Information

Listing Status: Endangered; 7/23/1978; Southeast Region (R4)

Physical Description

A reddish-brown sea turtle with a relatively large head. There are 5 or more costals (pleurals) on each side of the carapace. Limbs are flattened flippers; tail of adult male (extends past tips of back-stretched hind flippers) is much longer than that of adult female (barely reaches rear edge of carapace); young are brown or reddish-brown dorsally and have 3 dorsal keels and 2 plastral keels; adult carapace length usually 70-125 cm (to 122+ cm), mass 70-180 kg (to 227+ kg); hatchling shell length is 4-5 cm, mass about 20 g (Dodd 1988, 1992; Conant and Collins 1991) (NatureServe, 2015). The loggerhead sea turtle is distinguished from other turtles by its reddish-brown carapace, large head and powerful jaws (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

The generic name Caretta was introduced by Rafinesque (1814). The specific name caretta was first used by Linnaeus (1758). The name Caretta is a latinized version of the French word "caret", meaning turtle, tortoise, or sea turtle (Smith and Smith 1980). Smith and Smith (1980) suggested that the Indo-Pacific and Atlantic populations were differentiated at the sub-specific level, but this conclusion has been challenged by Hughes (1974) and Pritchard and Trebbau (1984). In recent synopses of the biological data available on this species, Dodd (1988, 1990) considered Caretta caretta to be monotypic (NMFS and USFWS, 1998).

Historical Range

Geographic scope (from a U.S. jurisdictional perspective) for all six of the U.S. Pacific sea turtle recovery plans (written for five species and one regionally important population) is defined as follows: in the eastern Pacific, the west coast of the continental United States; in the central Pacific, the state of Hawaii and the unincorporated U.S. territories of Howland, Baker, Wake, Jarvis, and Midway Islands, Johnston Atoll, Palmyra Atoll, and Kingman Reef; in Oceania, Guam, the Commonwealth of the Northern Mariana Islands (CNMI), and American Samoa (NMFS and USFWS, 1998).

Current Range

Loggerhead sea turtles originating from the North Pacific north of the equator and south of 60° N. Lat. The U.S. territory in which this DPS occurs in Oregon (NatureServe, 2015). In the North Pacific, loggerhead nesting is essentially restricted to Japan (USFWS ad NMFS, 2007). Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans. North Pacific Ocean DPS loggerheads are found throughout the Pacific Ocean, north of the equator. Their range extends from the West Coast of North America to eastern Asia (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans, returning to their natal region for mating and nesting. Adults and sub-adults occupy nearshore habitat. While in their oceanic phase, loggerheads undergo long migrations using ocean currents. Individuals from multiple nesting colonies can be found on a single feeding ground. Hatchlings from Japanese nesting beaches use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to foraging grounds. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off of Mexico's Baja California Peninsula. Both of these feeding grounds are frequented by individuals from Japanese nesting beaches (Abecassis et al. 2013; Seminoff et al. 2014) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

North Pacific Ocean

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Hatchlings rely substantially on an anaerobic metabolism during both nest emergence and subsequent rapid movement to the surf (Dial 1987). Moody (1979) identified various gastropod species from juvenile loggerheads captured in Queensland, in addition to several pelycepod species (NMFS and USFWS, 1998).

Adult: Adult loggerheads typically prey on benthic invertebrates in hard bottom habitats, although fish and plants are occasionally taken. Based on published references, Dodd (1988) concluded that the diet of loggerheads in Queensland, Australia (the only Pacific location for which data are available) consists of cnidarians, cephalopods, a wide variety of gastropods and pelycepods, decapods, echinoderms, and fish. Limpus (1979) measured rates of 0-0.26 cm/yr. for adults in eastern Australia (NMFS and USFWS, 1998). It exhibits a circadian phenology (NatureServe, 2015).

Reproduction Narrative

Egg: Eggs hatch in about 45-65 days. Hatch success in in situ nests ranges from 0-100%, with a global average of nearly 75% (estimated from Dodd 1988) (NMFS and USFWS, 1998).

Juvenile: Of every thousand hatchlings, only a few are believed to survive to adulthood; this is characteristic even of stable populations (Dodd 1988) (NatureServe, 2015).

Adult: Nesting occurs usually on open sandy beaches above high-tide mark, seaward of well-developed dunes. It is a colonial breeder (NatureServe, 2015). Approximately a decade will pass for the average female from the time her oviducts commence to enlarge until her first ovulation (Limpus 1990). Upon maturity, females migrate at multiple year intervals (mean = 3.5 yrs. in Queensland, Limpus 1985; 2.6 in a summary by van Buskirk and Crowder 1994) from resident foraging grounds to suitable nesting beaches. Nesting in the People's Republic of China occurs between April and August (Chu-Chien 1982). In the Japanese islands, the breeding season extends from late May through August, apparently initiated when 20oC isothermal waters approach the coast of Japan in the spring. Individuals return faithfully to the same nesting area over many years, probably over their entire reproductive lives. The female approaches the beach at night, selects a nest site, prepares a body pit, excavates a nest cavity, deposits her eggs, covers and disguises the nest, and returns to the sea (Bustard et al. 1975; Dodd 1988). The nesting sequence generally lasts 45-90 min (e.g., Hirth 1980; Geldiay et al. 1982; Kaufmann 1973). Clutch size averages about 110 eggs in the Indian Ocean, 120 eggs in the western Atlantic, and 130 eggs in Queensland, Australia (summarized by Dodd 1988). A female lays hundreds or thousands of eggs during her lifetime, a necessary response to high mortality in early life stages (NMFS and USFWS, 1998). Mean age at first reproduction for female loggerhead sea turtles is thirty years. Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (i.e., coastal waters). Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Site Fidelity

Adult: High (see reproduction narrative)

Habitat Narrative

Egg: Temperature, moisture, and gas diffusion are important to successful embryo development (e.g., Ackerman 1981a,b; Maloney et al. 1990). Ambient temperatures during incubation influence hatchling sex. A predominance of females is produced at temperatures >32oC and a predominance of males at temperatures (NMFS and USFWS, 1998).

Juvenile: Maximum hatching success and hatchling size occur when sand moisture level is about 25% (NatureServe, 2015). Hatchlings move directly to sea after hatching, often float in masses of sea plants (Sargassum); may remain associated with sargassum rafts perhaps for 3-5 years (NatureServe, 2015). Newly hatched loggerheads are strongly influenced by certain wavelengths of light (Witherington and Bjorndal 1991), which presumably aids in their sea-finding ability (NMFS and USFWS, 1998).

Adult: Inhabits the open sea to more than 500 miles from shore, mostly over continental shelf, and in bays, estuaries, lagoons, creeks, and mouths of rivers; mainly warm temperate and subtropical regions not far from shorelines. Adults occupy various habitats, from turbid bays to clear waters of reefs. Subadults occur mainly in nearshore and estuarine waters (NatureServe, 2015).

Dispersal/Migration

Motility/Mobility

Juvenile: High (NMFS and USFWS, 1998)

Adult: High (NMFS and USFWS, 1998)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Juvenile: High (NMFS and USFWS, 1998)

Adult: High (NMFS and USFWS, 1998)

Dispersal/Migration Narrative

Juvenile: The transition from newborn to young juvenile may occur in the open sea, and perhaps involve transpacific movement. In the Pacific, Pritchard (1982a) remarked that small specimens (8-10 cm) have been found along the northern areas of New Zealand, typically in late winter, which would correlate with their having hatched approximately six months before on beaches in Queensland and passively drifting southeast to New Zealand (NMFS and USFWS, 1998).

Adult: Pacific nesting beaches (e.g., Japan, Australia) are widely separated from some known foraging grounds (e.g., Baja California), suggesting that Pacific populations probably have a pelagic stage similar to that described in the North Atlantic (NMFS and USFWS, 1998). Migrates between nesting beaches and marine waters (NatureServe, 2015)

Population Information and Trends

Population Trends:

50 - 90% decline in nesting population (USFWS and NMFS, 2007)

Species Trends:

Increasing (USFWS and NMFS, 2007)

Resiliency:

Very high (inferred from NMFS and USFWS, 1998; see historical range/distribution)

Population Size:

Unknown; possibly 10,000 (NMFS and USFWS, 1998)

Resistance to Disease:

Unknown (NMFS and USFWS, 1998)

Adaptability:

Low (inferred from NatureServe, 2015)

Population Narrative:

Although reliable estimates are not available, as many as 2,000-3,000 loggerheads may nest annually on beaches throughout Japan (Balazs and Wetherall 1991). Estimates of juvenile foraging populations off Baja California, Mexico, range from "thousands, if not tens of thousands" (Pitman 1990) to "at least 300,000 turtles" (Bartlett 1989). Extrapolating from 1988 offshore census data, Ramirez-Cruz et al. (1991) estimated approximately 4,000 turtles in March, with a maximum in July of nearly 10,000 turtles. These aggregations have only recently been reported; their status with regard to increasing or declining abundance has not been determined. The extent to which disease contributes to disability or mortality among wild loggerheads in the Pacific Ocean is unstudied (NMFS and USFWS, 1998). This species is highly vulnerable to current stressors (NatureServe, 2015). Annual nest numbers from 2001 - 2004 increased from 3,122 to 4,854 (Matsuzawa, 2006). Using information collected from Japanese nesting beaches, Kamezaki et al. (2003) concluded a substantial decline (50 - 90%) in the size of the annual loggerhead nesting population in Japan in recent decades (USFWS and NMFS, 2007). Neritic juveniles and adults in the North Pacific Ocean DPS are at risk of mortality from coastal fisheries in Japan and Baja California, Mexico. Habitat degradation in the form of coastal development and armoring pose a threat to nesting females. Based on these threats and the relatively small population size, the Biological Review Team concluded that the North Pacific Ocean DPS is currently at risk of extinction (Conant et al. 2009) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size. Adult nesting females often account for less than one% of total population numbers (Bjorndal et al. 2005). The North Pacific Ocean DPS has a nesting population of about 2,300 nesting females (Matsuzawa 2011). Loggerhead abundance on foraging grounds off the Pacific Coast of the Baja California Peninsula, Mexico, was estimated to be 43,226 individuals (Seminoff et al. 2014). Productivity / Population Growth Rate Overall, Gilman (2009) estimated that the number of loggerheads nesting in the Pacific has declined by 80% in the past 20 years. There was a steep (50 to 90%) decline in the annual nesting population in Japan during the last half of the twentieth century (Kamezaki et al. 2003) Since then, nesting has gradually increased, but is still considered to be depressed compared to historical numbers, and the population growth rate is negative (- 0.032) (Conant et al. 2009). Genetic Diversity Recent mitochondrial DNA analysis using longer sequences has revealed a more complex population sub-structure for the North Pacific Ocean DPS. Previously, five haplotypes were present, and now, nine haplotypes have been identified in the North Pacific Ocean DPS. This evidence supports the designation of three management units in the North Pacific Ocean DPS: 1) the Ryukyu management unit (Okinawa, Okinoerabu, and Amami), 2) Yakushima Island management unit and 3) Mainland management unit (Bousou, Enshu-nada, Shikoku, Kii and Eastern Kyushu) (Matsuzawa et al. 2016). Genetic analysis of loggerheads captured on the feeding grounds of Sanriku, Japan, found only haplotypes present in Japanese rookeries (Nishizawa et al. 2014) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Harvest (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: The harvest of sea turtles and/or their eggs for food or any other domestic or commercial use constitutes a widespread threat to these species. Removing breeding adults from a population can accelerate the extinction of local stocks, and the persistent collection of eggs guarantees that future population recruitment will be reduced (NMFS and USFWS, 1998).

Stressor: Disturbance/recreation (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Human populations are growing rapidly in many areas of the Pacific and this expansion is exerting increasing pressure on limited coastal resources. Threats to sea turtles include increased recreational and commercial use of nesting beaches, the loss of nesting habitat

to human activities (e.g., pig pens on beaches), beach camping and fires, an increase in litter and other refuse, and the general harassment of turtles. Driving on the beach causes sand compaction and rutting, and can accelerate erosion. Driving on beaches used by turtles for egg-laying can crush incubating eggs, crush hatchlings in the nest, and trap hatchlings after they emerge from the nest cavity and begin their trek to the sea. In the latter case, hatchlings are exposed to exhaustion and predators when they fall into and cannot climb out of tire ruts that are typically oriented parallel to the sea. Removal of accumulated seaweeds and other debris from a nesting beach should be accomplished by hand-raking only. The use of heavy equipment can crush turtle eggs and hatchlings and can remove sand vital to incubating eggs. Sea turtles can be injured or killed when struck by a boat, especially if struck by an engaged propeller. Recreational equipment, such as jet skis, also pose a danger due to collisions and harassment (NMFS and USFWS, 1998)

Stressor: Habitat destruction and degradation (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: The most valuable land is often located along the coastline, particularly when it is associated with a sandy beach. Coastal construction is occurring at a rapid rate and is resulting in a loss of sea turtle nesting areas. Construction-related threats to the region's sea turtle nesting beaches include the construction of buildings (hotels, houses, restaurants), recreational facilities (tennis courts, swimming pools), or roads on the beach; the construction of sea walls, jetties, or other armoring activities that can result in the erosion of adjacent sandy beaches; clearing stabilizing beach vegetation (which accelerates erosion); and the use of heavy construction equipment on the beach, which can cause sand compaction or beach erosion. Sand and coral rubble are removed from beaches for construction or landscaping purposes. The extraction of sand from beaches destabilizes the coastline (e.g., reduces protection from storms), removes beach vegetation through extraction or flooding and, in severe cases, eliminates the beach completely. When mining occurs on or behind a nesting beach, the result can be the degradation or complete loss of the rookery. In addition, females can become confused when they emerge from the sea only to find themselves heading down slope into a depression formed by mining activities; too often the outcome is that the female returns to the sea without laying her eggs. Even when eggs are successfully deposited, reduced hatch success results if nests are flooded or excavated during mining. The nourishment or replacement of beaches diminished by storms, seawalls or coastal development can reduce sea turtle hatching success by deeply burying incubating eggs, depositing substrate (generally from offshore deposits) that is not conducive to the incubation of sea turtle eggs, obstructing females coming ashore to nest (machinery, pipelines, etc.), and/or killing turtles during nearshore dredging operations. Most sea turtle species depend upon algal beds, seagrass and/or reef habitats for food and refuge. The destruction or degradation of these habitats is a widespread and serious threat to the recovery of depleted sea turtle stocks. The general degradation of these habitats can be affected by eutrophication, sedimentation, chemical poisoning, collecting/gleaning, trampling (fisherman, skin and SCUBA divers) and anchoring. The development of marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat. This type of development also leads to increased boat traffic resulting in collision-related injury and mortality of turtles. Fueling facilities at marinas can result in discharge of oil and gas into sensitive estuarine habitats. There is increasing demand to install marinas and docks and develop inland coastal areas where turtles are known or are likely to exist in Baja

California and southern California. Active dredging machinery (especially hopper dredges) may injure or kill sea turtles, and channelization may alter natural current patterns and sediment transportation. Coral reef and sea grass ecosystems may be excavated and lost, and suspended materials may smother adjacent coral and seagrass communities. Oil exploration and development pose direct and indirect threats to sea turtles. A rise in transport traffic increases the amount of oil in the water, such as from bilge pumping, as well as the likelihood of a major oil spill. Oil spills resulting from blow-outs, ruptured pipelines, or tanker accidents, can result in death to sea turtles. Indirect consequences include destruction of foraging habitat by drilling, anchoring, and pollution. Blasting can injure or kill sea turtles in the immediate area. The use of dynamite to construct or maintain harbors, break up rock formations or improve nearshore access can decimate sea turtle habitat. Anchoring and related activities employed in support of the blasting can also degrade reefs and other benthic communities that support sea turtles. Some types of dynamiting have minimal impact to marine life, such as placing explosive in pre-drilled holes (drilling and shooting) prior to detonation and is the standard practice to secure armor rock (NMFS and USFWS, 1998).

Stressor: Nest predation (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: The loss of eggs to non-human predators is a severe problem in some areas. These predators include domestic animals, such as cats, dogs and pigs, as well as wild species such as rats, mongoose, birds, monitor lizards, snakes, and crabs, ants and other invertebrates (NMFS and USFWS, 1998).

Stressor: Artificial lighting (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Hatchling sea turtles orient to the sea using a sophisticated suite of cues primarily associated with ambient light levels. Hatchlings become disoriented and misdirected in the presence of artificial lights behind (landward of) their hatching site. These lights cause the hatchlings to orient inland, whereupon they fall prey to predators, are crushed by passing cars, or die of exhaustion or exposure in the morning sun. Nesting adults are also sensitive to light and can become disoriented after nesting, heading inland and then dying in the heat of the next morning, far from the sea. Security and street lights, restaurant, hotel and other commercial lights, recreational lights (e.g., sports arenas), and village lights, especially mercury vapor and other full spectrum lights, misdirect hatchlings by the thousands throughout the Pacific every year (NMFS and USFWS, 1998).

Stressor: Stochastic weather events (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Natural phenomena, such as cyclones, can contribute to the mortality of turtles at sea, particularly in shallow waters. Disease epidemics and other debilitating conditions that affect prey items (sea grass, coral, sponges, reef invertebrates) can also harm sea turtle populations. Storms can alter current patterns and blow migrating turtles off course into cold water.

Unseasonal warm water incursions from subtropical regions into the northeastern Pacific, known as "El Niño" events, may cause loggerheads to migrate north where they "cold stun" once they encounter colder water. El Niño events can also cause reduced food production for some turtle species which can reduce growth and fecundity (NMFS and USFWS, 1998).

Stressor: Exotic vegetation (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Introduced species can displace native dune and beach vegetation through shading and/or chemical inhibition. Dense new vegetation shades nests, potentially altering natural hatchling sex ratios. Thick root masses can also entangle eggs and hatchlings (NMFS and USFWS, 1998).

Stressor: Contaminants and pollution (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Chemical contamination of the marine environment due to sewage, agricultural runoff, pesticides, solvents, petroleum and industrial discharges is widespread along the coastal waters of the western United States, particularly near the populated coastal areas of southern California where loggerheads are likely to be found. The entanglement in and ingestion of persistent marine debris threatens the survival of loggerhead turtles in the eastern Pacific. Turtles become entangled in abandoned fishing gear (lines, ropes and nets) and cannot submerge to feed or surface to breathe; they may lose a limb or attract predators with their struggling. A juvenile loggerhead was found in June 1991 off Dana Point in southern California, entangled in the hose attached to a five-gallon boat gasoline tank floating in the water (Mike Couffer, pers. comm.). Loggerhead turtles will also ingest debris such as plastic bags, plastic sheets, plastic six-pack rings, tar balls, Styrofoam, and other refuse. Necropsies of stranded turtles have revealed mortalities due to ingested garbage resulting in poisoning or obstruction of the esophagus (NMFS and USFWS, 1998).

Stressor: Fisheries bycatch (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Loggerhead turtles are accidentally taken in several commercial and recreational fisheries. These include bottom trawls commonly used by shrimp vessels in the Gulf of California, gillnets, traps, pound nets haul seines and beach seines commonly used in inshore and coastal waters of Baja California. Forty-one loggerheads were captured incidentally by a single fisherman during 1985-1987 near Bahia de la Paz, Baja California (Alvarado and Figueroa 1990). In addition, trawls, purse seines, hook and line, driftnets, bottom and surface longlines may kill an as yet unknown number of turtles in different areas of the eastern Pacific. Loggerheads comprised 36% of the annual observed take of all species of turtles by the Hawaiian-based longline fishery between 1990-1994 (NMFS 1995). The predicted annual take of loggerheads by this fishery is 305 turtles. Although most of these are released alive, the post-release mortality has not been determined. Loggerheads are one of the most commonly caught sea turtles in the pelagic squid

driftnet fishery, although they are not specifically identified in the bycatch statistics (Gjernes et al. 1990) (NMFS and USFWS, 1998).

Stressor: Power plant entrapment (NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: The entrainment and entrapment of juvenile and sub-adult loggerhead turtles in the saltwater cooling intake systems of coastal power plants have been documented in southern California at San Diego Gas & Electric (SDG&E) plant at Carlsbad, as well as the Southern California Edison Nuclear Generating Station at San Onofre (Kent Miles, SDG&E, pers. comm.; Joe Cordaro, NMFS, pers. comm.). Some of these turtles are released unharmed (NMFS and USFWS, 1998).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. To the best extent possible, reduce the take in international waters (have and enforce agreements) (NMFS and USFWS, 1998).

2. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters (NMFS and USFWS, 1998).

3. All females estimated to nest annually (FENA) at "source beaches" are either stable or increasing for over 25 years (NMFS and USFWS, 1998).

4. Each stock must average 5,000 FENA (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) over six years (NMFS and USFWS, 1998).

5. Existing foraging areas are maintained as healthy environments (NMFS and USFWS, 1998).

6. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region (NMFS and USFWS, 1998).

7. All Priority #1 tasks have been implemented (NMFS and USFWS, 1998).

8. A management plan designed to maintain stable or increasing populations of turtles is in place (NMFS and USFWS, 1998).

9. Ensure formal cooperative relationship with a regional sea turtle management program (SPREP) (NMFS and USFWS, 1998).

10. International agreements are in place to protect shared stocks (e.g., Mexico and Japan) (NMFS and USFWS, 1998).

Recovery Actions:

- Reduce incidental capture of loggerheads by coastal and high seas commercial fishing operations (NMFS and USFWS, 1998).
- Establish bilateral agreements with Japan and Mexico to support their efforts to census and monitor loggerhead populations and to minimize impacts of coastal development and fisheries on loggerhead stocks (NMFS and USFWS, 1998).
- Identify stock home ranges using DNA analysis (NMFS and USFWS, 1998).
- Determine population size and status (in U.S. jurisdiction) through regular aerial or on-water surveys (NMFS and USFWS, 1998).
- Identify and protect primary foraging areas for the species (NMFS and USFWS, 1998).

Conservation Measures and Best Management Practices:

- The Service has preliminary information that indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the loggerhead turtle. Since the species' listing, a substantial amount of information has become available on population structure, nesting and foraging distribution, movements, and demography. These data appear to indicate a possible separation of populations by ocean basins, however a more in depth analysis, beyond the scope of this five-year review, is needed. To determine the application of the DPS policy to the loggerhead turtle, the Services intended to fully assemble and analyze all relevant information in accordance with the DPS policy (USFWS and NMFS, 2007).

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SPECIES ACCOUNT: *Caretta caretta* (Loggerhead sea turtle (NW Atlantic DPS))

Species Taxonomic and Listing Information

Listing Status: Threatened; 7/23/1978; Southeast Region (R4) (USFWS, 2015)

Physical Description

A reddish-brown sea turtle with a relatively large head. There are 5 or more costals (pleurals) on each side of the carapace. Limbs are flattened flippers; tail of adult male (extends past tips of back-stretched hind flippers) is much longer than that of adult female (barely reaches rear edge of carapace); young are brown or reddish-brown dorsally and have 3 dorsal keels and 2 plastral keels; adult carapace length usually 70-125 cm (to 122+ cm), mass 70-180 kg (to 227+ kg); hatchling shell length is 4-5 cm, mass about 20 g (Dodd 1988, 1992; Conant and Collins 1991) (NatureServe, 2015). The loggerhead sea turtle is distinguished from other turtles by its reddish-brown carapace, large head and powerful jaws (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017)

Taxonomy

The loggerhead was first described by Linnaeus in 1758 and named Testudo caretta. Over the next two centuries more than 35 names were applied to the species (Dodd 1988), but there is now general agreement on Caretta caretta as the valid name. While Deraniyagala described an Indo-Pacific form as C. gigas in 1933, he revised that view in 1939 to hold that gigas was a subspecies of C. caretta. The genus has generally been regarded as monotypic since that time (NMFS and USFWS, 2008).

Historical Range

Originating from the Northeast Atlantic Ocean north of the equator, south of 60oN. Lat., and east of 40oW. Long., except in the vicinity of the Strait of Gibraltar (NatureServe, 2015).

Current Range

In the Atlantic, previously unknown or unquantified nesting assemblages have been documented on the Cape Verde Islands, on the Cay Sal Bank in the eastern Bahamas, and in Cuba. Loggerhead nesting no longer occurs in Jamaica, Haiti, the Dominican Republic, and Puerto Rico (USFWS and NMFS, 2007). In the U.S., loggerheads nest from Texas to Virginia. The loggerhead is commonly found throughout the North Atlantic including the Gulf of Mexico, the northern Caribbean, The Bahamas archipelago (Dow et al. 2007), and eastward to West Africa, the western Mediterranean, and the west coast of Europe (NMFS and USFWS, 2008). Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans. Northwest Atlantic Ocean DPS loggerheads are found along eastern North America, Central America, and northern South America (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71 to 88%) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madiera, Canary Islands and

Adalusia, Gulf of Mexico and Brazil (Masuda 2010) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

Northwest Atlantic Ocean

Critical Habitat Designated

Yes; 8/11/2014.

Legal Description

On July 10, 2014, the U.S. Fish and Wildlife Service, designated specific areas in the terrestrial environment of the U.S. Atlantic and Gulf of Mexico coasts as critical habitat for the Northwest Atlantic Ocean distinct population segment of the loggerhead sea turtle (Caretta caretta) under the Endangered Species Act of 1973, as amended. In total, approximately 1,102 kilometers (685 miles) fall within the boundaries of the critical habitat designation.

Critical Habitat Designation

Approximately 1,102.1 km (684.8 mi) in 88 units in the terrestrial environment are designated as critical habitat for the loggerhead sea turtle. Under section 4(a)(3) of the Act, the Service has exempted four areas owned or controlled by DOD that are subject to INRMP's determined to provide a benefit to the species. Additionally, under 4(b)(2) of the Act, the Service excluded 2 units and portions of 3 units that were identified in the proposed rule for possible inclusion as critical habitat.

LOGG–T–NC–01—Bogue Banks, Carteret County: This unit consists of 38.9 km (24.2 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway and Bogue Sound. The unit extends from Beaufort Inlet to Bogue Inlet. The unit includes lands from the MHW line landward to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is Fort Macon State Park, which is managed by the North Carolina Division of Parks and Recreation. This unit supports expansion of nesting from an adjacent unit (LOGG–T–NC–02) that has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–02—Bear Island, Onslow County: This unit consists of 6.6 km (4.1 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway and salt marsh. The unit extends from Bogue Inlet to Bear Inlet. The unit includes lands from the MHW line landward to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. The island is managed by the North Carolina Division of Parks and Recreation as Hammocks Beach State Park. This unit has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–03—Topsail Island, Onslow and Pender Counties: This unit consists of 35.0 km (21.8 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Chadwick Bay, Alligator Bay, Goose Bay, Rogers Bay, Everett Bay, Spicer Bay, Waters Bay, Stump Sound, Banks Channel, and salt marsh. The unit extends from New River Inlet to New Topsail Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The local municipality portion is the North Topsail Beach Park, which is managed by the Town of North Topsail Beach. This unit has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–04—Lea-Hutaff Island, Pender County: This unit consists of 6.1 km (3.8 mi) of island shoreline along the Atlantic Ocean. Following the closure of Old Topsail Inlet in 1998, two islands, Lea Island and Hutaff Island, joined to form what is now a single island referred to as Lea-Hutaff Island. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Topsail Sound, Eddy Sound, Long Point Channel, Green Channel, and salt marsh. The unit extends from New Topsail Inlet to Rich Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is part of the Lea Island State Natural Area, which includes most of the original Lea Island, and is owned by the North Carolina Division of Parks and Recreation and managed by Audubon North Carolina. The remainder of the original Lea Island is privately owned. The original Hutaff Island is entirely privately owned. This unit supports expansion of nesting from an adjacent unit (LOGG–T–NC–03) that has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, climate change, beach erosion, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–05—Pleasure Island, New Hanover County: This unit consists of 18.6 km (11.5 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Cape Fear River, Upper Midnight Channel Range, Lower Midnight Channel Range, Reaves Point Channel Range, Horseshoe Shoal Channel Range, Snow Marsh Channel Range, and The Basin (bay). The unit extends from Carolina Beach Inlet to 33.91433 N, 77.94408 W (historic location of Corncake Inlet). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, private, and other ownership. The State portion is Fort Fisher State Recreation Area, which is managed by the North Carolina Division of Parks and Recreation. The local municipality portion includes half of Freeman Park Recreation Area, which is managed by the Town of Carolina Beach. The County portion includes the other half of Freeman Park Recreation Area, which is also managed by the Town of Carolina Beach under an interlocal agreement with New Hanover County. This unit supports expansion of nesting from an adjacent unit (LOGG–T– NC–06) that has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, humancaused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–06—Bald Head Island, Brunswick County: This unit consists of 15.1 km (9.4 mi) of island shoreline along the Atlantic Ocean. The island is part of the Smith Island Complex, which is a barrier spit that includes Bald Head, Middle, and Bluff Islands. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Cape Fear River, Battery Island Channel, Lower Swash Channel Range, Buzzard Bay, Smith Island Range, Southport Channel, and salt marsh. The unit extends from 33.91433 N, 77.94408W (historic location of Corncake Inlet) to the mouth of the Cape Fear River. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private and other ownership. The State portion is Bald Head State Natural Area. This unit has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–07—Oak Island, Brunswick County: This unit consists of 20.9 km (13.0 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Cape Fear River, Eastern Channel, and salt marsh. The unit extends from the mouth of the Cape Fear River to Lockwoods Folly Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–NC–08—Holden Beach, Brunswick County: This unit consists of 13.4 km (8.3 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Elizabeth River, Montgomery Slough, Boone Channel, and salt marsh. The unit extends from Lockwoods Folly Inlet to Shallotte Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit supports expansion of nesting from an adjacent unit (LOGG– T–NC–07) that has high-density nesting by loggerhead sea turtles in North Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, humancaused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–SC–01—North Island, Georgetown County: This unit consists of 13.2 km (8.2 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Winyah Bay, Mud Bay, Oyster Bay, and salt marsh. The unit extends from North Inlet to Winyah Bay. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the Tom Yawkey Wildlife Center Heritage Preserve, which is managed by the SCDNR. This unit supports expansion of nesting from an adjacent unit (LOGG–T– SC–02) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, artificial lighting, habitat obstructions, human-caused disasters, and response to disasters. The Tom Yawkey Wildlife Center has a management plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, feral hog removal, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Dozier 2006, pp. 31, 64–65).

LOGG–T–SC–02—Sand Island, Georgetown County: This unit consists of 4.7 km (2.9 mi) of island shoreline along the Atlantic Ocean and Winyah Bay. The island is separated from the mainland by the Atlantic Intracoastal Waterway and salt marsh. The unit extends from Winyah Bay to 33.17534 N, 79.19206 W (northern boundary of an unnamed inlet separating Sand Island and South Island). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the Tom Yawkey Wildlife Center Heritage Preserve, which is managed by the SCDNR. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, inwater and shoreline alterations, beach erosion, climate change, artificial lighting, human-caused disasters, and response to disasters. The Tom Yawkey Wildlife Center has a management plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, feral hog removal, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Dozier 2006, pp. 31, 64–65).

LOGG–T–SC–03—South Island, Georgetown County: This unit consists of 6.7 km (4.2 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, North Santee Bay, and salt marsh. The unit extends from 33.17242 N, 79.19366 W (southern boundary of an unnamed inlet separating Sand Island and South Island) to North Santee Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the Tom Yawkey Wildlife Center Heritage Preserve, which is managed by the SCDNR. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, beach erosion, climate change, artificial lighting, human-caused disasters, and response to disasters. The Tom Yawkey Wildlife Center has a management plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, feral hog removal, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Dozier 2006, pp. 31, 64–65).

LOGG–T–SC–04—Cedar Island, Georgetown County: This unit consists of 4.1 km (2.5 mi) of island shoreline along the Atlantic Ocean and North Santee Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway and salt marsh. The unit extends from North Santee Inlet to South Santee Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the Santee Coastal Reserve Wildlife Management Area, which is managed by the SCDNR. This unit supports expansion of nesting from an adjacent unit (LOGG–T–SC–03) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. The Santee Coastal Reserve Wildlife Management Area has a draft management plan that includes recommendations to reduce sea turtle nest depredation by raccoons (SCDNR 2002, p. 21), but there is currently no other management for protection of loggerhead sea turtle nests.

LOGG–T–SC–05—Murphy Island, Charleston County: This unit consists of 8.0 km (5.0 mi) of island shoreline along the Atlantic Ocean and South Santee Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway and inland marsh. The unit extends from South Santee Inlet to 33.08335 N, 79.34285 W. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the Santee Coastal Reserve Wildlife Management Area, which is managed by the SCDNR. This unit supports expansion of nesting from an adjacent unit (LOGG–T–SC–06) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. The Santee Coastal Reserve Wildlife Management Area has a draft management plan that includes recommendations to reduce sea turtle nest depredation by raccoons (SCDNR 2002, p. 21), but there is currently no other management for protection of loggerhead sea turtle nests.

LOGG–T–SC–06—Cape Island, Charleston County: This unit consists of 8.3 km (5.1 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Cape Romain Harbor, coastal islands, and salt marsh. The unit extends from Cape Romain Inlet to 33.00988 N, 79.36529 W (northern boundary of an unnamed inlet between Cape Island and Lighthouse Island). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is the northernmost island in the Cape Romain National Wildlife Refuge (NWR), which is managed by USFWS. This unit has high-density nesting by loggerhead sea turtles in South Carolina. It is the highest nesting density beach in the Northern Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, in-water and shoreline alterations, beach erosion, climate change, human-caused disasters, and response to disasters. Cape Romain NWR has a Comprehensive Conservation Plan (CCP) that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, minimizing human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2010a, pp. 45–46).

LOGG–T–SC–07—Lighthouse Island, Charleston County: This unit consists of 5.3 km (3.3 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from 33.01306 N, 79.36659 W (southern boundary of an unnamed inlet between Cape Island and Lighthouse Island) to Key Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Cape Romain NWR, which is managed by USFWS. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, in-water and shoreline alterations, beach erosion, climate change, human-caused disasters, and response to disasters.

Cape Romain NWR has a CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, minimizing human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2010a, pp. 45–46).

LOGG–T–SC–08—Raccoon Key, Charleston County: This unit consists of 4.8 km (3.0 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from Raccoon Creek Inlet to Five Fathom Creek Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Cape Romain NWR, which is managed by USFWS. This unit supports expansion of nesting from an adjacent unit (LOGG–T–SC–07) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, in-water and shoreline alterations, beach erosion, climate change, human-caused disasters, and response to disasters. Cape Romain NWR has a CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, minimizing human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2010a, pp. 45–46).

LOGG–T–SC–09—Folly Island, Charleston County: This unit consists of 11.2 km (7.0 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Folly River, a network of coastal islands, and salt marsh. The unit extends from Lighthouse Inlet to Folly River Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, and private and other ownership. The Lighthouse Inlet Heritage Preserve, is owned by the County, with a 10 percent undivided interest from the South Carolina Department of Natural Resource. The Folly Beach County Park is owned by the County. Both are managed by the Charleston County Park and Recreation Commission. This unit supports expansion of nesting from an adjacent unit (LOGG–T–SC–10) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBF in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach sand placement activities, inwater and shoreline alterations, coastal development, beach erosion, climate change, artificial lighting, human-caused disasters, and response to disasters. The City of Folly Beach has a beach management plan that includes measures to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (City of Folly Beach 1991, pp. 32–35). These measures apply to both the private and other lands within this critical habitat unit.

LOGG–T–SC–10—Kiawah Island, Charleston County: This unit consists of 17.0 km (10.6 mi) of island shoreline along the Atlantic Ocean and Stono Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Wadmalaw Island, Johns Island, Kiawah River, and salt marsh. The unit extends from Stono Inlet to Captain Sam's Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The County portion includes Kiawah Beachwalker Park and Isle of Palms County Park, which are managed by the Charleston County Park and Recreation Commission. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, beach erosion, climate change, human-caused disasters, and response to disasters. The Town of Kiawah Island has a Local Comprehensive Beach Management Plan that describes actions, such as nest monitoring, education, pet and vehicular restrictions, and a lighting ordinance, taken by the Town to minimize impacts to nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Town of Kiawah Island 2006, pp. 4–11—4–13). These measures apply to both the private and other lands within this critical habitat unit although the degree of implementation is uncertain.

LOGG–T–SC–11—Seabrook Island, Charleston County: This unit consists of 5.8 km (3.6 mi) of island shoreline along the Atlantic Ocean and North Edisto Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Wadmalaw Island, Johns Island, and salt marsh. The unit extends from Captain Sam's Inlet to North Edisto Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit supports expansion of nesting from adjacent units (LOGG–T–SC–10 and LOGG–T–SC–12) that have high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, coastal development, beach erosion, climate change, artificial lighting, human-caused disasters, and response to disasters. The Town of Seabrook Island has a beach management plan that includes the implementation of sea turtle nesting surveys, nest marking, and actions to minimize human disturbance impacts to nesting and hatchling loggerhead sea turtles (Town Council of Seabrook 1991, p. 15). These measures apply to the private lands within this critical habitat unit although the degree of implementation is uncertain.

LOGG–T–SC–12—Botany Bay Island and Botany Bay Plantation, Charleston County: This unit consists of 6.6 km (4.1 mi) of island shoreline along the Atlantic Ocean and North Edisto Inlet. It includes the shoreline of Botany Bay Island and Botany Bay Plantation, which is located on the north end of Edisto Island. Botany Bay Island and Botany Bay Plantation were originally separated by South Creek Inlet. However, due to beach accretion on the south end of Botany Bay Island, it is now continuous with Botany Bay Plantation. This unit is separated from the mainland by the Atlantic Intracoastal Waterway, Ocella Creek, Townsend River, South Creek Inlet, a network of coastal islands, and salt marsh. The unit extends from North Edisto Inlet to 32.53710 N, 80.24614 W (northern boundary of an unnamed inlet separating Botany Bay Plantation and Interlude Beach). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private and other ownership. The Botany Bay Island portion is privately owned; however, the owner has placed a conservation easement on the property with The Nature Conservancy. The State portion is part of the Botany Bay Plantation Wildlife Management Area Heritage Preserve, which is managed by the SCDNR. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. The Botany Bay Plantation Wildlife Management Area Heritage Preserve has a management plan that includes the implementation of sea turtle nesting surveys, nest marking, actions to minimize human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (SCDNR 2009, p. 12).

LOGG–T–SC–13—Interlude Beach, Charleston County: This unit consists of 0.9 km (0.6 mi) of island shoreline along the Atlantic Ocean. This unit includes a section of Edisto Island, which is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from 32.53636 N, 80.24647 W (southern boundary of an unnamed inlet separating Interlude Beach and Botany Bay Plantation) to Frampton Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the Botany Bay Plantation Wildlife Management Area Heritage Preserve, which is managed by the SCDNR. This unit supports expansion of nesting from adjacent units (LOGG–T–SC–12 and LOGG–T–SC–14) that have high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, beach erosion, climate change, human-caused disasters, and response to disasters. The Botany Bay Plantation Wildlife Management Area Heritage Preserve has a management plan that includes the implementation of sea turtle nesting surveys, nest marking, actions to minimize human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (SCDNR 2009, p. 12).

LOGG–T–SC–14—Edingsville Beach, Charleston County: This unit consists of 2.7 km (1.7 mi) of island shoreline along the Atlantic Ocean. This unit includes a section of Edisto Island, which is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from Frampton Inlet to Jeremy Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, beach erosion, climate change, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–SC–15—Edisto Beach State Park, Colleton County: This unit consists of 2.2 km (1.4 mi) of island shoreline along the Atlantic Ocean. This unit includes a section of Edisto Island, which is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from Jeremy Inlet to 32.50307 N, 80.29625 W (State Park boundary separating Edisto Beach State Park and the Town of Edisto Beach). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is managed by the South Carolina Department of Parks, Recreation, and Tourism as the Edisto Beach State Park. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, artificial lighting, human-caused disasters, and response to disasters. The Edisto Beach State Park has a General Management Plan that includes the implementation of sea turtle nesting surveys, nest marking, and education intended to minimize impacts to nesting and hatchling loggerhead sea turtles (Edisto Beach State Park 2010, pp. 17–18, 21–22).

LOGG–T–SC–16—Edisto Beach, Colleton County: This unit consists of 6.8 km (4.2 mi) of island shoreline along the Atlantic Ocean and South Edisto River. This unit includes a section of Edisto Island, which is separated from the mainland by the Atlantic Intracoastal Waterway, Big Bay Creek, a network of coastal islands, and salt marsh. The unit extends from 32.50307 N, 80.29625 W (State Park boundary separating Edisto Beach State Park and the Town of Edisto Beach) to South Edisto Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. The unit occurs within the town limits of Edisto Beach. Land in this unit is in private and other ownership. This unit supports expansion of nesting from an adjacent unit

(LOGG–T– SC–15) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, beach erosion, climate change, artificial lighting, human-caused disasters, and response to disasters. The Town of Edisto Beach has a Local Comprehensive Beach Management Plan that includes the implementation of sea turtle nesting surveys, nest marking, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Town of Edisto Beach 2011, p. 25). These measures apply to the private lands within this critical habitat unit although the degree of implementation is uncertain.

LOGG–T–SC–17—Pine Island, Colleton County: This unit consists of 1.2 km (0.7 mi) of island shoreline along the South Edisto Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Fish Creek, a network of coastal islands, and salt marsh. The unit extends from South Edisto River to 32.49266 N, 80.36846 W (northern boundary of an unnamed inlet to Fish Creek). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is managed by the SCDNR as part of the AshepooCombahee-Edisto (ACE) Basin National Estuarine Research Reserve (NERR). This unit supports expansion of nesting from an adjacent unit (LOGG–T–SC–18) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–SC–18—Otter Island, Colleton County: This unit consists of 4.1 km (2.5 mi) of island shoreline along the Atlantic Ocean and Saint Helena Sound. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Ashepoo River, a network of coastal islands, and salt marsh. The unit extends from Fish Creek Inlet to Saint Helena Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. It is part of the St. Helena Sound Heritage Preserve and the ACE Basin Estuarine Research Reserve, which are managed by the SCDNR. This unit was occupied at the time of listing and is currently occupied. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–SC–19—Harbor Island, Beaufort County: This unit consists of 2.9 km (1.8 mi) of island shoreline along the Atlantic Ocean and Saint Helena Sound. The island is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from Harbor Inlet to Johnson Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit supports expansion of nesting from an adjacent unit (LOGG– T–SC–18) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, artificial lighting, habitat obstructions, human-caused disasters, and response to disasters. Beaufort County has a Comprehensive Beach Management Plan that includes the implementation of sea turtle nesting surveys, nest marking, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Beaufort County Planning Board 2010, p. 5–19). These measures apply to the private lands within this critical habitat unit.

LOGG–T–SC–20—Little Capers Island, Beaufort County: This unit consists of 4.6 km (2.9 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from ‘‘Pritchards Inlet’’ (there is some uncertainty about the true name of this water feature) located at 32.29009 N, 80.54459 W to Trenchards Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit supports expansion of nesting from an adjacent unit (LOGG– T–SC–21) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, artificial lighting, habitat obstructions, human-caused disasters, and response to disasters. Beaufort County has a Comprehensive Beach Management Plan that includes the implementation of sea turtle nesting surveys, nest marking, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (Beaufort County Planning Board 2010, p. 5–19). These measures apply to the private lands within this critical habitat unit.

LOGG–T–SC–21—St. Phillips Island, Beaufort County: This unit consists of 2.3 km (1.4 mi) of island shoreline along the Atlantic Ocean and Trenchards Inlet. The island is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from Trenchards Inlet to Morse Island Creek Inlet East. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. Although privately owned, the island is protected in perpetuity by a conservation easement with The Nature Conservancy. This unit has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–SC–22—Bay Point Island, Beaufort County: This unit consists of 4.3 km (2.7 mi) of island shoreline along the Atlantic Ocean and Port Royal Sound. The island is separated from the mainland by the Atlantic Intracoastal Waterway, a network of coastal islands, and salt marsh. The unit extends from Morse Island Creek Inlet East along the Atlantic Ocean shoreline to Morse Island Creek Inlet West along the Port Royal Sound shoreline. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. This unit supports expansion of nesting from an adjacent unit (LOGG– T–SC–21) that has high-density nesting by loggerhead sea turtles in South Carolina. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, beach driving, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–GA–01—Little Tybee Island, Chatham County: This unit consists of 8.6 km (5.3 mi) of island shoreline along the Atlantic Ocean. Little Tybee Island is not a specific island, rather it is a complex of several small, low-lying islands, including Myrtle and Williamson Islands, that are separated by tidal flows, creeks, or sloughs. The island complex is separated from the mainland by the Atlantic Intracoastal Waterway, Tybee Creek, Bull River, a network of coastal islands, and salt marsh. The unit extends from Tybee Creek Inlet to Wassaw Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. The island is owned by the GDNR and managed by The Nature Conservancy as the Little Tybee Island Natural Heritage Preserve. This unit supports expansion of nesting from an adjacent unit (LOGG– T–GA–02) that has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, beach erosion, climate change, human-caused disasters, and response to disasters. The GDNR signed a Memorandum of Agreement with the USFWS, NPS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, Little Cumberland Island Homeowners Association, and Little St. Simons Island, Ltd. mandating that land owned by the State adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDRN 1994, pp. 6–9).

LOGG–T–GA–02—Wassaw Island, Chatham County: This unit consists of 10.1 km (6.3 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Romerly Marshes, Odingsell River, and a network of coastal islands. The unit extends from Wassaw Sound to Ossabaw Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal and private ownership. The majority of the island is managed by USFWS as the Wassaw NWR. This unit has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, habitat obstructions, human-caused disasters, and response to disasters. Wassaw NWR is part of the Savannah Coastal Refuges Complex, which has a draft CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2010b, pp. 37, 104). USFWS signed a Memorandum of Agreement with the GDNR, NPS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, Little Cumberland Island Homeowners Association, and Little St. Simons Island, Ltd. mandating that land owned by the Refuge adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–GA–03—Ossabaw Island, Chatham County: This unit consists of 17.1 km (10.6 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Bear River, a network of coastal islands, and extensive salt marshes. Ossabaw Island is divided into four contiguous sections of beach: Bradley (North), North Middle, South Middle, and South beaches. The unit extends from Ogeechee River to St. Catherines Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership (see Table 1). The island is managed by the GDNR. This unit has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach erosion, climate change, human-caused disasters, and response to disasters. A Comprehensive Management Plan for Ossabaw Island includes actions to minimize human disturbance and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 2001, pp. 37, 40, 43). The GDNR signed a Memorandum of Agreement with the USFWS, NPS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, Little Cumberland Island Homeowners Association, and Little St. Simons Island, Ltd. mandating that land owned by the State adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–GA–04—St. Catherines Island, Liberty County: This unit consists of 18.4 km (11.5 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, North Newport River, South Newport River, a network of coastal islands, and extensive salt marshes. The unit extends from St. Catherines Sound to Sapelo Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit supports expansion of nesting from adjacent units (LOGG– T–GA–03 and LOGG–T–GA–05) that have high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, habitat obstructions, beach erosion, climate change, human-caused disasters, and response to disasters. The St. Catherines Island Foundation signed a Memorandum of Agreement with the GDNR, USFWS, NPS, Jekyll Island Authority, City of Tybee Island, Glynn County, Little Cumberland Island Homeowners Association, and Little St. Simons Island, Ltd. mandating that land owned by the Foundation adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–GA–05—Blackbeard Island, McIntosh County: This unit consists of 13.5 km (8.4 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Blackbeard Creek, Mud River, a network of coastal islands, and extensive salt marshes. The unit extends from Sapelo Sound to Cabretta Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. The island is managed by USFWS as the Blackbeard Island NWR. This unit has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, habitat obstructions, beach erosion, climate change, human-caused disasters, and response to disasters. Blackbeard Island NWR is part of the Savannah Coastal Refuges Complex, which has a draft CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2010b, pp. 125, 136). USFWS signed a Memorandum of Agreement with the GDNR, NPS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, Little Cumberland Island Homeowners Association, and Little St. Simons Island, Ltd. mandating that land owned by the Refuge adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–GA–06—Sapelo Island, McIntosh County: This unit consists of 9.3 km (5.8 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Doboy Sound, Mud Creek, Teakettle Creek, a network of coastal islands, and extensive salt marshes. Sapelo Island is divided into two contiguous sections of beach: Nannygoat and Cabretta beaches. The unit extends from Cabretta Inlet to Doboy Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. The island is managed by the GDNR. This unit supports expansion of nesting from an adjacent unit (LOGG– T–GA–05) that has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, poaching, beach driving, predation, beach erosion, climate change, human-caused disasters, and response to disasters. A Comprehensive Management Plan for Sapelo Island includes actions to minimize human disturbance and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1998, pp. 5, 36, 55). The GDNR signed a Memorandum of Agreement with the USFWS, NPS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, Little Cumberland Island Homeowners Association, and Little St. Simons Island, Ltd. mandating that land owned by the State adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–GA–07—Little Cumberland Island, Camden County: This unit consists of 4.9 km (3.0 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Cumberland River, and salt marsh. The unit extends from St. Andrew Sound to Christmas Creek. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. Although Little Cumberland Island is privately owned, it lies within the boundaries of Cumberland Island National Seashore and is recognized as a Special Use Zone where private property owners have entered into an agreement with the NPS. This unit supports expansion of nesting from an adjacent unit (LOGG–T–GA–08) that has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach erosion, climate change, human-caused disasters, and response to disasters. The Little Cumberland Island Homeowners Association signed a Memorandum of Agreement with the GDNR, USFWS, NPS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, and Little St. Simons Island, Ltd. mandating that land owned by the Association adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–GA–08—Cumberland Island, Camden County: This unit consists of 29.7 km (18.4 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Cumberland River, Cumberland Sound, Brickhill River, a network of coastal islands, and extensive salt marsh. The unit extends from Christmas Creek to St. Marys River. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal and private ownership. The Federal portion is part of Cumberland Island National Seashore, which is managed by the NPS. This unit has high-density nesting by loggerhead sea turtles in Georgia. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach erosion, climate change, human-caused disasters, and response to disasters. Cumberland Island National Seashore has a General Management Plan that includes predator removal and dune preservation intended to minimize impacts to nesting and hatchling loggerhead sea turtles (NPS 1984, pp. 22–23). The NPS signed a Memorandum of Agreement with the GDNR, USFWS, St. Catherines Island Foundation, Jekyll Island Authority, City of Tybee Island, Glynn County, and Little St. Simons Island, Ltd. mandating that land owned by the Cumberland Island National Seashore adhere to actions listed in the Management Plan for the Protection of Nesting Loggerhead Sea Turtles and their Habitat in Georgia. This includes working with partners on the implementation of sea turtle nesting surveys, nest marking and protection, education, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (GDNR 1994, pp. 6–9).

LOGG–T–FL–01—South Duval County Beaches—Duval and St. Johns County line: This unit consists of 11.5 km (7.1 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Pablo Creek, and Lake Ponte Vedra. The unit extends from the south boundary of Kathryn Abbey Hanna Park in Duval County to the Duval-St. Johns County line. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit supports expansion of nesting from an adjacent beach (St. Johns County beaches) that has high-density nesting by loggerhead sea turtles in the Northern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach sand placement activities, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters.

LOGG–T–FL–02—Fort Matanzas National Monument, St. Johns County: This unit consists of 1.4 km (0.9 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Matanzas River, which is part of the Atlantic Intracoastal Waterway. The unit extends from the northern boundary of Fort Matanzas National Monument to the southern boundary of Fort Matanzas National Monument. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. The Fort Matanzas National Monument is managed by the NPS. This unit supports expansion of nesting from adjacent units (St. Johns County beaches and LOGG– T–FL–03) that have high-density nesting by loggerhead sea turtles in the Northern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach sand placement activities, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Fort Matanzas National Monument has a General Management Plan that includes exotic organism removal if necessary and possible, which may protect nesting and hatchling loggerhead sea turtles (NPS 1982a, p. 27). This Management Plan is being revised.

LOGG–T–FL–03—River to Sea Preserve at Marineland—North Peninsula State Park, Flagler and Volusia Counties: This unit consists of 31.8 km (19.8 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Matanzas River, which is part of the Atlantic Intracoastal Waterway, and Smith Creek. The unit extends from the north boundary of the River to Sea Preserve at Marineland to the south boundary of North Peninsula State Park. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, private, and other ownership. The State portion is North Peninsula State Park, which is managed by FDEP. The County portion includes the River to Sea Preserve at Marineland and Varn Park, which are managed by the Flagler County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Northern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, beach sand placement activities, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. The North Peninsula State Park Unit Management Plan addresses the species in the State portion of the unit. The Unit Management Plan includes procedures for the implementation of sea turtle nesting surveys, nest marking, removal of nonnative species (feral cats, feral hogs, and nine-banded armadillos) when encountered, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2006a, pp. 15–16).

LOGG–T–FL–04—Canaveral National Seashore North, Volusia County: This unit consists of 18.2 km (11.3 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Mosquito Lagoon, and a network of coastal islands. The unit extends from the north boundary of Canaveral National Seashore to the Volusia-Brevard County line. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Canaveral National Seashore, which is managed by the NPS. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–05) that has high-density nesting by loggerhead sea turtles in the Central Eastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. Canaveral National Seashore has a General Management Plan that includes beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 1982b, p. 52).

LOGG–T–FL–05—Canaveral National Seashore South-Merritt Island NWR– Kennedy Space Center, Brevard County: This unit consists of 28.4 km (17.6 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Mosquito Lagoon, Indian River Lagoon, Merritt Island, and scattered coastal islands. The unit extends from the Volusia-Brevard County line to the south boundary of Merritt Island NWR–Kennedy Space Center (Merritt Island NWR was established in 1963 as an overlay of the National Aeronautics and Space Administration's (NASA) John F. Kennedy Space Center). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. The northern portion is part of the Canaveral National Seashore in Brevard County, which is managed by the NPS. The southern portion is part of Merritt Island

NWR–Kennedy Space Center, which is managed by USFWS. This unit has high-density nesting by loggerhead sea turtles in the Central Eastern Florida Region of the Peninsular Florida Recovery Unit. (Note: Although the mean nesting densities in this unit were not in the top 25 percent of nesting for the Central Eastern Florida Region, the unit was included because of the still high nesting density that occurs here and to ensure a good spatial distribution of nesting within this region.) The PBFs in this unit may require special management considerations or protections to ameliorate the threats of predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Canaveral National Seashore has a General Management Plan that includes beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 1982b, p. 52). Merritt Island NWR has a CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2008a, pp. 82, 93–94).

LOGG–T–FL–06—Central Brevard Beaches, Brevard County: This unit consists of 19.5 km (12.1 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Indian River Lagoon, Banana River, and Merritt Island. The unit extends from the south boundary of Patrick Air Force Base to the north boundary of Archie Carr NWR. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The County portion includes Paradise Beach North, Spessard Holland North Beach Park, Spessard Holland South Beach Park, and Ocean Ridge Sanctuary, which are managed by the Brevard County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Central Eastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, coastal development, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, we are not aware of any management plans that address this species in this area.

LOGG–T–FL–07—South Brevard Beaches, Brevard County: This unit consists of 20.8 km (12.9 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Indian River Lagoon, and scattered coastal islands. The unit extends from the north boundary of Archie Carr NWR to Sebastian Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal, State, private, and other ownership. The Federal portion is part of Archie Carr NWR, which is managed by USFWS. The State portion is part of Sebastian Inlet State Park, which is managed by FDEP. The Brevard County portion includes Sea Oats Park, Coconut Point Park, Ponce Landing and Coconut Point Sanctuary, Twin Shores Park, Hog Point Sanctuary, Apollo Eleven Park, Martine Hammock Sanctuary, Judith Resnick Memorial Park, Barrier Island Ecosystem Center, and Louis Bonsteel III Memorial Park, which are managed by the Brevard County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Central Eastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Archie Carr NWR has a CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, minimizing human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2008b, pp. 74–76).

Sebastian Inlet State Park has a Unit Management Plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, nonnative species removal when encountered (feral cats, feral hogs, and nine-banded armadillos), problem native species removal (raccoons), and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2008a, pp. 39–41).

LOGG–T–FL–08—Sebastian Inlet State Park-Archie Carr NWR South, Indian River County: This unit consists of 4.1 km (2.6 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Indian River Lagoon, Indian River Narrows, a network of coastal islands, and salt marsh. The unit includes Sebastian Inlet State Park and parcels within the Archie Carr NWR. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal and State ownership. The Federal portion is part of Archie Carr NWR, which is managed by USFWS. The State portion is part of Sebastian Inlet State Park, which is managed by the FDEP. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–07) that has high-density nesting by loggerhead sea turtles in the Central Eastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. The Archie Carr NWR has a CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, minimizing human disturbance, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2008b, pp. 74–76). The Sebastian Inlet State Park has a Unit Management Plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, removal of nonnative species (feral cats, feral hogs, and nine-banded armadillos) when encountered and problem native species (raccoons), and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2008a, pp. 39–41).

LOGG–T–FL–09—Fort Pierce Inlet-St. Lucie Inlet, St. Lucie and Martin Counties: This unit consists of 35.2 km (21.9 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway and the Indian River Lagoon. The unit extends from Fort Pierce Inlet to St. Lucie Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The St. Lucie County portion includes Blind Creek Natural Area and John Brooks Park, which are managed by the St. Lucie County Environmental Resources Department. The St. Lucie County portion also includes Fredrick Douglas Memorial Park, Ocean Bay, Blind Creek Beach, and Dollman Tract, which are managed by the St. Lucie Parks, Recreation, and Facility Department. The Martin County portion includes Glasscock Beach Park, Sea Turtle Park, Jensen Beach Park, Muscara, Bob Graham Beach Park, Curtis Beach Park, Beachwalk Pasley, Bryn Mawr Beach, Virginia Forrest Beach Park, Tiger Shores Beach, Stuart Beach Park and Addition, Santa Lucea, Olsen Property, Clifton S. Perry Beach, House of Refuge Park, Chastain Beach Park, and Bathtub Beach Park, which are managed by the Martin County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Southeastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. John Brooks Park has a management plan that includes protection of nests and nonnative species removal to minimize impacts to nesting and hatchling loggerhead sea turtles (St. Lucie County Environmental Resources Department 2008, p. 29). Blind Creek Natural Area has a draft management plan that includes nonnative plant (Casuarina equisetifolia (Australian pine)) removal to minimize impacts to nesting and hatchling loggerhead sea turtles (St. Lucie County Environmental Resources Department 2011, p. 26).

LOGG–T–FL–10—St. Lucie Inlet-Jupiter Inlet, Martin and Palm Beach Counties: This unit consists of 24.9 km (15.5 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Great Pocket, Peck Lake, Hobe Sound, South Jupiter Narrows, Jupiter Sound, and a network of coastal islands. The unit extends from St. Lucie Inlet to Jupiter Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal, State, private, and other ownership. The Federal portion is Hobe Sound NWR, which is managed by USFWS. The State portion is St. Lucie Inlet Preserve State Park, which is managed by FDEP. The County portion is Coral Cove Park, which is managed by the Palm Beach County Parks and Recreation Department. A portion of the private lands includes Blowing Rocks Preserve, which is owned and managed by The Nature Conservancy. This unit has high-density nesting by loggerhead sea turtles in the Southeastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Hobe Sound NWR has a CCP that includes working with partners on the implementation of sea turtle nesting surveys, nest marking, education, nonnative species removal, and minimizing human disturbance intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2006, pp. 81–86). St. Lucie Inlet Preserve State Park has a Unit Management Plan that includes maintaining a long-term data set of sea turtle nests, removal of nonnative species (feral cats) when encountered and problem native species (raccoons), and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2002a, pp. 20–21).

LOGG–T–FL–11—Jupiter Inlet–Lake Worth Inlet, Palm Beach County: This unit consists of 18.8 km (11.7 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Lake Worth Creek, Lake Worth, Munyon Island, Little Munyon Island, Singer Island, and Peanut Island. The unit extends from Jupiter Inlet to Lake Worth Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, private, and other ownership. The State portion is John D. MacArthur Beach State Park, which is managed by FDEP. The County portion includes Jupiter Beach Park, Carlin Park, Radnor, Juno Dunes Natural Area, and Loggerhead Park, which are managed by the Palm Beach County Parks and Recreation Department. This unit was occupied at the time of listing and is currently occupied. This unit has high-density nesting by loggerhead sea turtles in the Southeastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach placement activities, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. John D. MacArthur Beach State Park has a Unit Management Plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, artificial lighting management, problem species removal, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2005a, pp. 20–21).

LOGG–T–FL–12—Lake Worth Inlet– Boynton Inlet, Palm Beach County: This unit consists of 24.3 km (15.1 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Lake Worth, and scattered coastal islands. The unit extends from Lake Worth Inlet to Boynton Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit has high-density nesting by loggerhead sea turtles in the Southeastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–13—Boynton Inlet–Boca Raton Inlet, Palm Beach County: This unit consists of 22.6 km (14.1 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway, Lake Rogers, Lake Wyman, and Lake Boca Raton. The unit extends from Boynton Inlet to Boca Raton Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The County portion is Ocean Ridge Hammock Park, which is managed by the Palm Beach County Parks and Recreation Department. The municipality portion includes Spanish River Park, Red Reef Park, and South Beach Park, which are managed by the City of Boca Raton. This unit supports expansion of nesting from adjacent units (LOGG–T–FL–12 and LOGG–T–FL–14) that have high-density nesting by loggerhead sea turtles in the Southeastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–14—Boca Raton Inlet– Hillsboro Inlet, Palm Beach and Broward Counties: This unit consists of 8.3 km (5.2 mi) of island shoreline along the Atlantic Ocean. The island is separated from the mainland by the Atlantic Intracoastal Waterway and the Hillsboro River. The unit extends from Boca Raton Inlet to Hillsboro Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The County portion is South Inlet Park, which is managed by the Palm Beach County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Southeastern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, we are not aware of any management plans that address this species in this area.

LOGG–T–FL–15—Long Key, Monroe County: This unit consists of 4.2 km (2.6 mi) of island shoreline along the Atlantic Ocean. The island is bordered on the east by the Atlantic Ocean, on the west by Florida Bay, and on the north and south by natural channels between Keys (Fiesta Key to the north and Conch Key to the south). This unit extends from the natural channel between Fiesta Key and Long Key to the natural channel between Long Key and Conch Key. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. The island is managed by FDEP as Long Key State Park. This unit was included to ensure conservation of the unique nesting habitat in the Florida Keys. Nesting beaches in the Florida Keys are unique from the other beaches in the Peninsular Florida Recovery Unit in that they are limestone islands with narrow, low-energy beaches (beaches where waves are not powerful); they have carbonate sands; and they are relatively close to the major offshore currents that facilitate the dispersal of post-hatchling loggerheads. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, sand beach placement activities, climate change, beach erosion, human-caused disasters, and response to disasters. Long Key State Park has a Unit Management Plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, problem species removal, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2004, pp. 18–19).

LOGG–T–FL–16—Bahia Honda Key, Monroe County: This unit consists of 3.7 km (2.3 mi) of island shoreline along the Atlantic Ocean. The island is bordered on the east by the Atlantic Ocean, on the west by Florida Bay, and on the north and south by natural channels between Keys (Ohio Key to the north and Spanish Harbor Key to the south). This unit extends from the natural channel between Ohio Key and Bahia Honda Key to the natural channel between Bahia Honda Key and Spanish Harbor Key. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. The island is managed by FDEP as Bahia Honda State Park. This unit was included to ensure conservation of the unique nesting habitat in this Florida Keys. Nesting beaches in the Florida Keys are unique from the other beaches in the Peninsular Florida Recovery Unit in that they are limestone islands with narrow, low-energy beaches; they have carbonate sands; and they are relatively close to the major offshore currents that are known to facilitate the dispersal of post-hatchling loggerheads. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. Bahia Honda State Park has a Unit Management Plan that includes procedures for the implementation of sea turtle nesting surveys and nest marking intended to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2003a, pp. 18–20).

LOGG–T–FL–17—Longboat Key, Manatee and Sarasota Counties: This unit consists of 16.0 km (9.9 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by Sarasota Pass. The unit extends from Longboat Pass to New Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit supports expansion of nesting from an adjacent unit (LOGG– T–FL–18) that has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–18—Siesta and Casey Keys, Sarasota County: This unit consists of 20.8 km (13.0 mi) of island shoreline along the Gulf of Mexico. It includes the shoreline of Siesta Key and Casey Key, which were originally two separate islands divided by Midnight Pass. When Midnight Pass was closed in 1983, the two islands were combined into a single island. The island is separated from the mainland by the Intracoastal Waterway, Roberts Bay, Little Sarasota Bay, Dryman Bay, Blackburn Bay, and scattered coastal islands. The unit extends from Big Sarasota Pass to Venice Inlet. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The County portion includes Turtle Beach County Park and Palmer Point County Park, which are managed by the Sarasota County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–19—Venice Beaches and Manasota Key, Sarasota and Charlotte Counties: This unit consists of 26.0 km (16.1 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Intracoastal Waterway, Roberts Bay, Red Lake, Lemon Bay, and scattered coastal islands. The unit extends from Venice Inlet to Stump Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, private, and other ownership. The State portion is Stump Pass Beach State Park, which is managed by FDEP. The Sarasota County portion includes Service Club Park, Brohard Beach, Paw Beach, Caspersen Beach County Park, and Blind Pass Park, which are managed by the Sarasota County Parks and Recreation Department. This unit has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Stump Pass Beach State Park has a Unit Management Plan that includes procedures for the implementation of sea turtle nesting surveys, nest marking, education, problem species (raccoons) removal, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2003b, pp. 4–5).

LOGG–T–FL–20—Knight, Don Pedro, and Little Gasparilla Islands, Charlotte County: This unit consists of 10.8 km (6.7 mi) of island shoreline along the Gulf of Mexico. It includes the shoreline of Knight Island, Don Pedro Island, and Little Gasparilla Island, which were originally three separate islands divided by passes. When the passes closed during the 1960s, the three islands were combined into a single island. The island is separated from the mainland by the Intracoastal Waterway, Lemon Bay, Placida Harbor, and scattered keys and islands. The unit extends from Stump Pass to Gasparilla Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is Don Pedro Island State Park, which is managed by FDEP. This unit has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Don Pedro Island State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, education, problem species removal, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2001a, pp. 16–20).

LOGG–T–FL–21—Gasparilla Island, Charlotte and Lee Counties: This unit consists of 11.2 km (6.9 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Intracoastal Waterway, Gasparilla Sound, Charlotte Harbor, Turtle Bay, Bull Bay, and a network of keys. The unit extends from Gasparilla Pass to Boca Grande Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is Gasparilla Island State Park, which is managed by FDEP. This unit has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Gasparilla Island State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, terrestrial predator control, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2002b, p. 4).

LOGG–T–FL–22—Cayo Costa, Lee County: This unit consists of 13.5 km (8.4 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Intracoastal Waterway, Pine Island Sound, Matlacha Pass, Pelican Bay, Primo Bay, Pine Island, Little Pine Island, and numerous smaller keys and islands. The unit extends from Boca Grande Pass to Captiva Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is Cayo Costa State Park, which is managed by FDEP. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–21) that has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, climate change, beach erosion, human-caused disasters, and response to disasters. Cayo Costa State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, terrestrial predator control, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2005b, pp. 14, 30).

LOGG–T–FL–23—Captiva Island, Lee County: This unit consists of 7.6 km (4.7 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Intracoastal Waterway, Pine Island Sound, Matlacha Pass, San Carlos Bay, Pine Island, and scattered keys and islands. The unit extends from Redfish Pass to Blind Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–24) that has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–24—Sanibel Island West, Lee County: This unit consists of 12.2 km (7.6 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Intracoastal Waterway, San Carlos Bay, Pine Island Sound, Matlacha Pass, Pine Island, and numerous keys and islands. The unit extends from Blind Pass to Tarpon Bay Road. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The municipality portion includes Silver Key and Bowman's Beach Regional Park, which are managed by the City of Sanibel Natural Resources Department. This unit has high-density nesting by loggerhead sea turtles in the Central Western Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–25—Little Hickory Island, Lee and Collier Counties: This unit consists of 8.7 km (5.4 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by Estero Bay, Hogue Channel, Fish Trap Bay, Little Hickory Bay, Big Hickory Island, and extensive mangroves and mangrove islands. The unit extends from Big Hickory Pass to Wiggins Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private and other ownership. The Collier County portion is Barefoot Beach County Preserve Park, which is managed by the Collier County Parks and Recreation Department. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–24) that has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, habitat obstructions, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–26—Wiggins Pass—Clam Pass, Collier County: This unit consists of 7.7 km (4.8 mi) of mainland shoreline along the Gulf of Mexico. This section of the mainland is bounded on the west by Vanderbilt Channel, Vanderbilt Lagoon, Inner Clam Bay, and extensive mangrove vegetative shorelines. The unit extends from Wiggins Pass to Clam Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, private, and other ownership. The State portion is Delnor–Wiggins Pass State Park, which is managed by FDEP. The County portion is Vanderbilt Beach County Park, which is managed by the Collier County Parks and Recreation Department. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–28) that has highdensity nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Delnor–Wiggins Pass State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, terrestrial predator control, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2009, pp. 16–23).

LOGG–T–FL–27—Clam Pass—Doctors Pass, Collier County: This unit consists of 4.9 km (3.0 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by Moorings Bay, Outer Doctors Bay, Inner Doctors Bay, Venetian Bay, and Outer Clam Bay. The unit extends from Clam Pass to Doctors Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–28) that has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–28–Keewaydin Island and Sea Oat Island, Collier County: This unit consists of 13.1 km (8.1 mi) of island shoreline along the Gulf of Mexico. These islands are separated from the mainland by Dollar Bay, Bartell Bay, Periwinkle Bay, Rookery Bay, Hall Bay, Nature Conservancy Bay, Johnson Bay, Shell Bay, Sand Hill Bay, Hall Bay, Little Marco Pass, and a network of mangroves, coastal islands, and salt marsh. The unit extends from Gordon Pass to Big Marco Pass. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State and part of the private ownership (National Audubon Society) portions are part of the Rookery Bay National Estuarine Research Reserve (NERR), which is managed by FDEP's Office of Coastal and Aquatic Managed Areas. This unit has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Rookery Bay NERR has a management plan that includes working with partners for the implementation of nesting surveys, nest marking, terrestrial predator control, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2012a, pp. 62–77, 223, 269).

LOGG–T–FL–29—Cape Romano, Collier County: This unit consists of 9.2 km (5.7 mi) of island shoreline along the Gulf of Mexico and Gullivan Bay. Cape Romano is a coastal island complex within the Rookery Bay National Estuarine Research Reserve (NERR) and is located off the southwest coast of Florida in Collier County. Loggerhead sea turtle nesting has been regularly monitored and documented within this island complex. This island complex is separated from the mainland by Caxambas Bay, Grassy Bay, Barfield Bay, Goodland Bay, Gullivan Bay, and a network of other keys and islands. From north to south, the islands and keys included in this unit are: Kice Island, Big Morgan Island, Morgan Keys, Carr Island, and Cape Romano Island. Kice Island is in State ownership and is part of Rookery Bay NERR. It has 3.9 km (2.4 mi) of shoreline. Big Morgan Island is in State ownership (as part of Rookery Bay NERR) and other ownership. It has 1.4 km (0.9 mi) of shoreline. Morgan Key is in State ownership (as part of Rookery Bay NERR) and other ownership. It has 0.7 km (0.4 mi) of shoreline. Carr Island is in State ownership and is part of Rookery Bay NERR. It has 0.3 km (0.2 mi) of shoreline. Cape Romano is in State ownership (as part of Rookery Bay NERR) and other ownership. It has 2.9 km (1.8 mi) of shoreline. The unit extends from Caxambas Pass to Gullivan Bay. This unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and other ownership. The State portion is part of the Rookery Bay NERR, which is owned by the State of Florida and managed by FDEP's Office of Coastal and Aquatic Managed Areas. This unit has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. Rookery Bay NERR has a management plan that includes working with partners such as the Conservancy of Southwest Florida for the implementation of nesting surveys, nest marking, terrestrial predator control, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2012a, pp. 62–77, 223, 269).

LOGG–T–FL–30—Ten Thousand Islands North, Collier County: This unit consists of 7.8 km (4.9 mi) of island shoreline along the Gulf of Mexico. The Ten Thousand Islands are a chain of islands and mangrove islets off the southwest coast of Florida in Collier and Monroe Counties. This unit includes nine keys where loggerhead sea turtle nesting has been documented within the northern part of the Ten Thousand Islands in Collier County in both the Ten Thousand Islands NWR and the Rookery Bay National Estuarine Research Reserve (NERR). These keys are separated from the mainland by Sugar Bay, Palm Bay, Blackwater Bay, Buttonwood Bay, Pumpkin Bay, Santina Bay, and a network of keys and islands. From west to east and north to south, these nine keys are: Coon Key, Brush Island, B Key, Turtle Key, Gullivan Key, White Horse Key, Hog Key, Panther Key, and Round Key. Coon Key is part of Ten Thousand Islands NWR and has 0.4 km (0.2 mi) of shoreline. Brush Island is in State ownership and is part of Rookery Bay NERR. It has 0.6 km (0.4 mi) of shoreline. B Key (25.89055 N, 81.59641 W) is in Federal and State ownership and is part of both Ten Thousand Islands NWR and Rookery Bay NERR. It has 0.5 km (0.3 mi) of shoreline. Turtle Key is in State ownership and is part of Rookery Bay NERR. It has 0.5 km (0.3 mi) of shoreline. Gullivan Key is in State ownership and is part of Rookery Bay NERR. It has 1.1 km (0.7 mi) of shoreline. White Horse Key is in State ownership and is part of Rookery Bay NERR. It has 1.6 km (1.0 mi) of shoreline. Hog Key is in Federal and State ownership and is part of both Ten Thousand Islands NWR and Rookery Bay NERR. It has 0.9 km (0.6 mi) of shoreline. Panther Key is in Federal ownership and is part of Ten Thousand Islands NWR. It has 2.0 km (1.3 mi) of shoreline. Round Key is in Federal ownership and is part Ten Thousand Islands NWR. It has 0.3 km (0.2 mi) of shoreline. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal and State ownership. The Ten Thousand Islands NWR portion is managed by USFWS. The Rookery Bay NERR portion is managed by FDEP's Office of Coastal and Aquatic Managed Areas. This unit supports expansion of nesting from an adjacent unit (LOGG–T– FL–29) that has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. Rookery Bay NERR has a management plan that includes working with partners for the implementation of nesting surveys, nest marking, terrestrial predator control, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2012a, pp. 62–77, 223, 269). Thousand Islands NWR has a CCP that includes implementation of nesting surveys, nest marking, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2001, pp. 12, 20–22).

LOGG–T–FL–31—Highland Beach, Monroe County: This unit consists of 7.2 km (4.5 mi) of island (Key McLaughlin) shoreline along the Gulf of Mexico. The island is separated from the mainland by Rogers River Bay, Big Bay, Big Lostmans Bay, extensive salt marsh, and a network of keys and islands. The unit extends from First Bay to Rogers River Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Everglades National Park, which is managed by the NPS. This unit supports expansion of nesting from an adjacent unit (LOGG–T– FL–32) that has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, climate change, beach erosion, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–32—Graveyard Creek-Shark Point, Monroe County: This unit consists of 0.9 km (0.6 mi) of mainland shoreline along the Gulf of Mexico. The unit extends from Shark Point (25.38796 N, 81.14933 W) to Graveyard Creek Inlet. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Everglades National Park, which is managed by the NPS. This unit has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–33—Cape Sable, Monroe County: This unit consists of 21.3 km (13.2 mi) of mainland shoreline along the Gulf of Mexico. The unit extends from the north boundary of Cape Sable at 25.25924 N, 81.16687 W to the south boundary of Cape Sable at 25.12470 N, 81.06681 W. Land in this unit is in Federal ownership. It is part of the Everglades National Park, which is managed by the NPS. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. This unit has high-density nesting by loggerhead sea turtles in the Southwestern Florida Region of the Peninsular Florida Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–34—Dry Tortugas, Monroe County: This unit consists of 5.7 km (3.6 mi) of shoreline along the Gulf of Mexico. The Dry Tortugas are a small group of seven islands located at the end of the Florida Keys about 108 km (67 mi) west of Key West. This unit includes six islands where loggerhead sea turtle nesting has been documented within the Dry Tortugas. From west to east, these six islands are: Loggerhead Key, Garden Key, Bush Key, Long Key, Hospital Key, and East Key. Loggerhead Key is the largest island in the chain and has 2.4 km (1.5 mi) of beach. Garden Key, the second largest island in the chain, is 4.0 km (2.5 mi) east of Loggerhead Key and has 0.2 km (0.1 mi) of beach. Bush Key is located 0.1 km (0.1 mi) east of Garden Key and has 2.0 km (1.3 mi) of beach; Bush Key is occasionally connected to Garden Key by a sand bar. Long Key is located 0.1 km (0.1 mi) south of the eastern end of Bush Key and has 0.3 km (0.2 mi) of beach; Long Key is occasionally connected to Bush Key by a sand bar. Hospital Key is located 2.5 km (1.6 mi) northeast of Garden Key and Bush Key and has 0.2 km (0.1 mi) of beach. East Key is located 0.6

km (0.3 mi) east of Middle Key (Middle Key is not included in the unit) and has 0.6 km (0.3 mi) of beach. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures (such as a sea plane landing area, fort walls). Land in this unit is in Federal ownership. It is part of the Dry Tortugas National Park, which is managed by the NPS. This unit was included because of the extremely small size of the Dry Tortugas Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, habitat obstructions, human-caused disasters, and response to disasters. Dry Tortugas National Park has a General Management Plan that includes special protection zones intended to manage the beach to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 2000, p. 38).

LOGG–T–FL–35—Marquesas Keys, Monroe County: This unit consists of 5.6 km (3.5 mi) of shoreline along the Gulf of Mexico. The Marquesas Keys are a small group of eight islands located at the end of the Florida Keys about 29.3 km (18.2 mi) west of Key West. This unit includes four islands where loggerhead sea turtle nesting has been documented within the Marquesas Keys: Marquesas Key, Unnamed Key 1, Unnamed Key 2, and Unnamed Key 3. Marquesas Key is the largest key in the northeastern region of the island group and has 3.8 km (2.4 mi) of shoreline. Unnamed Keys 1, 2, and 3 are at the far westernmost side of the island group. Unnamed Key 1 is the northernmost key of the three and has 0.4 km (0.2 mi) of shoreline. Unnamed Key 2 is just south of Unnamed Key 1 and has 1.0 km (0.6 mi) of shoreline. Unnamed Key 3 is southwest of Unnamed Key 2 and has 0.5 km (0.3 mi) of shoreline. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. The Marquesas Keys are part of the Key West NWR, which is managed by USFWS. This unit was included because of the extremely small size of the Dry Tortugas Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, climate change, beach erosion, human-caused disasters, and response to disasters. Key West NWR is included within the Lower Florida Keys National Wildlife Refuges Comprehensive Conservation Plan, which includes implementation of nesting surveys, nest marking, debris removal, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2009, pp. 67–68).

LOGG–T–FL–36—Boca Grande Key, Monroe County: This unit consists of 1.3 km (0.8 mi) of island shoreline along the Gulf of Mexico. Boca Grande Key is one of the outlying islands of the Florida Keys and is located about 18.9 km (11.7 mi) west of Key West. The unit extends from 24.53767 N, 82.00763 W (at the northern end of the key) to 24.52757 N, 82.00581 W (at the southern end of the key). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Key West NWR, which is managed by USFWS. This unit was included because of the extremely small size of the Dry Tortugas Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, climate change, beach erosion, human-caused disasters, and response to disasters. Key West NWR is included within the Lower Florida Keys National Wildlife Refuges Comprehensive Conservation Plan, which includes implementation of nesting surveys, nest marking, debris removal, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2009, pp. 67–68).

LOGG–T–FL–37—Woman Key, Monroe County: This unit consists of 1.3 km (0.8 mi) of island shoreline along the Gulf of Mexico. Woman Key is one of the outlying islands of the Florida Keys and is located about 15.9 km (9.9 mi) west of Key West. The unit extends from 24.52452 N, 81.97893 W (at the western end of the key) to 24.52385 N, 81.96680 W (at the eastern end of the key). The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. It is part of the Key West NWR, which is managed by USFWS. This unit was included because of the extremely small size of the Dry Tortugas Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, climate change, beach erosion, human-caused disasters, and response to disasters. Key West NWR is included within the Lower Florida Keys National Wildlife Refuges Comprehensive Conservation Plan, which includes implementation of nesting surveys, nest marking, debris removal, and predator removal intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2009, pp. 67–68).

LOGG–T–MS–01—Horn Island, Jackson County: This unit consists of 18.6 km (11.5 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Gulf Intracoastal Waterway, Mississippi Sound, Pascagoula Bay, and scattered coastal islands. The unit extends from Dog Keys Pass to the easternmost point of the ocean facing island shore. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal and private ownership. The Federal portion is part of the Gulf Islands National Seashore, Mississippi District, which is managed by the NPS. Nesting was confirmed by weekly aerial surveys prior to 2006. Although regular surveys have not been conducted since 2005, loggerhead nesting was documented in 2010 and 2011 during the Deepwater Horizon event response efforts. This unit was included because Horn Island has been documented as one of two islands in Mississippi with the greatest number of nests. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. The existing Gulf Islands National Seashore General Management Plan includes controlling nonnative species to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 1978, p. 46). The management plan is being revised and a draft is under review. The draft Gulf Islands National Seashore General Management Plan includes management efforts that would emphasize sea turtle nest monitoring and closure areas around nests intended to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 2011, p. 85).

LOGG–T–MS–02—Petit Bois Island, Jackson County: This unit consists of 9.8 km (6.1 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Gulf Intracoastal Waterway, Mississippi Sound, Point Aux Chenes Bay, scattered coastal islands, and salt marsh. The unit extends from Horn Island Pass to Petit Bois Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. Petit Bois Island is part of the Gulf Islands National Seashore, Mississippi District, which is managed by the NPS. Nesting was confirmed by weekly aerial surveys prior to 2006. Although regular surveys have not been conducted since 2005, loggerhead nesting was documented in 2010 and 2011 during Deepwater Horizon event response efforts. This unit was included because Petit Bois Island has been documented as one of two islands in Mississippi with the greatest number of nests. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, human-caused disasters, and response to disasters. The existing Gulf Islands National Seashore General Management Plan includes controlling nonnative species to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 1978, p. 46). The management plan is being revised, and a draft is under review. The draft Gulf Islands National Seashore General Management Plan includes management efforts that would emphasize sea turtle nest monitoring and closure areas around nests intended to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 2011, p. 85).

LOGG–T–AL–01—Mobile Bay-Little Lagoon Pass, Baldwin County: This unit consists of 28.0 km (17.4 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Gulf Intracoastal Waterway, Bon Secour Bay, and Little Lagoon. The unit extends from Mobile Bay Inlet to Little Lagoon Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal, State, and private ownership. The Federal portion includes part of the Bon Secour NWR and four Bureau of Land Management (BLM) parcels. Bon Secour NWR assists in managing one of the BLM parcels; BLM manages their remaining three parcels. The State portion includes Fort Morgan State Park, which is managed by USFWS. This unit has high-density nesting by loggerhead sea turtles in Alabama. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. Bon Secour NWR has a CCP that includes working with partners for the implementation of nesting surveys, nest marking, education, minimizing human disturbance, predator removal, and other conservation efforts intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2005, pp. 54–55).

LOGG–T–AL–02—Gulf State ParkPerdido Pass, Baldwin County: This unit consists of 10.7 km (6.7 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Gulf Intracoastal Coastal Waterway, Shelby Lakes, Little Lake, Portage Creek, Wolf Bay, Bay La Launch, Cotton Bayou, and Terry Cove. The unit extends from the west boundary of Gulf State Park to Perdido Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is part of Gulf State Park, which is managed by the Alabama State Parks. This unit has high-density nesting by loggerhead sea turtles in Alabama. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, coastal development, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

LOGG–T–AL–03—Perdido PassFlorida-Alabama line, Baldwin County: This unit consists of 3.3 km (2.0 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Gulf Intracoastal Waterway, Old River, Bayou St. John, Terry Cover, Amica Bay, and coastal islands. The unit extends from Perdido Pass to the Alabama–Florida border. This area is referred to as Alabama/ Florida Point. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is part of Gulf State Park, which is managed by the Alabama State Parks. This unit supports expansion of nesting from an adjacent unit (LOGG–T–AL–02) that has high-density nesting by loggerhead sea turtles in Alabama. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time,the Service is not aware of any management plans that address this species in this area.

LOGG–T–FL–38—Perdido Key, Escambia County: This unit consists of 20.2 km (12.6 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Gulf Intracoastal Waterway, Old River, Perdido Bay, Big Lagoon, and coastal islands. The unit extends from the Alabama-Florida border to Pensacola Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal, State, and private ownership. The Federal portion is part of Gulf Islands National Seashore, Florida District, which is managed by the NPS. The State portion is Perdido Key State Park, which is managed by FDEP. This unit supports expansion of nesting from an adjacent unit (LOGG–T–AL–02) that has highdensity nesting by loggerhead sea turtles in the Alabama portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, beach sand placement activities, in-water and shoreline alterations, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. The existing Gulf Islands National Seashore General Management Plan includes controlling nonnative species to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 1978, p. 46). The management plan is being revised, and a draft is under review. The draft Gulf Islands National Seashore General Management Plan includes management efforts that would emphasize sea turtle nest monitoring and closure areas around nests intended to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (NPS 2011, p. 77). Perdido Key State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, terrestrial predator control, debris removal, artificial light reduction in adjacent developed areas, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2006b, p. 5).

LOGG–T–FL–39—Mexico Beach and St. Joe Beach, Bay and Gulf Counties: This unit consists of 18.7 km (11.7 mi) of mainland shoreline along the Gulf of Mexico. The unit extends from the eastern boundary of Tyndall Air Force Base to Gulf County Canal in St. Joseph Bay. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private ownership. This unit supports expansion of nesting from an adjacent unit (LOGG– T–FL–40) that has high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, in-water and shoreline alterations, beach sand placement activities, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this unit.

LOGG–T–FL–40—St. Joseph Peninsula, Gulf County: This unit consists of 23.5 km (14.6 mi) of a spit shoreline along the Gulf of Mexico. The spit is separated from the mainland by St. Joseph Bay. The unit extends from St. Joseph Bay to the west boundary of Eglin Air Force Base. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion includes T.H. Stone Memorial St. Joseph Peninsula State Park and part of the St. Joseph Bay Aquatic Preserve, which are managed by FDEP. This unit has high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach sand placement activities, beach driving, predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. T.H. Stone Memorial St. Joseph Peninsula State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, terrestrial predator control, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2001b, pp. 4–5, 18). The St. Joseph Bay Aquatic Preserve Management Plan includes working with partners on the implementation of nesting surveys, nest marking, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2008b, pp. 50–51, 77). Gulf County has a draft HCP that could include sea turtle nest monitoring, nest protection from vehicles on the beach, public education, artificial light management, land acquisition, beach horseback riding ordinance enforcement, and predator control. These measures apply to the private lands within this critical habitat unit and are intended to minimize and mitigate impacts to nesting and hatchling loggerhead sea turtles as a result of the County-authorized beach driving (Gulf County Board of County Commissioners 2004, pp. 5–6–5–10).

LOGG–T–FL–41—Cape San Blas, Gulf County: This unit consists of 11.0 km (6.8 mi) of mainland and spit shoreline along the Gulf of Mexico. The unit extends from the east boundary of Eglin Air Force Base to Indian Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State, private, and other ownership. The State portion is part of St. Joseph Bay State Buffer Preserve, which is managed by FDEP. The County portion is Salinas Park, which is managed by Gulf County. This unit supports expansion of nesting from adjacent units (LOGG–T–FL–40 and LOGG–T–FL–42) that have high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, coastal development, climate change, beach erosion, artificial lighting, habitat obstructions, human-caused disasters, and response to disasters. The draft St. Joseph Bay State Buffer Preserve Management Plan includes predator control (FDEP 2012b, p. 33).

LOGG–T–FL–42—St. Vincent Island, Franklin County: This unit consists of 15.1 km (9.4 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by St. Vincent Sound. The unit extends from Indian Pass to West Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in Federal ownership. This unit is managed by USFWS as the St. Vincent NWR. This unit has high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. St. Vincent NWR has a draft CCP that includes the implementation of nesting surveys, nest marking, education, minimizing human disturbance, predator removal, and other conservation efforts intended to minimize impacts to nesting and hatchling loggerhead sea turtles (USFWS 2012, pp. 64–65).

LOGG–T–FL–43—Little St. George Island, Franklin County: This unit consists of 15.4 km (9.6 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by Apalachicola Bay and St. Vincent Sound. The unit extends from West Pass to Bob Sikes Cut. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State ownership. This unit is managed by FDEP as the Apalachicola NERR.

This unit has high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. The existing Apalachicola NERR Management Plan includes working with partners on the implementation of nesting surveys and controlling nonnative species to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 1998, pp. 78, 126, 161). The management plan is being revised, and a draft is under review. The draft management plan includes working with partners on the implementation of nesting surveys, nest marking, predator removal, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2011, pp. 48–49, 73–76).

LOGG–T–FL–44—St. George Island, Franklin County: This unit consists of 30.7 km (19.1 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by the Intracoastal Waterway, Apalachicola Bay, and East Bay. The unit extends from Bob Sikes Cut to East Pass. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in State and private ownership. The State portion is Dr. Julian G. Bruce St. George Island State Park, which is managed by FDEP. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–43) that has high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. The Dr. Julian G. Bruce St. George Island State Park has a Unit Management Plan that includes procedures for the implementation of nesting surveys, nest marking, terrestrial predator control, debris removal, artificial light reduction in adjacent developed areas, education, and beach management to protect nesting and hatchling loggerhead sea turtles from anthropogenic disturbances (FDEP 2003c, pp. 16–18).

LOGG–T–FL–45—Dog Island, Franklin County: This unit consists of 13.1 km (8.1 mi) of island shoreline along the Gulf of Mexico. The island is separated from the mainland by St. George Sound. The unit extends from East Pass to St. George Sound. The unit includes lands from the MHW line to the toe of the secondary dune or developed structures. Land in this unit is in private conservation ownership (The Nature Conservancy). The unit includes the Jeff Lewis Wilderness Preserve, which is owned and managed by The Nature Conservancy. This unit supports expansion of nesting from an adjacent unit (LOGG–T–FL–43) that has high-density nesting by loggerhead sea turtles in the Florida portion of the Northern Gulf of Mexico Recovery Unit. The PBFs in this unit may require special management considerations or protections to ameliorate the threats of recreational use, beach driving, predation, climate change, beach erosion, artificial lighting, human-caused disasters, and response to disasters. At this time, the Service is not aware of any management plans that address this species in this area.

NMFS has designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles. On July 10, 2014, NMFS and the U.S. Fish and Wildlife Service designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi (79 FR 39856). These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors. The critical habitat is categorized into thirtyeight occupied marine areas and 685 miles of nesting beaches. The physical or biological features and primary constituent elements identified for the different habitat types include waters adjacent to high density nesting beaches, waters with minimal obstructions and manmade structures, high densities of reproductive males and females, appropriate passage conditions for migration, conditions that support sargassum habitat, available prey, and sufficient water depth and proximity to currents to ensure offshore transport of post-hatchlings (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for the following areas: (i) North Carolina—Brunswick, Carteret, New Hanover, Onslow, and Pender Counties; (ii) South Carolina—Beaufort, Charleston, Colleton, and Georgetown Counties; (iii) Georgia—Camden, Chatham, Liberty, and McIntosh Counties; (iv) Florida—Bay, Brevard, Broward, Charlotte, Collier, Duval, Escambia, Flagler, Franklin, Gulf, Indian River, Lee, Manatee, Martin, Monroe, Palm Beach, Sarasota, St. Johns, St. Lucie, and Volusia Counties; (v) Alabama—Baldwin County; and (vi) Mississippi—Jackson County. Within these areas, the primary constituent elements of the physical or biological features essential to the conservation of the Northwest Atlantic Ocean distinct population segment of the loggerhead sea turtle are the extratidal or dry sandy beaches from the mean high-water line to the toe of the secondary dune, which are capable of supporting a high density of nests or serving as an expansion area for beaches with a high density of nests and that are well distributed within each State, or region within a State, and representative of total nesting, consisting of four components:

(i) Suitable nesting beach habitat that: (A) Has relatively unimpeded nearshore access from the ocean to the beach for nesting females and from the beach to the ocean for both post-nesting females and hatchlings; and (B) Is located above mean high water to avoid being inundated frequently by high tides.

(ii) Sand that: (A) Allows for suitable nest construction; (B) Is suitable for facilitating gas diffusion conducive to embryo development; and (C) Is able to develop and maintain temperatures and a moisture content conducive to embryo development.

(iii) Suitable nesting beach habitat with sufficient darkness to ensure that nesting turtles are not deterred from emerging onto the beach and hatchlings and post-nesting females orient to the sea.

(iv) Natural coastal processes or artificially created or maintained habitat mimicking natural conditions. This includes artificial habitat types that mimic the natural conditions described in paragraphs (2)(i), (2)(ii), and (2)(iii) of this entry for beach access, nest site selection, nest construction, egg deposition and incubation, and hatchling emergence and movement to the sea. Habitat modification and loss occurs with beach stabilization activities that prevent the natural transfer and erosion and accretion of sediments along the ocean shoreline. Beach stabilization efforts that may impact loggerhead nesting include beach nourishment, beach maintenance, sediment dredging and disposal, inlet channelization, and construction of jetties and other hard structures. However, when sand placement activities result in beach habitat that mimics the natural beach habitat conditions, impacts to sea turtle nesting habitat are minimized.

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 August 11, 2014.

For loggerhead sea turtle terrestrial habitat, the features essential to the conservation of this species may require special management considerations or protection to reduce the following threats, which we have grouped into 12 categories: (1) Recreational beach use (beach cleaning, human presence (e.g., dog beach, special events, piers, and recreational beach equipment)); (2) Beach driving (essential and nonessential off-road vehicles, allterrain vehicles, and recreational access and use); (3) Predation (depredation of eggs and hatchlings by native and nonnative predators); (4) Beach sand placement activities (beach nourishment, beach restoration, inlet sand bypassing, dredge material disposal, dune construction, emergency sand placement after natural disaster, berm construction, and dune and berm planting); (5) In-water and shoreline alterations (artificial in-water and shoreline stabilization measures (e.g., in-water erosion control structures, such as groins, breakwaters, jetties), inlet relocation, inlet dredging, nearshore dredging, and dredging and deepening channels); (6) Coastal development (residential and commercial development and associated activities including beach armoring (e.g., sea walls, geotextile tubes, rock revetments, sandbags, emergency temporary armoring); and activities associated with construction, repair, and maintenance of upland structures, stormwater outfalls, and piers); (7) Lights on land or in the adjacent water, which can deter nesting and disorient hatchlings and nesting females, direct or indirect lighting visible from the nesting beach, including skyglow and bonfires, particularly artificial lighting that has an unshielded lamp and a short wave length (below 540 nm). (8) Beach erosion (erosion due to aperiodic, short-term weather-related erosion events, such as atmospheric fronts, northeasters, tropical storms, and hurricanes); (9) Climate change (includes sea level rise); (10) Habitat obstructions (tree stumps, fallen trees, and other debris on the beach; nearshore sand bars; and ponding along beachfront seaward of dry beach); (11) Human-caused disasters and response to natural and human-caused disasters (oil spills, oil spill response including beach cleaning and berm construction, and debris cleanup after natural disasters); and (12) Military testing and training activities (troop presence, pyrotechnics and nighttime lighting, vehicles and amphibious watercraft usage on the beach, helicopter drops and extractions, live fire exercises, and placement and removal of objects on the beach).

Life History

Feeding Narrative

Juvenile: Hatchlings swimming from land rely on an approximately 5-day store of energy and nutrients within their retained yolk sac (Kraemer and Bennett 1981). Neonate loggerheads are infrequently low-energy swimmers and they have begun to feed, no longer relying on their retained yolk (Witherington 2002). Witherington (2002) found that small animals commonly associated with the Sargassum community, such as hydroids and copepods, were most commonly found in esophageal lavage samples. Bjorndal et al. (2003a) estimated a mean growth rate of 5.4 cm CCL per year (SD = 1.8 cm) (NMFS and USFWS, 2008). Young feed on prey (e.g., gastropods, fragments of crustaceans and sargassum) concentrated at the surface (NatureServe, 2015).

Adult: Eats various marine invertebrates (crustaceans, mollusks, sponges, cnidaria, echinoderms, etc.), few plants; also fish (carrion or slow-moving species). Adults forage primarily on the bottom (e.g., see Preen 1996, J. Herpetol. 30:94-96), also take jellyfish from surface. Adults and immatures are piscivorous, invertivorous, and herbivorous. The species may bury in bottom mud during cold periods in some areas (e.g., Port Canaveral ship channel off eastern Florida, Gulf of California) (Dodd 1988). The species exhibits a circadian phenology (NatureServe, 2015). Mean growth rates of adult female loggerheads nesting along the southeast U.S. coast was 0.57 cm/year (SCL) (Bjorndal et al. 1983). The growth rate (CCL) of adult male loggerheads (maturity assumed at >40 cm tail length, measured from plastron to tail tip) inhabiting inshore foraging areas in Florida Bay was essentially zero (Schroeder, unpublished data) (NMFS and USFWS, 2008).

Reproduction Narrative

Egg: Eggs hatch in about 7-11 weeks (generally 8-9 weeks in the southeastern U.S.) (NatureServe, 2015).

Juvenile: Of every thousand hatchlings, only a few are believed to survive to adulthood (Dodd 1988). Juveniles are 65 - 70% female. Hatching occurs in late June to early November. At ages before loggerheads begin to emigrate from the oceanic zone (2 to 6 years of age), the estimate of annual survival probability is 0.911. After emigration begins at 7 years of age, the estimate of annual survival probability drops to 0.643 (NMFS and USFWS, 2008).

Adult: In the southeastern U.S., mating occurs late March-early June. Lays 1-9 clutches (mostly 2-6) of about 45-200 eggs (average 120) at intervals of about 2 weeks, mostly every 2-3 years. In the U.S., nests late April-early September, peak in June. Females are sexually mature at an average age of about 15-30 years and are reproductively active over a period of about 30 years (CSTC 1990). In Georgia, annual survivorship of adult females was 0.81. Maximum reproductive life span 32 years (Frazer 1983). Nesting occurs usually on open sandy beaches above high-tide mark, seaward of well-developed dunes. Nests primarily on high-energy beaches on barrier strands adjacent to continental land masses in warm temperate and subtropical regions (CSTC 1990). Renesting generally occurs at the same beach or within a few km; generally returns to the same area in subsequent years if habitat remains suitable. In Florida, nesting on urban beaches was strongly correlated with the presence of tall objects (trees, buildings), which apparently shield the beach from city lights (Salmon et al. 1995) (NatureServe, 2015). The lifespan is greater than 57 years (NMFS and USFWS, 2008). Mean age at first reproduction for female loggerhead sea turtles is thirty years. Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (i.e., coastal waters). Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Spatial Arrangements of the Population

Adult: Scattered; local concentrations (NatureServe ,2015)

Environmental Specificity

Adult: Very narrow to narrow (NatureServe, 2015)

Site Fidelity

Adult: High (NatureServe, 2015; see reproduction narrative)

Dependency on Other Individuals or Species for Habitat

Juvenile: Sargassum spp. (NatureServe, 2015)

Habitat Narrative

Egg: Embryonic development occurs in the supralittoral zone of the nesting beach. Sea turtle eggs require a high-humidity substrate that allows for sufficient gas exchange for development (Miller 1997, Miller et al. 2003). The warmer the sand surrounding the egg chamber, the faster the embryos develop (Mrosovsky and Yntema 1980). Incubation temperatures near the upper end of the tolerable range produce only female hatchlings while incubation temperatures near the lower end of the tolerable range produce only male hatchlings. The pivotal temperature (i.e., the incubation temperature that produces equal numbers of males and females) in loggerheads is approximately 29oC (Limpus et al. 1983, Mrosovsky 1988, Marcovaldi et al. 1997) (NMFS and USFWS, 2008).

Juvenile: Hatchlings move directly to sea after hatching, often float in masses of sea plants (Sargassum); may remain associated with sargassum rafts perhaps for 3-5 years. Maximum hatching success and hatchling size occur when sand moisture level is about 25% (NatureServe, 2015). Hatchlings emerge from their nests end masse almost exclusively at night, and presumably using decreasing sand temperature as a cue (Hendrickson 1958, Mrosovsky 1968, Witherington et al. 1990). On naturally lighted beaches without artificial lighting, ambient light from the open sky creates a relatively bright horizon compared to the dark silhouette of the dune and vegetation landward of the nest. This contrast guides the hatchlings to the ocean (Daniel and Smith 1947, Limpus 1971, Salmon et al. 1992, Witherington 1997, Witherington and Martin 1996, Stewart and Wyneken 2004) (NMFS and USFWS, 2008).

Adult: Occurs in open sea to more than 500 miles from shore, mostly over continental shelf, and in bays, estuaries, lagoons, creeks, and mouths of rivers; mainly warm temperate and subtropical regions not far from shorelines. Off North Carolina, loggerheads inhabited waters of 13-28 C (available range 5-32 C) (Coles and Musick 2000). Adults occupy various habitats, from turbid bays to clear waters of reefs. Subadults occur mainly in nearshore and estuarine waters. It does not form schools but local concentrations may occur at sea or near nesting beaches. The environmental specificity is very narrow to narrow (NatureServe, 2015).

Dispersal/Migration

Motility/Mobility

Juvenile: High (NMFS and USFWS, 2008)

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Juvenile: Migratory (inferred from NatureServe, 2015)

Adult: Migratory (NatureServe, 2015)

Dispersal

Juvenile: High (NMFS and USFWS, 2008)

Adult: High (NatureServe, 2015)

Immigration/Emigration

Juvenile: Emigrates from nest (NMFS and USFWS, 2008)

Dispersal/Migration Narrative

Juvenile: Immediately after hatchlings emerge from the nest, they begin a period of frenzied activity. During this active period, hatchlings move from their nest to the surf, swim and are swept through the surf zone, and continue swimming away from land for approximately 20 to 30 hours (Carr and Ogren 1960; Carr 1962, 1982; Wyneken and Salmon 1992; Witherington 1995) (NMFS and USFWS, 2008). Hatchlings from the southeastern U.S. apparently enter drift lines and ride currents to Europe and the Azores and back (Dodd 1990) (NatureServe, 2015).

Adult: Migrates between nesting beaches and marine waters. At least some temperate zone nesters migrate to tropical waters after the nesting season (Dodd 1990). Females that nest on east coast of Florida migrate to the Gulf of Mexico and West Indies for non-nesting periods. Some individuals in the southeastern U.S. move north in spring (e.g., see Morreale and Standora, no date), south as fall approaches; others apparently remain in Florida waters year-round (NatureServe, 2015).

Population Information and Trends

Population Trends:

Significant 20 year decline (NatureServe, 2015)

Resiliency:

Very high (inferred from NMFS and USFWS, 2008); see current range/distribution)

Representation:

Low (USFWS and NMFS, 2007)

Redundancy:

Low (inferred from NMFS and USFWS, 2008)

Number of Populations:

5 (NMFS and USFWS, 2008)

Population Size:

Unknown; > 20,000 nesting females (NMFS and USFWS, 2008)

Population Narrative:

The northern subpopulation in the western North Atlantic has declined dramatically over the past 20 years. Nesting trends at Cape Island, South Carolina, and Little Cumberland Island, Georgia, nesting beaches that have been consistently surveyed since the early 1970s: from 1973 to 1995, nesting at Cape Island declined on average 3.2 percent per year, and from 1964 to

1995, Little Cumberland nesting activity declined at 2.6 percent per year (see NMFS 2002, Jenkins 2002). Indian River and Brevard counties contain the second densest aggregations of nesting loggerheads in the world (about 6000-15,000 females nesting/year (NatureServe, 2015). Fiver different nesting populations have been identified in the northwest Atlantic, and low gene flow and strong nesting site fidelity may make these subpopulations vulnerable to extirpation (USFWS and NMFS, 2007). The most recent reviews show that only two loggerhead nesting aggregations have greater than 10,000 females nesting per year (Baldwin et al. 2003, Ehrhart et al. 2003, Kamezaki et al. 2003, Limpus and Limpus 2003, Margaritoulis et al. 2003): South Florida (U.S.) and Masirah (Oman). Those nesting aggregations with 1,000 to 9,999 females nesting each year are Georgia through North Carolina (U.S.). At present, there are no data on population size in the oceanic habitat. There are five recovery units representing nesting assemblages (NMFS and USFWS, 2008). Due to declines in nest counts at index beaches in the United States and Mexico, and continued mortality of juveniles and adults from fishery bycatch, the Northwest Atlantic Ocean DPS is at risk and likely to decline in the foreseeable future (Conant et al. 2009) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance: There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size. Adult nesting females often account for less than one% of total population numbers (Bjorndal et al. 2005). Using a stage/age demographic model, the adult female population size of the DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS-SEFSC 2009). Based on genetic information, the Northwest Atlantic Ocean DPS is further categorized into five recovery units corresponding to nesting beaches. These are Northern Recovery Unit, Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, Northern Gulf of Mexico Recovery Unit, and the Greater Caribbean Recovery Unit. The Northern Recovery Unit, from North Carolina to northeastern Florida, and is the second largest nesting aggregation in the DPS, with an average of 5,215 nests from 1989 to 2008, and approximately 1,272 nesting females (NMFS and USFWS 2008). The Peninsular Florida Recovery Unit hosts more than 10,000 females nesting annually, which constitutes 87% of all nesting effort in the DPS (Ehrhart et al. 2003). The Greater Caribbean Recovery Unit encompasses nesting subpopulations in Mexico to French Guiana, the Bahamas, and the Lesser and Greater Antilles. The majority of nesting for this recovery unit occurs on the Yucatán peninsula, in Quintana Roo, Mexico, with 903 to 2,331 nests annually (Zurita et al. 2003). Other significant nesting sites are found throughout the Caribbean, and including Cuba, with approximately 250 to 300 nests annually (Ehrhart et al. 2003), and over one hundred nests annually in Cay Sal in the Bahamas (NMFS and USFWS 2008). The Dry Tortugas Recovery Unit includes all islands west of Key West, Florida. The only available data for the nesting subpopulation on Key West comes from a census conducted from 1995 to 2004 (excluding 2002), which provided a mean of 246 nests per year, or about sixty nesting females (NMFS and USFWS 2007). The Gulf of Mexico Recovery Unit has between one hundred to 999 nesting females annually, and a mean of 910 nests per year (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Productivity / Population Growth Rate: The population growth rate for each of the four of the recovery units for the Northwest Atlantic DPS (Peninsular Florida, Northern, Northern Gulf of Mexico, and Greater Caribbean) all exhibit negative growth rates (Conant et al. 2009). Nest counts taken at index beaches in Peninsular Florida show a significant decline in loggerhead nesting from 1989 to 2006, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Loggerhead nesting on the Archie Carr National Wildlife Refuge (representing individuals of the Peninsular Florida subpopulation) has fluctuated over the past few decades. There was an average of 9,300 nests throughout the 1980s, with the number of nests increasing into the 1990s until it reached an all-time high in 1998, with 17,629 nests. From that point, the number of loggerhead nests at the Refuge have declined steeply to a low of 6,405 in 2007, increasing again to 15,539, still a lower number of nests than in 1998 (Bagley et al. 2013). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina and Georgia declined at 1.9% annually from 1983 to 2005 (NMFS and USFWS 2007). The nesting subpopulation in the Florida panhandle has exhibited a significant declining trend from 1995 to 2005 (Conant et al. 2009; NMFS and USFWS 2007). Recent model estimates predict an overall population decline of 17% for the St. Joseph Peninsula, Florida subpopulation of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014). Genetic Diversity: Based on genetic analysis of nesting subpopulations, the Northwest Atlantic Ocean DPS is further divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant et al. 2009). A more recent analysis using expanded mitochondrial DNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct, and that rookeries from Mexico's Caribbean coast express high haplotype diversity (Shamblin et al. 2014). Furthermore, the results suggest that the Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Harvest (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: In the U.S., killing of nesting loggerheads is infrequent. However, on some beaches, human poaching of turtle nests and clandestine markets for eggs has been a problem (Ehrhart and Witherington 1987; Mark Dodd, GDNR, personal communication, 2000; Jorge Picon, FWS, personal communication, 2002). From 1983 to 1989, the Florida Marine Patrol made 29 arrests for illegal possession of turtle eggs (figure not apportioned by species). In Palm Beach, Martin, and St. Lucie counties only (Florida coastal areas with what may be the highest prevalence of egg poaching), there were 33 arrests for possession or sale of sea turtle eggs from 1980 to 2002 (Captain Jeff Ardelean, FFWCC, personal communication, 2002). Illegal harvest, outside the U.S., is summarized in Dow et al. (2007) and Bräutigam and Eckert (2006). Bräutigam and Eckert (2006) documented illegal harvest of sea turtles in 26 jurisdictions surveyed in the Lesser Antilles, Caribbean, and Central and South America. Illegal harvest included the taking of eggs and the killing of nesting females. In some jurisdictions, illegal take of sea turtles was recognized as a serious management challenge although the extent to which loggerhead turtles were taken was not determined (NMFS and USFWS, 2008).

Stressor: Beach cleaning (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Beach cleaning to collect debris and trash may damage nests and hatchlings. Several methods are used to clean beaches, including mechanical raking, hand raking, and picking up

debris by hand. In mechanical raking, heavy machinery can repeatedly traverse nests and potentially compact the sand above them. Mann (1977) suggested that mortality within nests might increase when externally applied pressure from beach-cleaning machinery is common on soft beaches with large-grain sand. Beach cleaning vehicles also may leave ruts along the beach that hinder or trap emergent hatchlings (Hosier et al. 1981). Mechanically pulled rakes and hand rakes, particularly if the tongs are longer than 10 cm, penetrate the beach surface and may disturb incubating nests or uncover pre-emergent hatchlings near the surface of the nest. In some areas, collected debris is buried directly on the beach, and this can lead to excavation and destruction of incubating egg clutches. Disposal of debris near the dune line or on the high beach can cover incubating egg clutches, hinder and entrap emergent hatchlings, and alter natural nest temperatures (NMFS and USFWS, 2008).

Stressor: Disturbance (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: The greatest threat posed by humans on the beach at night is disturbance of female turtles before they have finished nesting. From the time a female exits the surf until she has begun covering her nest, she is highly vulnerable to disturbance, especially prior to and during the early stages of egg laying. Females that abort a nesting attempt may attempt to nest again at or near the same location or select a new site later that night or the following night. However, repeated interruption of nesting attempts may cause a turtle to construct her nest in a sub-optimum incubation environment, postpone nesting for several days, prompt movement many kilometers from the original chosen nesting site, or result in the shedding of eggs at sea (Murphy 1985). Direct harassment may also cause adult turtles to reduce the time spent covering the nest (Johnson et al. 1996). Visitors using flashlights or lanterns or lighting campfires on the beach at night during the nesting season may deter nesting females from coming ashore and may disorient hatchlings (Mortimer 1989). In addition, heavy pedestrian traffic may compact sand over unmarked nests (Mann 1977), although the effect of this compaction has not been determined and may be negligible (Arianoutsou 1988). Depending on the nesting substrate, pedestrian traffic over nests near the time of emergence can cause nests to collapse and result in hatchling mortality (Mann 1977, Dutton et al. 1994). The use and storage of lounge chairs, cabanas, umbrellas, catamarans, and other types of recreational equipment on the beach can hamper or deter nesting by adult females and trap or impede hatchlings during their nest to sea migration. The documentation of non-nesting emergences (also referred to as false crawls) at these obstacles is becoming increasingly common as more recreational beach equipment is left on the beach at night. The presence of vehicles on the beach has the potential to negatively impact sea turtles by running over nesting females, hatchlings, stranded turtles that have washed ashore, and nests. In addition, the ruts left by vehicles in the sand may prevent or impede hatchlings from reaching the ocean following emergence from the nest (Mann 1977, Hosier et al. 1981, Cox et al. 1994, Hughes and Caine 1994). Vehicle lights and vehicle movement on the beach after dark can deter females from nesting and disorient hatchlings. Sand compaction due to vehicles on the beach may hinder nest construction and hatchling emergence from nests. Additionally, vehicle traffic on nesting beaches may contribute to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune. Research and conservation management activities (e.g., nesting surveys, tagging of nesting females, nest manipulation) are tools to advance the recovery of the loggerhead; however, they have the potential to adversely affect nesting females, hatchlings, and developing embryos if not

properly conducted. Military training activities that occur on coastal bases in the southeast U.S. (i.e., Camp Lejeune Marine Corps Base in North Carolina, and Eglin and Tyndall Air Force Bases in Florida) have the potential to increase non-nesting emergences of nesting females, run over nesting females and emerging hatchlings, and destroy nests. Periodic training exercises include such activities as beach landings of air cushioned landing craft, amphibious assault vehicles, and other craft; aerial bombing simulations over the beach; excavation of bunkers on the beach; testing missile defense systems; troops movements on the beach; and mission-related beach driving needs.

Stressor: Development and construction (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Beach sand placement refers to beach restoration, beach nourishment, and inlet maintenance projects carried out to provide a temporary remedy for beach erosion. Beach sand placement is generally viewed as less harmful to sea turtles than armoring, but it too can affect sea turtle reproductive success in a variety of ways. Although placing sand on beaches may provide a greater quantity of nesting habitat, the quality of that habitat may be less suitable than pre-existing natural beaches. Sub-optimal nesting habitat may cause decreased nesting success, place an increased energy burden on nesting females, result in abnormal nest construction, and reduce the survivorship of eggs and hatchlings. During the nesting and hatching season, construction impacts of sand placement projects can occur. Pipelines and heavy equipment can create barriers to nesting females, causing a higher incidence of non-nesting emergences. Increased human activity on the project beach at night may cause further disturbance to nesting females. Reduced nesting success on constructed beaches has been attributed to increased sand compaction, escarpment formation, and changes in beach profile (Nelson et al. 1987, Crain et al. 1995, Lutcavage et al. 1997, Steinitz et al. 1998, Ernest and Martin 1999, Rumbold et al. 2001). Beach sand placement can affect the incubation environment of nests by altering the moisture content, gas exchange, and temperature of sediments (Ackerman et al. 1991, Ackerman 1997, Parkinson et al. 1999). Although inlet maintenance and sand bypassing efforts have the potential to reduce downdrift erosion effects, there may be effects on sea turtle reproduction that are similar to those from beach nourishment. Considerable anecdotal information suggests that permanent armoring structures can diminish the quality of sea turtle nesting habitat. Construction of groins and jetties during the nesting season may result in the destruction of nests, disturbance of females attempting to nest, and disorientation of emerging hatchlings from project lighting. Following construction, the presence of groins and jetties may interfere with nesting turtle access to the beach, result in a change in beach profile and width (downdrift erosion, loss of sandy berms, and escarpment formation), trap hatchlings, and concentrate predatory fishes, resulting in higher probabilities of hatchling predation. Breakwaters are typically constructed from rock or concrete and are placed in nearshore waters to reduce wave energy (National Research Council 1990b). The breakwater then functions as a barrier to the longshore transport of material in a manner similar to a groin, resulting in downdrift erosion (National Research Council 1995) and degradation of downdrift sea turtle nesting habitat. If improperly placed, sand fencing may act as a barrier to nesting females or trap hatchlings (National Research Council 1990a). Runoff from beachfront parking lots, building rooftops, roads, decks, and draining swimming pools adjacent to the beach is frequently discharged directly to the beach and dune either by sheet flow, through stormwater collection system outfalls, or through small diameter pipes. These outfalls are known to create localized erosion channels,

prevent natural dune establishment, and wash out sea turtle nests (FFWCC, unpublished data). In addition to shoreline protection activities, there are a variety of other coastal construction activities that may affect sea turtles. These include construction, repair, and maintenance of upland structures and dune crossovers; installation of utility cables; installation and repair of public infrastructure (such as coastal highways and emergency evacuation routes); and construction equipment and lighting associated with any of these activities. Periodic dredging of sediments from navigational channels is necessary to provide for the passage of large commercial, military, and recreational vessels. In addition, sand mining (dredging) for beach renourishment occurs along the Atlantic and Gulf of Mexico. The negative impacts of dredging include destruction or degradation of habitat and incidental mortality of sea turtles. Using explosives to remove existing bridge or piling structures and to create or deepen navigation channels can result in injury or death of loggerhead turtles inhabiting the area (Klima et al. 1988; Barbara Schroeder, NMFS, personal communication, 2005). Developing marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat (NMFS and USFWS, 2008).

Stressor: Erosion (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Natural beach erosion events may influence the quality of nesting habitat. Nesting females may deposit eggs at the base of an escarpment formed during an erosion event where they are more susceptible to repeated tidal inundation. Erosion, frequent or prolonged tidal inundation, and accretion can negatively affect incubating egg clutches. Short-term erosion events (e.g., atmospheric fronts, northeasters, tropical storms, and hurricanes) are common phenomena throughout the loggerhead nesting range and may vary considerably from year to year. During erosion events, some nests may be uncovered or completely washed away. Nests that are not washed away may suffer reduced reproductive success as the result of frequent or prolonged tidal inundation. Eggs saturated with seawater are susceptible to embryonic mortality (Bustard and Greenham 1968, Milton et al. 1994, Martin 1996) (NMFS and USFWS, 2008).

Stressor: Oil and gas activities (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Several activities associated with offshore oil and gas production, including oil spills, water quality (operational discharge), seismic surveys, explosive platform removal, platform lighting, and noise from drillships and production activities, are known to impact loggerheads. Currently, there are 3,443 federally regulated offshore platforms in the Gulf of Mexico dedicated to natural gas and oil production. Additional state-regulated platforms are located in state waters (Texas and Louisiana). Operational discharge of produced waters, drill muds, and drill cuttings are routinely discharged in marine waters as a result of petroleum production activities (MMS 2000). Loggerheads may bioaccumulate heavy metals found in drill muds resulting in debilitation or death. Oil exploration and development on live bottom areas may disrupt foraging grounds by smothering benthic organisms with sediments and drilling muds (Coston-Clements and Hoss 1983). The explosive removal of offshore oil and gas platforms is known to have impacts on loggerheads ranging from capillary damage, disorientation, loss of motor control, and mortality (National Research Council 1996, Viada et al. 2008). Oil spills in the vicinity of nesting beaches

just prior to or during the nesting season could place nesting females, incubating egg clutches, and hatchlings at significant risk (Fritts and McGehee 1982, Lutcavage et al. 1997, Witherington 1999). Fritts and McGehee (1982) conducted both field and laboratory studies to determine the effects of petroleum on the development and survival of sea turtle embryos. Their results suggest that an oil spill resulting in contamination of nesting beaches before the nesting season may affect nesting success for only a short period, if at all, but a spill resulting in the deposition of oil on eggs or on top of an incubating nest is likely to increase mortality and result in abnormal development of hatchlings. Two oil spills that occurred near loggerhead nesting beaches in Florida were observed to affect eggs, hatchlings, and nesting females. Approximately 350,000 gallons of fuel oil spilled in Tampa Bay in August 1993 and was carried onto nesting beaches in Pinellas County. Observed mortalities included 31 hatchlings and 176 oil covered nests; an additional 2,177 eggs and hatchlings were either exposed to oil or disturbed by response activities (FDEP et al. 1997). Another spill near the beaches of Broward County in August 2000 involved approximately 15,000 gallons of oil and tar (NOAA and FDEP 2002). Models estimated that approximately 1,500 to 2,000 hatchlings and 0 to 1 adults were injured or killed. Oil cleanup activities can also be harmful. Earth-moving equipment can dissuade females from nesting and destroy nests, containment booms can entrap hatchlings, and lighting from nighttime activities can misdirect turtles (Witherington 1999) (NMFS and USFWS, 2008).

Stressor: Light pollution (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Both nesting and hatchling sea turtles are adversely affected by the presence of artificial lighting on or near the beach (Witherington and Martin 1996). Experimental studies have shown that artificial lighting deters adult female turtles from emerging from the ocean to nest (Witherington 1992). Witherington (1986) noted that loggerheads aborted nesting attempts at a greater frequency in lighted areas. Because adult females rely on visual brightness cues to find their way back to the ocean after nesting, those turtles that nest on lighted beaches may become disoriented (unable to maintain constant directional movement) or misoriented (able to maintain constant directional movement but in the wrong direction) by artificial lighting and have difficulty finding their way back to the ocean. Hatchlings have a tendency to orient toward the brightest direction as integrated over a broad horizontal area. On natural undeveloped beaches, the brightest direction is commonly away from elevated shapes (e.g., dune, vegetation, etc.) and their silhouettes and toward the broad open horizon of the sea. On developed beaches, the brightest direction is often away from the ocean and toward lighted structures. Hatchlings unable to find the ocean, or delayed in reaching it, are likely to incur high mortality from dehydration, exhaustion, or predation (Carr and Ogren 1960, Ehrhart and Witherington 1987, Witherington and Martin 1996) (NMFS and USFWS, 2008).

Stressor: Pollution (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Hatchlings often must navigate through a variety of obstacles before reaching the ocean. These include natural and human-made debris. Debris on the beach may interfere with a hatchling's progress toward the ocean. Research has shown that travel times of hatchlings from the nest to the water may be extended when traversing areas of heavy foot traffic or vehicular

ruts (Hosier et al. 1981); the same is true of debris on the beach. Some beach debris may have the potential to trap hatchlings and prevent them from successfully reaching the ocean. In addition, debris over the tops of nests may impede or prevent hatchling emergence. Agricultural runoff, urban runoff, leaking septic systems, sewage discharges, and similar sources can increase the flow of nutrients and organic substances into aquatic systems. Eutrophication caused by excessive nutrient pollution in coastal waters can affect sea turtles both directly and indirectly (Milton and Lutz 2003). Loggerheads have been found entangled in a wide variety of materials, including steel and monofilament line, synthetic and natural rope, plastic onion sacks, and discarded plastic netting materials (Balazs 1985; Plotkin and Amos 1988; NMFS, unpublished data). Effects of debris ingestion can include direct obstruction of the gut, absorption of toxic byproducts, and reduced absorption of nutrients across the gut wall (Balazs 1985). Keller et al. (2004) found that widespread and persistent organochlorine contaminants, such as polychlorinated biphenyls (PCBs) and pesticides, may be affecting the health of loggerheads even though sea turtles accumulate lower concentrations of organochlorine contaminants compared with other wildlife (NMFS and USFWS, 2008).

Stressor: Predation (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Predation of eggs and hatchlings by native and introduced species occurs on almost all nesting beaches. The most common predators in the southeast U.S. are ghost crabs (Ocypode quadrata), raccoons (Procyon lotor), feral hogs (Sus scrofa), foxes (Urocyon cinereoargenteus and Vulpes vulpes), coyotes (Canis latrans), armadillos (Dasypus novemcinctus), and red fire ants (Solenopsis invicta) (Dodd 1988, Stancyk 1982). In the absence of nest protection programs in a number of locations throughout the southeast U.S., raccoons may depredate up to 96% of all nests deposited on a beach (Davis and Whiting 1977, Hopkins and Murphy 1980, Stancyk et al. 1980, Talbert et al. 1980, Schroeder 1981, Labisky et al. 1986). Prior to hog control efforts, up to 45% of all nests deposited at the Cape Canaveral Air Force Station, Florida, were depredated by feral hogs (FFWCC, unpublished data). In 1990, an estimated 70% of loggerhead nests were destroyed by feral hogs on Ossabaw Island, Georgia (GDNR, unpublished data) (NMFS and USFWS, 2008).

Stressor: Exotic vegetation (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Non-native vegetation has invaded many coastal areas and often outcompetes native species such as sea oats, railroad vine, sea grape (Coccoloba uvifera), bitter panicgrass (Panicum amarum), and seaside pennywort (Hydrocotyle bonariensis). The invasion of less stabilizing vegetation can lead to increased erosion and degradation of suitable nesting habitat. Exotic vegetation may also form impenetrable root mats that can prevent proper nest cavity excavation, invade and desiccate eggs, or trap hatchlings. The Australian pine (Casuarina equisetifolia) is particularly harmful to sea turtles. Dense stands have taken over many coastal areas throughout central and south Florida. Australian pines cause excessive shading of the beach that would not otherwise occur. Studies in Florida suggest that nests laid in shaded areas are subjected to lower incubation temperatures, which may alter the natural hatchling sex ratio (Marcus and Maley 1987, Schmelz and Mezich 1988, Hanson et al. 1998). Fallen Australian pines

limit access to suitable nest sites and can entrap nesting females (Austin 1978, Reardon and Mansfield 1997). The shallow root network of these pines can interfere with nest construction (Schmelz and Mezich 1988). Beach vitex (Vitex rotundifolia) was introduced to the horticulture trade in the mid-1980s and is often sold as a “dune stabilizer.” The plant is native to Japan, Korea, and Hawaii. Its presence on North Carolina and South Carolina beaches could have a negative effect on sea turtle nesting. This exotic plant is crowding out the native species, such as sea oats and bitter panicum, and can colonize large areas in just a few years (NMFS and USFWS, 2008).

Stressor: Climate change (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: One of the most certain consequences of climate change is rising sea levels (Titus and Narayanan 1995), which will result in increased erosion rates along nesting beaches. This could particularly impact areas with low-lying beaches where sand depth is a limiting factor, as the sea will inundate nesting sites and decrease available nesting habitat (Daniels et al. 1993, Fish et al. 2005, Baker et al. 2006). The loss of habitat as a result of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006, Baker et al. 2006). Climate change may also affect loggerhead sex ratios. Loggerhead turtles exhibit temperature-dependent sex determination. Rapidly increasing global temperatures may result in warmer incubation temperatures and highly female-biased sex ratios (e.g., Glen and Mrosovsky 2004).

Stressor: Fisheries (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Of all commercial and recreational fisheries in the U.S., shrimp trawling is the most detrimental to the recovery of sea turtle populations. In a 1990 study, the National Academy of Sciences estimated that between 5,000 and 50,000 loggerheads were killed annually by the offshore shrimping fleet in the southeast U.S. Atlantic and Gulf of Mexico (National Research Council 1990a). Mortality associated with shrimp trawls was estimated to be 10 times greater than that of all other human-related factors combined. Dredge fishing gear is the predominant gear used to harvest sea scallops off the mid- and northeastern Atlantic coast. Sea scallop dredges are composed of a heavy steel frame and cutting bar located on the bottom part of the frame and a bag, made of metal rings and mesh twine, attached to the frame. The gear is fished along the bottom and weighs from 500-1,000 pounds (National Research Council 2002). Turtles can be struck and injured or killed by the dredge frame and/or captured in the bag where they may drown or be further injured or killed when the catch and heavy gear are dumped on the vessel deck. NMFS (2008a) anticipates that up to 929 loggerheads will be captured biennially in the U.S. Atlantic scallop dredge fishery, 595 of these captures are anticipated to be lethal. The principal longline fishery affecting loggerheads in the neritic environment is the commercial bottom longline fishery for sharks, which operates in summer off the mid-Atlantic States and all year long off the south Atlantic and Gulf states. NMFS estimated 974 hardshelled turtles (433 alive, 325 dead, and 216 unknown condition), predominantly loggerheads, were caught in the Gulf of Mexico reef fish fishery from July 2006 through December 2007 (NMFS 2008b). Turtle

captures on recreational hook and line gear are not uncommon, but the overall level of take and percent mortality are unknown. It is assumed that most turtles captured in the commercial and recreational hook and line fisheries are released alive, but ingested hooks and entanglement in associated monofilament or steel line have been documented as the probable cause of death for some stranded turtles (NMFS, unpublished data). Federal fisheries including the bluefish, monkfish, northeast multispecies, spiny dogfish, summer and southern flounder, Spanish and king mackerel, and shark fisheries all have gillnet components. The impact of some of these fisheries, particularly those using large mesh nets, could be significant. Sea turtle mortalities have been documented in the leader of certain pound nets. NMFS has several records of turtles, including loggerheads, captured in weirs (Ellen Keane, NMFS, personal communication, 2008). Loggerheads may be particularly vulnerable to entanglement in vertical lines because of their attraction to, or attempts to feed on, baits and species caught in the traps and epibionts (living organisms) growing on traps, trap lines, and floats. Haul seines and channel nets have been reported to take loggerheads in North Carolina (NMFS 2001), but it is not known how many, if any, loggerhead mortalities are caused by these fisheries. Although no interactions were observed between sea turtles and purse seines in a study of finfish bycatch in Chesapeake Bay (Herbert Austin, VIMS, personal communication, 2000), sea turtles trapped in menhaden purse seines might be impinged on the grates of inlet pipes used to suck the catch into the hold. The decline in horseshoe crab availability has apparently caused a diet shift in juvenile loggerheads, from predominantly horseshoe crabs in the early to mid-1980s to blue crabs in the late 1980s and early 1990s, to mostly finfish in the late 1990s and early 2000s (Seney 2003, Seney and Musick 2007). Studies on the effects of fishing activities on loggerhead prey and foraging ecology are urgently needed to assess the magnitude of this threat and to provide information for addressing it (NMFS and USFWS, 2008).

Stressor: Power generation activities (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: The entrainment and entrapment of loggerheads in saltwater cooling intake systems of coastal power plants has been documented in New Jersey, North Carolina, Florida, and Texas (Eggers 1989; National Research Council 1990a; Carolina Power and Light Company 2003; FPL and Quantum Resources, Inc. 2005; Progress Energy Florida, Inc. 2003). Average annual incidental capture rates for most coastal plants from which captures have been reported amount to several turtles per plant per year. Wind power, generated by enormous windmills sited in neritic habitats, is cause for concern with regard to the effects of construction, artificial lighting, noise, and potential ecosystem alterations on loggerheads. The conversion of wave or tidal energy into power is cause for concern when these projects are located in loggerhead habitats, especially adjacent to nesting beaches (NMFS and USFWS, 2008).

Stressor: Vessel strikes (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Propeller and collision injuries from boats and ships are common in sea turtles. From 1997 to 2005, 14.9% of all stranded loggerheads in the U.S. Atlantic and Gulf of Mexico were documented as having sustained some type of propeller or collision injuries although it is not known what proportion of these injuries were post or ante-mortem. The incidence of propeller

wounds has risen from approximately 10% in the late 1980s to a record high of 20.5% in 2004 (NMFS, unpublished data). Propeller wounds are greatest in southeast Florida (Palm Beach through Miami-Dade County); during some years, as many as 60% of the loggerhead strandings found in these areas had propeller wounds (FFWCC, unpublished data) (NMFS and USFWS, 2008).

Stressor: Aquaculture (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Aquaculture netting, particularly large mesh sizes, may entangle and drown sea turtles. Net pens and associated aquaculture structures, depending on their siting, may “collect” seaweed rafts or interfere with their natural passive movements and, therefore, may entangle, capture, or disrupt migratory movements of post-hatchling or pelagic stage sea turtles. Artificial lighting at aquaculture facilities, depending on their siting, may misorient hatchlings and/or adult females in the proximity of nesting beaches (NMFS and USFWS, 2008).

Stressor: Disease and parasites (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: At least two bacterial diseases have been described in wild loggerhead populations, including bacterial encephalitis and ulcerative stomatitis/obstructive rhinitis/pneumonia (George 1997), and Bartonella was recently reported in wild loggerheads from North Carolina (Valentine et al. 2007). Viral diseases have not been documented in free-ranging loggerheads, with the possible exception of sea turtle fibropapillomatosis, which may have a viral etiology (Herbst and Jacobson 1995, George 1997). A variety of endoparasites, including trematodes, tapeworms, and nematodes have been described in loggerheads (Herbst and Jacobson 1995). Ectoparasites, including leeches and barnacles, may have debilitating effects on loggerheads. Large marine leech infestations may result in anemia and act as vectors for other disease producing organisms (George 1997) (NMFS and USFWS, 2008).

Stressor: Algal blooms (NMFS and USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: During four red tide events along the west coast of Florida, sea turtle stranding trends indicated that these events were acting as an additional mortality factor (Redlow et al. 2003). Sea turtles that washed ashore alive during these red tide events displayed symptoms that were consistent with acute brevitoxicosis (e.g., uncoordinated and lethargic but otherwise robust and healthy in appearance) and completely recovered within days of being removed from the area of the red tide (NMFS and USFWS, 2008).

Recovery

Reclassification Criteria:
See the 2009 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads for complete down listing/delisting criteria for each of the following recovery objectives. 24. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds

to an increase in the number of nesting females. 25. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes. 26. Manage sufficient nesting beach habitat to ensure successful nesting. 27. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction. 28. Eliminate legal harvest. 29. Implement scientifically based nest management plans. 30. Minimize nest predation. 31. Recognize and respond to mass/unusual mortality or disease events appropriately. 32. Develop and implement local, state, Federal and international legislation to ensure longterm protection of loggerheads and their terrestrial and marine habitats. 33. Minimize bycatch in domestic and international commercial and artisanal fisheries. 34. Minimize trophic changes from fishery harvest and habitat alteration. 35. Minimize marine debris ingestion and entanglement. 36. Minimize vessel strike mortality (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Delisting Criteria:
1. The adult female population in Florida is increasing and in North Carolina, South Carolina, and Georgia, it has returned to pre-listing nesting levels (NC = 800 nests/season; SC = 10,000 nests/season; GA = 2,000 nests/season). The above conditions must be met with data from standardized surveys which will continue for at least 5 years after delisting. This criterion must be met over a period of 25 years (USFWS and NMFS, 2007).

2. At least 25 percent (560 km) of all available nesting beaches (2240 km) is in public ownership, distributed over the entire nesting range and encompassing at least 50 percent of the nesting activity within each State. This criterion must be met over a period of 25 years (USFWS and NMFS, 2007).

3. All priority one tasks have been successfully implemented over a period of 25 years (USFWS and NMFS, 2007).

Recovery Actions:
- Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females (NMFS and USFWS, 2008).
- Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes (NMFS and USFWS, 2008).
- Manage sufficient nesting beach habitat to ensure successful nesting (NMFS and USFWS, 2008).
- Manage sufficient feeding, migratory, and interesting marine habitats to ensure successful growth and reproduction (NMFS and USFWS, 2008).
- Eliminate legal harvest (NMFS and USFWS, 2008).
- Implement scientifically based nest management plans (NMFS and USFWS, 2008).
- Minimize nest predation (NMFS and USFWS, 2008).
- Recognize and respond to mass/unusual mortality or disease events appropriately (NMFS and USFWS, 2008).
- Develop and implement local, state, Federal, and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats (NMFS and USFWS, 2008).

- Minimize bycatch in domestic and international commercial and artisanal fisheries (NMFS and USFWS, 2008).
- Minimize trophic changes from fishery harvest and habitat alteration (NMFS and USFWS, 2008).
- Minimize marine debris ingestion and entanglement (NMFS and USFWS, 2008).
- Minimize vessel strike mortality (NMFS and USFWS, 2008).

Conservation Measures and Best Management Practices:

- The Service has preliminary information that indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the loggerhead turtle. Since the species' listing, a substantial amount of information has become available on population structure, nesting and foraging distribution, movements, and demography. These data appear to indicate a possible separation of populations by ocean basins, however a more in depth analysis, beyond the scope of this five-year review, is needed. To determine the application of the DPS policy to the loggerhead turtle, the Services intended to fully assemble and analyze all relevant information in accordance with the DPS policy (USFWS and NMFS, 2007).

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SPECIES ACCOUNT: *Chelonia mydas* (Green sea turtle (Central N Pacific DPS))

Species Taxonomic and Listing Information

Listing Status: Endangered; 05/06/2016; Pacific Region (R1) (USFWS, 2016a)

Physical Description

The green sea turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. Color is variable. Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Identifying characteristics include four pairs of costal scutes, none of which borders the nuchal scute, and only one pair of prefrontal scales between the eyes (USFWS, 2016a). The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter) (Figure 2). The species was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed eleven DPSs of green sea turtles as threatened or endangered under the ESA (81 FR 20057). The Central North Pacific DPS is listed as threatened (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

The green turtle was first described by Linnaeus in 1758 as Testudo mydas, with Ascension Island in the Atlantic as the type locality. Schweigger in 1812 first applied the binomial Chelonia mydas in use today. The current taxonomic status of the green turtle is uncertain. Mitochondrial DNA research conducted by Bowen et al. (1992) showed a fundamental phylogenetic split distinguishing all green turtles in the Atlantic-Mediterranean from those in the Indian-Pacific Oceans. The shallow evolutionary structure of Chelonia populations within ocean basins likely resulted from extinction and colonization of rookeries over time-frames that are short by evolutionary standards, but long by ecological standards (Bowen et al. 1992). Consequently, in terms of conservation and management, the available evidence indicates that breeding sites must be considered as demographically independent units (NMFS and USFWS, 1998).

Historical Range

The present distribution of the breeding sites has been largely affected by historical patterns of human exploitation. Most of the substantial breeding colonies left today are those that have not been permanently inhabited by humans or have not been heavily exploited until recently (Groombridge and Luxmoore 1989, Seminoff 2004) (NMFS and USFWS, 2007).

Current Range

The range of the Central North Pacific DPS includes the Hawaiian Archipelago and Johnston Atoll. It is bounded by a four-sided polygon with open ocean extents reaching to 41° N., 169° E. in the northwest corner, 41° N., 143° W. in the northeast, 9° N., 125° W. in southeast, and 9° N., 175° W. in the southwest (USFWS, 2016b). The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The Central North Pacific DPS green turtle is found in the Pacific Ocean near the Hawaiian Archipelago and Johnston Atoll (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Green turtles in the Central North Pacific DPS are found in the Hawaiian Archipelago and Johnston Atoll. The major nesting site for the DPS is at East Island, French Frigate Shoals, in the Northwestern Hawaiian islands; lesser nesting sites are found throughout the Northwestern Hawaiian Islands and the Main Hawaiian Islands (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017)

Distinct Population Segments Defined

Central North Pacific

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Hatchling green turtles eat a variety of plants and animals (USFWS, 2016a). The diets of post-hatchlings and juveniles living in pelagic habitats appear to be entirely carnivorous (e.g., invertebrates and fish eggs), but records are only known from the occasional turtles encountered (NMFS and USFWS, 1998). Growth rates of juveniles vary substantially between populations, ranging from < 1 cm/year (Green 1993) to > 5 cm/year (NMFS and USFWS, 2007).

Adult: Adults feed almost exclusively on seagrasses and marine algae (USFWS, 2016a). Green turtles consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey. Most green turtles exhibit slow growth rates (NMFS and USFWS, 2007). Foraging on marine vegetation occurs in benthic habitats (NMFS and USFWS, 1998).

Reproduction Narrative

Adult: Open beaches with a sloping platform and minimal disturbance are required for nesting. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Age at sexual maturity is believed to be 20 to 50 years (USFWS, 2016a). Estimates of reproductive longevity range from 17 - 23 years. A female may deposit 900 - 3,300 eggs during a lifetime. There is an increasing female bias in the sex ratio of hatchlings. Healthy beaches have intact dune structures and native vegetation, which maintain normal beach temperatures (NMFS and USFWS, 2007). Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Site Fidelity

Adult: High (USFWS, 2016a; see dispersal/migration narrative)

Dependency on Other Individuals or Species for Habitat

Juvenile: Sargassum spp. (USFWS, 2016a)

Habitat Narrative

Juvenile: Hatchlings have been observed to seek refuge and food in Sargassum rafts (USFWS, 2016a).

Adult: Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae (USFWS, 2016a). In addition to coastal foraging areas, oceanic habits are used by oceanic-stage juveniles, migrating adults, and turtles that reside in the oceanic zone for foraging (NMFS and USFWS, 2007).

Dispersal/Migration

Motility/Mobility

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (USFWS, 2016a)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2016a)

Dispersal

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (USFWS, 2016a)

Immigration/Emigration

Juvenile: Emigrates from nesting beach (NMFS and USFWS, 1998)

Dispersal/Migration Narrative

Juvenile: The pelagic movements of post-hatchling and young juveniles are undocumented. The proper dispersal of hatchlings by ocean currents off a particular nesting beach may be a crucial factor (Collard and Ogren 1990) (NMFS and USFWS, 1998).

Adult: Green turtles apparently have a strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches (USFWS, 2016a).

Population Information and Trends

Population Trends:

Not available

Species Trends:

Increasing (USFWS, 2016b)

Resiliency:

Moderate (inferred from USFWS, 2016b; see current range/distribution); low nesting resiliency (USFWS, 2016b)

Redundancy:

Moderate (based on nesting sites) (USFWS, 2016b)

Number of Populations:

1; 13 nesting sites (USFWS, 2016b)

Population Size:

3,846 - 4,000 nesting females annually (USFWS, 2016b)

Resistance to Disease:

Low (inferred from NMFS and USFWS, 2007; see threats)

Population Narrative:

The DPS exhibits low nesting abundance, with an estimated total nester abundance of 3,846 nesting females at 13 nesting sites. The most recent published study on this DPS estimates the total nester abundance at roughly 4,000 nesting females (Balazs et al., 2015). The nesting trend is increasing. Nesting site diversity is extremely limited: 96 percent of nesting occurs at one low-lying atoll (i.e., FFS) (USFWS, 2016b). Green turtles in the Hawaiian Archipelago were subjected to hunting pressure for subsistence and commercial trade, which was largely responsible for the decline in the region. Though the practice has been banned, there are still anecdotal reports of harvest. Incidental bycatch in fishing gear, ingestion of marine debris, and the loss of nesting habitat due to sea level rise are current threats to the population. Although these threats persist, the increase in annual nesting abundance, continuous scientific monitoring, legal enforcement and conservation programs are all factors that favor the resiliency of the DPS (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year. There are thirteen known nesting sites for the Central North Pacific DPS, with an estimated 3,846 nesting females. The DPS is very thoroughly monitored, and it is believed there is little chance that there are undocumented nesting sites. The largest nesting site is at French Frigate Shoals, Hawaii, which hosts 96% of the nesting females for the DPS (Seminoff et al. 2015). Productivity / Population Growth Rate Nesting surveys have been conducted since 1973. Nesting abundance at East Island, French Frigate Shoals, increases at 4.8% annually (Seminoff et al. 2015). Genetic Diversity: The majority of nesting for the Central North Pacific DPS is centered at one site on French Frigate Shoals, and there is little diversity in nesting areas. Overall, the Central North Pacific has a relatively low level of genetic diversity and stock sub-structuring (Seminoff et al. 2015) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Degradation of nesting habitat (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: In the MHI, nesting and basking habitats are degraded by coastal development and construction, vehicular and pedestrian traffic, beach pollution, tourism, and other human related activities (USFWS, 2016b).

Stressor: Degradation of marine habitat (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Foraging habitat is degraded by coastal development, marina construction, siltation, pollution, sewage, military activities, vessel traffic, and vessel groundings. Marine debris is a significant threat (e.g., WedemeyerStrombel et al., 2015); entanglement in lost or discarded fishing gear is the second leading cause of strandings and mortality in the MHI (Work et al., 2015) (USFWS, 2016b).

Stressor: Predation (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Numerous native and nonnative predators prey on hatchlings and eggs (USFWS, 2016b).

Stressor: Fisheries bycatch and vessel traffic (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: In addition to incidental capture in foreign longline fisheries, interactions with nearshore recreational fisheries occur (Work et al., 2015). Vessel strikes result in injury and mortality. Vessel traffic excludes turtles from their preferred foraging areas (USFWS, 2016b).

Stressor: Stochastic events (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: The extremely limited nesting diversity (i.e., 96 percent of nesting at FFS) increases extinction risk by rendering the DPS vulnerable to random variation and environmental stochasticities (USFWS, 2016b).

Stressor: Climate change (USFWS, 2016b)
Exposure:
Response:
Consequence:

Narrative: Sea level rise and the increasing frequency and intensity of storm events are likely to reduce available nesting habitat. A recent study indicated that increasing temperatures are likely to modify beach thermal regimes that are important to nesting and basking (Van Houtan et al., 2015). Temperature increases are also likely to result in increased hatchling mortality, skewed sex ratios, and changes in juvenile and adult distribution patterns (USFWS, 2016b).

Stressor: Fibropapillomatosis (NMFS and USFWS, 2007; USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: This disease is characterized by the presence of internal and/or external tumors that may grow large enough to hamper swimming, vision, feeding, and potential escape from predators (Herbst 1994). For unknown reasons, the frequency of FP is much higher in green turtles than in other species. The population-level impacts of this disease are not yet understood (NMFS and USFWS, 2007). As stated in a recent study, FP continues to cause the majority of green turtle strandings in Hawai1i (Work et al., 2015) and may be linked to environmental factors (Keller et al., 2014; Van Houtan et al., 2014; Work et al., 2014; NMFS, in progress) (USFWS, 2016b).

Stressor: Inadequacy of existing regulatory mechanisms (NMFS and USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: The conservation and recovery of sea turtles, and green turtles particularly, is facilitated by a number of regulatory instruments at international, regional, national, and local levels. Despite these advances, human impacts continue throughout the world. The lack of comprehensive and effective monitoring and bycatch reduction efforts in many pelagic and near-shore fisheries operations still allows substantial direct and indirect mortality, and the uncontrolled development of coastal and marine habitats threatens to destroy the supporting ecosystems of long-lived green turtles. Although several international agreements provide legal protection for sea turtles, additional multi-lateral efforts are needed to ensure they are sufficiently implemented and/or strengthened, and key non-signatory parties need to be encouraged to accede (NMFS and USFWS, 2007).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters (NMFS and USFWS, 1998).

2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years NMFS and USFWS, 1998).

3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period (NMFS and USFWS, 1998).

4. Existing foraging areas are maintained as healthy environments (NMFS and USFWS, 1998).

5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region (NMFS and USFWS, 1998).

6. All Priority #1 tasks have been implemented (NMFS and USFWS, 1998).

7. A management plan to maintain sustained populations of turtles is in place (NMFS and USFWS, 1998).

Recovery Actions:
- Eliminate the threat of fibropapillomas to green turtle populations (NMFS and USFWS, 1998).
- Reduce incidental harvest of green turtles by commercial and artisanal fisheries (NMFS and USFWS, 1998).
- Determine population size and status through regular nesting beach and in-water censuses (NMFs and USFWS, 1998).
- Identify stock home ranges using DNA analysis (NMFS and USFWS, 1998).
- Support conservation and biologically viable management of green turtle populations in countries that share U.S. green turtle stocks (NMFS and USFWS, 1998).
- Identify and protect primary nesting and foraging areas for the species (NMFS and USFWS, 1998).
- Eliminate adverse effects of development on green turtle nesting and foraging habitats (NMFS and USFWS, 1998).
- Control non-native predators of eggs and hatchlings, e.g., mongoose, feral cats, and pigs, in the Hawaiian population (NMFS and USFWS, 1998).
- Stop the direct harvest of green sea turtles and eggs, through education and law enforcement actions (NMFS and USFWS, 1998).

Conservation Measures and Best Management Practices:
- Preliminary information indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the green turtle. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The Service has not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the green turtle, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy (NMFS and USFWS, 2007).
- The current "Recovery Plan for U.S. Population of Atlantic Green Turtle (Chelonia mydas)" was completed in 1991, the "Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas)" was completed in 1998, and the "Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (Chelonia mydas)" was completed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the 2004 NMFS Interim Recovery Planning Guidance, are a viable measure of the species status. The species biology, demographic trends, and

population status information can be updated where appropriate; however, the recovery actions identified in the plans are appropriate and properly prioritized. While some additional recovery actions can no doubt be identified, the Service believe that the current plans remain valid conservation planning tools. The recovery plans should be re-examined over the next 5 - 10 year horizon, particularly if the DPS analysis results in restructuring of the current listing. To update the plans to conform to the 2004 NMFS Interim Recovery Planning Guidance. In the near-term, additional information and data are particularly needed on genetic relationships among nesting populations, impacts of coastal and pelagic fisheries, foraging areas and identification of threats at foraging areas, and long-term population trends (NMFS and USFWS, 2007).

- Overall, State and Federal conservation efforts have been successful in countering some threats. Important State initiatives include the regulation of gill net fishing and the distribution of barbless circle hooks (USFWS, 2016b).

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SPECIES ACCOUNT: *Chelonia mydas* (Green sea turtle (Central S Pacific DPS))

Species Taxonomic and Listing Information

Listing Status: Endangered; 05/06/2016; Pacific Region (R1) (USFWS, 2016a)

Physical Description

The green sea turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. Color is variable. Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Identifying characteristics include four pairs of costal scutes, none of which borders the nuchal scute, and only one pair of prefrontal scales between the eyes (USFWS, 2016a). The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The Central South Pacific DPS green turtle is found in the South Pacific Ocean throughout several island groups. The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

The green turtle was first described by Linnaeus in 1758 as Testudo mydas, with Ascension Island in the Atlantic as the type locality. Schweigger in 1812 first applied the binomial Chelonia mydas in use today. The current taxonomic status of the green turtle is uncertain. Mitochondrial DNA research conducted by Bowen et al. (1992) showed a fundamental phylogenetic split distinguishing all green turtles in the Atlantic-Mediterranean from those in the Indian-Pacific Oceans. The shallow evolutionary structure of Chelonia populations within ocean basins likely resulted from extinction and colonization of rookeries over time-frames that are short by evolutionary standards, but long by ecological standards (Bowen et al. 1992). Consequently, in terms of conservation and management, the available evidence indicates that breeding sites must be considered as demographically independent units (NMFS and USFWS, 1998).

Historical Range

The present distribution of the breeding sites has been largely affected by historical patterns of human exploitation. Most of the substantial breeding colonies left today are those that have not been permanently inhabited by humans or have not been heavily exploited until recently (Groombridge and Luxmoore 1989, Seminoff 2004) (NMFS and USFWS, 2007).

Current Range

The range of the DPS extends north and east of New Zealand to include a longitudinal expanse of 7,500 km, from Easter Island, Chile in the east to Fiji in the west, and encompasses American Samoa, French Polynesia, Cook Islands, Fiji, Kiribati, Tokelau, Tonga, and Tuvalu. Its open ocean polygonal boundary endpoints are (clockwise from the northwest-most extent): 9° N., 175° W. to 9° N., 125° W. to 40° S., 96° W. to 40° S., 176° E., to 13° S., 171° E., and back to 9° N., 175° W (USFWS, 2016b). (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. The Southwest Pacific DPS extends off the eastern coast of Australia, south of Papua New Guinea and goes east to encompass Vanuatu and New Caledonia. Major nesting sites for the DPS include the Great Barrier Reef, eastern Torres Strait and the northern Great Barrier Reef. Nesting also occurs in New Caledonia, Vanuatu and the Coral Sea Islands (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

Central South Pacific

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Hatchling green turtles eat a variety of plants and animals (USFWS, 2016a). The diets of post-hatchlings and juveniles living in pelagic habitats appear to be entirely carnivorous (e.g., invertebrates and fish eggs), but records are only known from the occasional turtles encountered (NMFS and USFWS, 1998). Growth rates of juveniles vary substantially between populations, ranging from < 1 cm/year (Green 1993) to > 5 cm/year (NMFS and USFWS, 2007).

Adult: Adults feed almost exclusively on seagrasses and marine algae (USFWS, 2016a). Green turtles consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey. Most green turtles exhibit slow growth rates (NMFS and USFWS, 2007). Foraging on marine vegetation occurs in benthic habitats (NMFS and USFWS, 1998).

Reproduction Narrative

Adult: Open beaches with a sloping platform and minimal disturbance are required for nesting. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Age at sexual maturity is believed to be 20 to 50 years (USFWS, 2016a). There is little diversity of nesting sites, with most nesting occurring on low-lying coral atolls or oceanic islands (USFWS, 2016b). Estimates of reproductive longevity range from 17 - 23 years. A female may deposit 900 - 3,300 eggs during a lifetime. There is an increasing female bias in the sex ratio of hatchlings. Healthy beaches have intact dune structures and native vegetation, which maintain normal beach temperatures (NMFS and USFWS, 2007). Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons.

Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Site Fidelity

Adult: High (USFWS, 2016a; see dispersal/migration narrative)

Dependency on Other Individuals or Species for Habitat

Juvenile: Sargassum spp. (USFWS, 2016a)

Habitat Narrative

Juvenile: Hatchlings have been observed to seek refuge and food in Sargassum rafts (USFWS, 2016a).

Adult: Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae (USFWS, 2016a). In addition to coastal foraging areas, oceanic habits are used by oceanic-stage juveniles, migrating adults, and turtles that reside in the oceanic zone for foraging (NMFS and USFWS, 2007).

Dispersal/Migration

Motility/Mobility

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (USFWS, 2016a)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2016a)

Dispersal

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (USFWS, 2016a)

Immigration/Emigration

Juvenile: Emigrates from nesting beach (NMFS and USFWS, 1998)

Dispersal/Migration Narrative

Juvenile: The pelagic movements of post-hatchling and young juveniles are undocumented. The proper dispersal of hatchlings by ocean currents off a particular nesting beach may be a crucial factor (Collard and Ogren 1990) (NMFS and USFWS, 1998).

Adult: Green turtles apparently have a strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches (USFWS, 2016a).

Population Information and Trends

Population Trends:

Not available

Species Trends:
Varied (USFWS, 2016b)

Resiliency:
High (inferred from USFWS, 2016b)

Redundancy:
High (based on nesting sites) (inferred from USFWS, 2016b)

Number of Populations:
1; 59 nesting sites (USFWS, 2016b)

Population Size:
2,677 - 3,600 nesting females annually (USFWS, 2016b)

Resistance to Disease:
Low (inferred from NMFS and USFWS, 2007; see threats)

Population Narrative:
The DPS exhibits low nesting abundance, with an estimated total nester abundance of 2,677 to 3,600 nesting females at 59 nesting sites. There is a negative nesting trend at the most abundant nesting site but increasing trends at less abundant nesting beaches. There are at least two genetic stocks within the DPS. Nesting is geographically broad (USFWS, 2016b). Historically, the Central South Pacific DPS declined due to harvest of eggs and females for human consumption or for their shells, a practice that still continues throughout the region. Incidental bycatch in commercial and artisanal fishing gear, lack of regulatory mechanisms and climate change are significant threats to the long-term viability of the DPS (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year. Nesting abundance information for the Central South Pacific DPS is limited, but is considered to be at low levels and spread out over a large geographic area. There are 59 known nesting sites (22 are unquantified), with an estimated 2,677 nesting females. The largest nesting site is at Scilly Atoll in French Polynesia, which hosts 36% of the nesting females for the DPS (Seminoff et al. 2015). Productivity / Population Growth Rate There are no estimates of population growth for the Central South Pacific DPS. The DPS suffers from a lack of consistent, systematic nesting monitoring, with no nesting site having even five years of continuous data. What data are available indicate steep declines at Scilly Atoll due to illegal harvest, with some smaller nesting sites (e.g., Rose Atoll) showing signs of stability (Seminoff et al. 2015). Genetic Diversity There is very limited information available for the Central South Pacific DPS. Mitochondrial DNA studies indicate at least two genetic stocks in the DPS—American Samoa and French Polynesia. Overall, there is a moderate level of diversity for the DPS, and the presence of unique haplotypes (Seminoff et al. 2015) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Degradation of nesting habitat (USFWS, 2016b)

Exposure:
Response:
Consequence:
Narrative: Some nesting beaches are degraded by coastal erosion, development, construction, sand extraction, artificial lighting, proximity to road traffic, and natural disasters, such as tsunamis (USFWS, 2016b).

Stressor: Degradation of marine habitat (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Marine habitat is degraded by runoff, sedimentation, dredging, ship groundings, natural disasters, and pollution (e.g., oil spills, toxic and industrial wastes, and heavy metals). Injury and mortality result from the entanglement in and ingestion of plastics, monofilament fishing line, and other marine debris (e.g., Wedemeyer-Strombel et al., 2015) (USFWS, 2016b).

Stressor: Harvest/bycatch (USFWs, 2016b)
Exposure:
Response:
Consequence:
Narrative: Commercial and traditional exploitation of turtles and eggs has resulted in declines at the most abundant nesting site and other locations. Illegal harvest of turtles and eggs is also a major threat. Incidental capture in artisanal and commercial fisheries (e.g., line, trap, and net fisheries) is a significant threat to the DPS. The primary gear types involved in these interactions include longlines, traps, and nets (USFWS, 2016b).

Stressor: Predation (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Predation by introduced species is a significant threat in some areas (USFWS, 2016b).

Stressor: Climate change (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Islands within the South Pacific are especially vulnerable to sea level rise, which together with increasing storm events, is likely to reduce available nesting habitat (USFWS, 2016b).

Stressor: Fibropapillomatosis (NMFS and USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: This disease is characterized by the presence of internal and/or external tumors that may grow large enough to hamper swimming, vision, feeding, and potential escape from predators (Herbst 1994). For unknown reasons, the frequency of FP is much higher in green

turtles than in other species. The population-level impacts of this disease are not yet understood (NMFS and USFWS, 2007).

Stressor: Inadequacy of existing regulatory mechanisms (NMFS and USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: The conservation and recovery of sea turtles, and green turtles particularly, is facilitated by a number of regulatory instruments at international, regional, national, and local levels. Despite these advances, human impacts continue throughout the world. The lack of comprehensive and effective monitoring and bycatch reduction efforts in many pelagic and near-shore fisheries operations still allows substantial direct and indirect mortality, and the uncontrolled development of coastal and marine habitats threatens to destroy the supporting ecosystems of long-lived green turtles. Although several international agreements provide legal protection for sea turtles, additional multi-lateral efforts are needed to ensure they are sufficiently implemented and/or strengthened, and key non-signatory parties need to be encouraged to accede (NMFS and USFWS, 2007).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters (NMFS and USFWS, 1998).

2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years NMFS and USFWS, 1998).

3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period (NMFS and USFWS, 1998).

4. Existing foraging areas are maintained as healthy environments (NMFS and USFWS, 1998).

5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region (NMFS and USFWS, 1998).

6. All Priority #1 tasks have been implemented (NMFS and USFWS, 1998).

7. A management plan to maintain sustained populations of turtles is in place (NMFS and USFWS, 1998).

Recovery Actions:
- Eliminate the threat of fibropapillomas to green turtle populations (NMFS and USFWS, 1998).

- Reduce incidental harvest of green turtles by commercial and artisanal fisheries (NMFS and USFWS, 1998).
- Determine population size and status through regular nesting beach and in-water censuses (NMFs and USFWS, 1998).
- Identify stock home ranges using DNA analysis (NMFS and USFWS, 1998).
- Support conservation and biologically viable management of green turtle populations in countries that share U.S. green turtle stocks (NMFS and USFWS, 1998).
- Identify and protect primary nesting and foraging areas for the species (NMFS and USFWS, 1998).
- Eliminate adverse effects of development on green turtle nesting and foraging habitats (NMFS and USFWS, 1998).
- Control non-native predators of eggs and hatchlings, e.g., mongoose, feral cats, and pigs, in the Hawaiian population (NMFS and USFWS, 1998).
- Stop the direct harvest of green sea turtles and eggs, through education and law enforcement actions (NMFS and USFWS, 1998).

Conservation Measures and Best Management Practices:

- Preliminary information indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the green turtle. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The Service has not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the green turtle, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy (NMFS and USFWS, 2007).
- The current "Recovery Plan for U.S. Population of Atlantic Green Turtle (Chelonia mydas)" was completed in 1991, the "Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas)" was completed in 1998, and the "Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (Chelonia mydas)" was completed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the 2004 NMFS Interim Recovery Planning Guidance, are a viable measure of the species status. The species biology, demographic trends, and population status information can be updated where appropriate; however, the recovery actions identified in the plans are appropriate and properly prioritized. While some additional recovery actions can no doubt be identified, the Service believe that the current plans remain valid conservation planning tools. The recovery plans should be re-examined over the next 5 - 10 year horizon, particularly if the DPS analysis results in restructuring of the current listing. To update the plans to conform to the 2004 NMFS Interim Recovery Planning Guidance. In the near-term, additional information and data are particularly needed on genetic relationships among nesting populations, impacts of coastal and pelagic fisheries, foraging areas and identification of threats at foraging areas, and long-term population trends (NMFS and USFWS, 2007).
- Conservation efforts throughout the region, such as establishment of protected areas and national legislation to protect turtles, provide some benefits to the DPS. The remoteness of some areas appears to provide the most conservation protection against certain threats, such as poaching (USFWS, 2016b).

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USFWS. 2016b. Endangered and Threatened Wildlife and Plants

Final Rule To List Eleven Distinct Population Segments of the Green Sea Turtle (Chelonia mydas) as Endangered or Threatened and Revision of Current Listings Under the Endangered Species Act. 81 Federal Register 66. April 6, 2016. Pages 20057 - 20090.

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SPECIES ACCOUNT: *Chelonia mydas* (Green sea turtle (Central W Pacific DPS))

Species Taxonomic and Listing Information

Listing Status: Endangered; 05/06/2016; Pacific Region (R1) (USFWS, 2016)

Physical Description

The green sea turtle grows to a maximum size of about 4 feet and a weight of 440 pounds. It has a heart-shaped shell, small head, and single-clawed flippers. Color is variable. Hatchlings generally have a black carapace, white plastron, and white margins on the shell and limbs. The adult carapace is smooth, keelless, and light to dark brown with dark mottling; the plastron is whitish to light yellow. Adult heads are light brown with yellow markings. Identifying characteristics include four pairs of costal scutes, none of which borders the nuchal scute, and only one pair of prefrontal scales between the eyes (USFWS, 2016a). The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The Central West Pacific DPS green turtle is found in the Pacific Ocean near Papua New Guinea, and West Papua, Indonesia. The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

The green turtle was first described by Linnaeus in 1758 as Testudo mydas, with Ascension Island in the Atlantic as the type locality. Schweigger in 1812 first applied the binomial Chelonia mydas in use today. The current taxonomic status of the green turtle is uncertain. Mitochondrial DNA research conducted by Bowen et al. (1992) showed a fundamental phylogenetic split distinguishing all green turtles in the Atlantic-Mediterranean from those in the Indian-Pacific Oceans. The shallow evolutionary structure of Chelonia populations within ocean basins likely resulted from extinction and colonization of rookeries over time-frames that are short by evolutionary standards, but long by ecological standards (Bowen et al. 1992). Consequently, in terms of conservation and management, the available evidence indicates that breeding sites must be considered as demographically independent units (NMFS and USFWS, 1998).

Historical Range

The present distribution of the breeding sites has been largely affected by historical patterns of human exploitation. Most of the substantial breeding colonies left today are those that have not been permanently inhabited by humans or have not been heavily exploited until recently (Groombridge and Luxmoore 1989, Seminoff 2004) (NMFS and USFWS, 2007).

Current Range

The range of the Central West Pacific DPS has a northern boundary of 41° N. latitude and is bounded by 41° N., 169° E. in the northeast corner, going southeast to 9° N., 175° W., then southwest to 13° S., 171° E., west and slightly north to the eastern tip of Papua New Guinea, along the northern shore of the Island of New Guinea to West Papua in Indonesia, northwest to 4.5° N., 129° E. then to West Papua in Indonesia, then north to 41° N., 146° E. It encompasses the Republic of Palau, Federated States of Micronesia, New Guinea, Solomon Islands, Marshall Islands, Guam, CNMI, and the Ogasawara Islands of Japan (USFWS, 2016b). The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. The Central West Pacific DPS is composed of nesting assemblages in the Federated States of Micronesia, the Japanese islands of Chichijima and Hahajima, the Marshall Islands, and Palau. Green turtles in this DPS are found throughout the western Pacific Ocean, in Indonesia, the Philippines, the Marshall Islands and Papua New Guinea (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017)

Distinct Population Segments Defined

Central West Pacific

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Hatchling green turtles eat a variety of plants and animals (USFWS, 2016a). The diets of post-hatchlings and juveniles living in pelagic habitats appear to be entirely carnivorous (e.g., invertebrates and fish eggs), but records are only known from the occasional turtles encountered (NMFS and USFWS, 1998). Growth rates of juveniles vary substantially between populations, ranging from < 1 cm/year (Green 1993) to > 5 cm/year (NMFS and USFWS, 2007).

Adult: Adults feed almost exclusively on seagrasses and marine algae (USFWS, 2016a). Green turtles consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey. Most green turtles exhibit slow growth rates (NMFS and USFWS, 2007). Foraging on marine vegetation occurs in benthic habitats (NMFS and USFWS, 1998).

Reproduction Narrative

Adult: Open beaches with a sloping platform and minimal disturbance are required for nesting. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Age at sexual maturity is believed to be 20 to 50 years (USFWS, 2016a). Nesting is relatively widespread but occurs only on islands and atolls (i.e., little nesting site diversity) (USFWS, 2016b). Estimates of reproductive longevity range from 17 - 23 years. A female may deposit 900 - 3,300 eggs during a lifetime. There is an increasing female bias in the sex ratio of hatchlings. Healthy beaches have intact dune structures and native vegetation, which maintain normal beach temperatures (NMFS and USFWS, 2007). Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Site Fidelity

Adult: High (USFWS, 2016a; see dispersal/migration narrative)

Dependency on Other Individuals or Species for Habitat

Juvenile: Sargassum spp. (USFWS, 2016a)

Habitat Narrative

Juvenile: Hatchlings have been observed to seek refuge and food in Sargassum rafts (USFWS, 2016a).

Adult: Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae (USFWS, 2016a). In addition to coastal foraging areas, oceanic habits are used by oceanic-stage juveniles, migrating adults, and turtles that reside in the oceanic zone for foraging (NMFS and USFWS, 2007).

Dispersal/Migration

Motility/Mobility

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (USFWS, 2016a)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2016a)

Dispersal

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (USFWS, 2016a)

Immigration/Emigration

Juvenile: Emigrates from nesting beach (NMFS and USFWS, 1998)

Dispersal/Migration Narrative

Juvenile: The pelagic movements of post-hatchling and young juveniles are undocumented. The proper dispersal of hatchlings by ocean currents off a particular nesting beach may be a crucial factor (Collard and Ogren 1990) (NMFS and USFWS, 1998).

Adult: Green turtles apparently have a strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches (USFWS, 2016a).

Population Information and Trends

Population Trends:
Not available

Species Trends:
Varied (USFWS, 2016b)

Resiliency:
High (inferred from USFWS, 2016b; see current range/distribution)

Redundancy:
High (based on nesting sites) (inferred from USFWS, 2016b)

Number of Populations:
1; 50 nesting sites (USFWS, 2016b)

Population Size:
6,518 nesting females annually (USFWS, 2016b)

Resistance to Disease:
Low (inferred from NMFS and USFWS, 2007; see threats)

Population Narrative:
This DPS exhibits low nesting abundance, with an estimated total nester abundance of 6,518 females at 50 nesting sites. Nesting data indicate increasing trends at one site but decreasing trends at others (USFWS, 2016b). The Central West Pacific DPS is impacted by incidental bycatch in fishing gear, predation of eggs by ghost crabs and rats, and directed harvest eggs and nesting females for human consumption. Historically, intentional harvest of eggs from nesting beaches was one of the principal causes for decline, and this practice continues today in many locations. The Central West Pacific DPS has a small number of nesting females and a widespread geographic range. These factors, coupled with the threats facing the DPS and the unknown status of many nesting sites makes the DPS vulnerable to future perturbations (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance: Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year. There are 51 nesting sites in the Central West Pacific DPS, with an estimated 6,518 nesting females. The largest nesting site is in the Federated States of Micronesia, which hosts 22% of the nesting females for the DPS (Seminoff et al. 2015). Productivity / Population Growth Rate: There are no estimates of population growth rates for the Central West Pacific DPS. Long-term nesting data is lacking for many of the nesting sites in the Central West Pacific DPS, making it difficult to assess population trends. The only site which as long-term data available—Chichijima, Japan—shows a positive trend in population growth (Seminoff et al. 2015). Genetic Diversity: The Central West Pacific DPS is made up of insular rookeries separated by broad geographic distances. Rookeries that are more than 1,000 km apart are significantly differentiated, while rookeries 500 km apart are not. Mitochondrial DNA analyses suggest that there are at least seven independent stocks in the region (Dutton et al. 2014) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Degradation of nesting habitat (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Nesting habitat is degraded by coastal development and construction, placement of barriers to nesting, beachfront lighting, tourism, vehicular and pedestrian traffic, sand extraction, beach erosion, beach pollution, removal of native vegetation, and the presence of non-native vegetation (USFWS, 2016b).

Stressor: Degradation of marine habitat (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Destruction and modification of marine habitat occurs as a result of coastal construction, tourism, sedimentation, pollution, sewage, runoff, military activities, dredging, destructive fishing methods, and boat anchoring. Marine debris results in the mortality of sea turtles through ingestion and entanglement (USFWS, 2016b).

Stressor: Harvest/bycatch (USFWs, 2016b)
Exposure:
Response:
Consequence:
Narrative: The harvest of turtles and eggs is a large and persistent threat throughout the range of this DPS. Turtles are incidentally caught in longline, pole and line, and purse seine fisheries (USFWS, 2016b).

Stressor: Predation (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Predation is a significant threat in some areas (USFWS, 2016b).

Stressor: Climate change (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Temperature increases, as a result of climate change, are the greatest long-term threat to atoll morphology in nations throughout the range of this DPS. Sea level rise is likely to reduce available nesting habitat. The increased frequency and intensity of storm events are likely to cause beach erosion and nest inundation, as demonstrated in a recent study by Summers et al. (in progress) (USFWS, 2016b).

Stressor: Fibropapillomatosis (NMFS and USFWS, 2007)
Exposure:
Response:
Consequence:

Narrative: This disease is characterized by the presence of internal and/or external tumors that may grow large enough to hamper swimming, vision, feeding, and potential escape from predators (Herbst 1994). For unknown reasons, the frequency of FP is much higher in green turtles than in other species. The population-level impacts of this disease are not yet understood (NMFS and USFWS, 2007).

Stressor: Inadequacy of existing regulatory mechanisms (NMFS and USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: The conservation and recovery of sea turtles, and green turtles particularly, is facilitated by a number of regulatory instruments at international, regional, national, and local levels. Despite these advances, human impacts continue throughout the world. The lack of comprehensive and effective monitoring and bycatch reduction efforts in many pelagic and near-shore fisheries operations still allows substantial direct and indirect mortality, and the uncontrolled development of coastal and marine habitats threatens to destroy the supporting ecosystems of long-lived green turtles. Although several international agreements provide legal protection for sea turtles, additional multi-lateral efforts are needed to ensure they are sufficiently implemented and/or strengthened, and key non-signatory parties need to be encouraged to accede (NMFS and USFWS, 2007).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters (NMFS and USFWS, 1998).

2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years NMFS and USFWS, 1998).

3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period (NMFS and USFWS, 1998).

4. Existing foraging areas are maintained as healthy environments (NMFS and USFWS, 1998).

5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region (NMFS and USFWS, 1998).

6. All Priority #1 tasks have been implemented (NMFS and USFWS, 1998).

7. A management plan to maintain sustained populations of turtles is in place (NMFS and USFWS, 1998).

Recovery Actions:

- Eliminate the threat of fibropapillomas to green turtle populations (NMFS and USFWS, 1998).
- Reduce incidental harvest of green turtles by commercial and artisanal fisheries (NMFS and USFWS, 1998).
- Determine population size and status through regular nesting beach and in-water censuses (NMFs and USFWS, 1998).
- Identify stock home ranges using DNA analysis (NMFS and USFWS, 1998).
- Support conservation and biologically viable management of green turtle populations in countries that share U.S. green turtle stocks (NMFS and USFWS, 1998).
- Identify and protect primary nesting and foraging areas for the species (NMFS and USFWS, 1998).
- Eliminate adverse effects of development on green turtle nesting and foraging habitats (NMFS and USFWS, 1998).
- Control non-native predators of eggs and hatchlings, e.g., mongoose, feral cats, and pigs, in the Hawaiian population (NMFS and USFWS, 1998).
- Stop the direct harvest of green sea turtles and eggs, through education and law enforcement actions (NMFS and USFWS, 1998).

Conservation Measures and Best Management Practices:

- Preliminary information indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the green turtle. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The Service has not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the green turtle, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy (NMFS and USFWS, 2007).
- The current "Recovery Plan for U.S. Population of Atlantic Green Turtle (Chelonia mydas)" was completed in 1991, the "Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas)" was completed in 1998, and the "Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (Chelonia mydas)" was completed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the 2004 NMFS Interim Recovery Planning Guidance, are a viable measure of the species status. The species biology, demographic trends, and population status information can be updated where appropriate; however, the recovery actions identified in the plans are appropriate and properly prioritized. While some additional recovery actions can no doubt be identified, the Service believe that the current plans remain valid conservation planning tools. The recovery plans should be re-examined over the next 5 - 10 year horizon, particularly if the DPS analysis results in restructuring of the current listing. To update the plans to conform to the 2004 NMFS Interim Recovery Planning Guidance. In the near-term, additional information and data are particularly needed on genetic relationships among nesting populations, impacts of coastal and pelagic fisheries, foraging areas and identification of threats at foraging areas, and long-term population trends (NMFS and USFWS, 2007).

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SPECIES ACCOUNT: *Chelonia mydas* (Green sea turtle (E Pacific DPS))

Species Taxonomic and Listing Information

Listing Status: Threatened; 05/06/2016; Pacific Southwest Region (R8) (USFWS, 2016a)

Physical Description

In adult East Pacific green turtles, the carapace and dorsal surfaces of the head and flippers are olive-green to dark gray or black, while the plastron varies from whitish-grey to bluish or olive-grey. Considerable gray pigment often infuses the plastron. Hatchlings are black to dark grey above and white below with a white border around the dorsal edge of the carapace and flippers. Young juveniles are usually brightly colored with a mottled or radiating carapacial pattern of light and dark brown, reddish brown, olive and yellow (Caldwell 1962). The East Pacific green turtle is distinguished from the green turtle mainly by size, coloration and carapace shape. The carapace of the adult East Pacific green turtle is narrower, more strongly vaulted and more indented over the rear flippers than that of the green turtle (Cornelius 1986; Márquez 1990). The East Pacific green turtle is also conspicuously smaller and lighter than the green turtle. In the rookeries of Michoacán, Mexico, the mean size for nesting females is 82.0 cm in curved carapace length (CCL) (range 60.0-102, n=718) (Alvarado and Figueroa 1990). On the Galapagos Islands, the mean CCL for nesting females is 80.0 cm (range 74.0-100) (Márquez 1990). The mean straight carapace length (SCL) of nesting females at Playa Naranjo, Costa Rica is 82.9 cm (range 73.0-97.0, n=73) (Cornelius 1976). Adult females weigh between 65 - 125 kgs (Cornelius 1986). Adult males in the rookeries of Mexico are smaller than females with an average CCL of 77.0 cm (range 71.0-85.0, n=32) (Figueroa 1989) (NMFS and USFWS, 1998). The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter). The species was listed under the ESA on July 28, 1978 (43 FR 32800) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

The generic name Chelonia was introduced by Brongniart (1800). The specific name mydas was first used by Linnaeus (1758). The genus Chelonia is often considered to include the single species C. mydas with two distinct subspecies recognized: the East Pacific green turtle C. m. agassizii (Bocourt 1868) in the eastern Pacific (from Baja California south to Peru and west to the Galapagos Islands) and the green turtle C. m. mydas (Linnaeus 1758) in the rest of the global range (Groombridge and Luxmoore 1989). Nevertheless, there has been some controversy over the taxonomic status of the East Pacific green turtle. In the absence of a thorough study of the morphology and genetics of the agassizii form, set in the context of the overall systematics of the C. mydas group, the East Pacific green turtle is considered to be a melanistic form of Chelonia mydas of the monotypic genus Chelonia for the purpose of this recovery plan (NMFS and USFWS, 1998).

Historical Range

Prior to commercial exploitation, the East Pacific green turtle was abundant in the eastern Pacific from Baja California south to Peru and west to the Galapagos Islands. Historically the species was plentiful in the feeding grounds within the Gulf of California (Sea of Cortez) and along the Pacific coast of Baja California (Cliffton et al. 1982). An indication of its former numbers is found in the report of the visit of the vessel Albatross to Tortugas Bay on the Pacific coast of Baja California (Mexico) in April 1889, when a catch of 162 turtles was made in a single haul by a 200 m seine (Parsons 1962). As late as the 1960s the East Pacific green turtle was still abundant in its major nesting grounds in North America; that is the beaches of Colola and Maruata Bay, Michoacán, Mexico (NMFS and USFWS, 1998).

Current Range

The range of the DPS extends from 41° N. southward along the Pacific coast of the Americas to central Chile (40° S.) and westward to 142° W. and 96° W., respectively. The offshore boundary of this DPS is a straight line between these two coordinates. The East Pacific DPS includes the Mexican Pacific coast breeding population, which was originally listed as endangered (43 FR 32800, July 28, 1978) (USFWS, 2016b). There is no known nesting by this species in the United States or in any territory under U.S. Jurisdiction. The main nesting sites for the East Pacific green turtle are located in the state of Michoacán, Mexico (Colola and Maruata beaches) and in the Galapagos Islands, Ecuador (NMFS and USFWS, 1998). The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The East Pacific DPS green turtle is found in the Pacific Ocean from California south to Chile (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Green turtles in the East Pacific DPS are found from the California/Oregon border south to central Chile. Major nesting sites occur at Michoacán, Mexico, and the Galapagos Islands, Ecuador. Smaller nesting sites are found on the Pacific Coast of Costa Rica, and in the Revillagigedos Archipelago, Mexico. Scattered nesting occurs in Columbia, Ecuador, Guatemala and Peru (Seminoff et al. 2015) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

East Pacific

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Hatchling green turtles eat a variety of plants and animals (USFWS, 2016a). Feeding habits of hatchlings and juveniles are unknown. In the Galapagos Islands, Green (1994) found a mean growth rate of 0.40 to 0.45 cm per year for juveniles 40 - 60 cm SCL (NMFS and USFWS, 1998). Growth rates of juveniles vary substantially between populations, ranging from < 1 cm/year (Green 1993) to > 5 cm/year (NMFS and USFWS, 2007).

Adult: Adults feed almost exclusively on seagrasses and marine algae (USFWS, 2016a). Green turtles consume invertebrates such as jellyfish, sponges, sea pens, and pelagic prey. Most green turtles exhibit slow growth rates (NMFS and USFWS, 2007). Food items vary among feeding grounds. In Peru the following food items have been reported in stomach content analysis: plants (Macrocystis, Rhodymenia and Gigartina), molluscs (Nassarius, Mytilus and Semele), polychaetes, jellyfish, amphipods, and fish (sardine and anchovy) (Hays-Brown and Brown 1982). Subadults (60.0 - 66.7 SCL) grew 0.15 cm per year in the Galapagos Islands. Growth rates for two individuals in San Diego Bay (SCL 54.4 and 46.7 cm) were 6.7 and 5.1 cm/yr, respectively, while an 86.7 cm female grew 3.9 cm in one year (McDonald et al. 1995). Turtles seem to be most active around midday; 30% of the green turtles seen swimming were seen around noon (IATTC, unpubl. data) (NMFS and USFWS, 1998).

Reproduction Narrative

Adult: Open beaches with a sloping platform and minimal disturbance are required for nesting. Nesting occurs nocturnally at 2, 3, or 4-year intervals. Only occasionally do females produce clutches in successive years. A female may lay as a many as nine clutches within a nesting season (overall average is about 3.3 nests per season) at about 13-day intervals. Clutch size varies from 75 to 200 eggs. Incubation ranges from about 45 to 75 days, depending on incubation temperatures. Age at sexual maturity is believed to be 20 to 50 years (USFWS, 2016a). Nesting occurs at both insular and continental sites, providing some spatial diversity (USFWS, 2016b). Estimates of reproductive longevity range from 17 - 23 years. A female may deposit 900 - 3,300 eggs during a lifetime. There is an increasing female bias in the sex ratio of hatchlings. Healthy beaches have intact dune structures and native vegetation, which maintain normal beach temperatures (NMFS and USFWS, 2007). The nesting season varies with location. Nesting occurs in Michoacán between August and January, with a peak in October-November (Alvarado et al. 1985), between March and July at Socorro and Clarion islands (Márquez 1990), between December and May with a peak in February-March on the Galapagos Islands (Green and Ortiz-Crespo 1982), and possibly year-round with a peak in October-March at Playa Naranjo, Costa Rica (Cornelius 1986) (NMFS and USFWS, 1998). Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Spatial Arrangements of the Population

Adult: Solitary or large groups (NMFS and USFWS, 1998)

Site Fidelity

Adult: High (USFWS, 2016a; see dispersal/migration narrative)

Dependency on Other Individuals or Species for Habitat

Juvenile: Sargassum spp. (USFWS, 2016a)

Habitat Narrative

Juvenile: Hatchlings have been observed to seek refuge and food in Sargassum rafts (USFWS, 2016a).

Adult: Green turtles are generally found in fairly shallow waters (except when migrating) inside reefs, bays, and inlets. The turtles are attracted to lagoons and shoals with an abundance of marine grass and algae (USFWS, 2016a). In addition to coastal foraging areas, oceanic habits are used by oceanic-stage juveniles, migrating adults, and turtles that reside in the oceanic zone for foraging (NMFS and USFWS, 2007). Although East Pacific greens usually occur singly, they are frequently seen in large groups, usually near the Galapagos Islands (e.g., a group of 59 was seen in July 1991) (NMFS and USFWS, 1998).

Dispersal/Migration

Motility/Mobility

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (NMFS and USFWS, 1998)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (USFWS, 2016a)

Dispersal

Juvenile: High (inferred form NMFS and USFWS, 1998)

Adult: High (NMFS and USFWS, 1998)

Immigration/Emigration

Juvenile: Emigrates from nesting beach (NMFS and USFWS, 1998)

Dispersal/Migration Narrative

Juvenile: The dispersal of East Pacific green turtle hatchlings from natal beaches has not been studied, but it can be assumed to include passive transport by ocean currents over vast distances (NMFS and USFWS, 1998).

Adult: Green turtles apparently have a strong nesting site fidelity and often make long distance migrations between feeding grounds and nesting beaches (USFWS, 2016a). According to tag-recovery data (as summarized by Alvarado and Figueroa 1990), East Pacific green turtle migrations occur between the northern and southern extremes of their range (NMFS and USFWS, 1998).

Population Information and Trends

Population Trends:

Increasing (USFWS, 2016b)

Resiliency:

Very high (inferred from USFWS, 2016b; see current range/distribution)

Representation:

High (inferred from USFWS, 2016b)

Redundancy:

High (based on nesting sites) (inferred from USFWS, 2016b)

Number of Populations:

1; 39 nesting sites; 4 genetic stocks (USFWS, 2016b)

Population Size:

20,112 nesting females annually (USFWS, 2016b)

Resistance to Disease:

Low (inferred from NMFS and USFWS, 2007; see threats)

Population Narrative:

The DPS exhibits an estimated total nester abundance of 20,112 females at 39 nesting sites. The largest nesting aggregation (Colola, Michoacán, Mexico) hosts more than 10,000 nesting females. Nesting data indicate increasing trends in recent decades. Within the DPS, there is additional substructure, and four regional genetic stocks have been identified; however, stocks mix at foraging areas (USFWS, 2016b). The population decline for the East Pacific DPS was primarily caused by commercial harvest of green turtles for subsistence and other uses (e.g., sea turtle oil as a cold remedy). Conservation laws are in place in several countries across the range of the DPS, but enforcement is inconsistent, limiting effectiveness. Incidental bycatch in commercial fishing gear, continued harvest, coastal development and beachfront lighting are all continuing threats for the DPS. The observed increases in nesting abundance for the largest nesting aggregation in the region (Michocán, Mexico), a stable trend at Galapagos, and record high numbers at sites in Costa Rica suggest that the population is resilient, particularly in Mexico (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance: Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year. There are 39 nesting sites for the East Pacific DPS, with an estimated 20,062 nesting females. The largest nesting site is at Colola, Mexico, which hosts 58% of the nesting females for the DPS (Seminoff et al. 2015). Productivity / Population Growth Rate: There are no estimates of population growth for the East Pacific DPS. Only one nesting site in the East Pacific DPS at Colola, Mexico, has sufficient long-term data to determine population trends. Data analysis indicates that the population there is increasing and is likely to continue to do so (Seminoff et al. 2015). Genetic Diversity: Genetic sampling has identified four regional stocks in the East Pacific DPS—Revillagigedos Archipelago, Mexico, Michoacán, Mexico, Central America (Costa Rica), and the Galapagos Islands, Ecuador (Seminoff et al. 2015) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Degradation of nesting habitat (USFWS, 2016b; NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Some nesting beaches are degraded by coastal development, tourism, and pedestrian traffic (USFWS, 2016b). Human populations are growing rapidly in many areas of the Pacific and this expansion is exerting increasing pressure on limited coastal resources. Threats to sea turtles include increased recreational and commercial use of nesting beaches, the loss of nesting habitat to human activities (e.g., pig pens on beaches), beach camping and fires, an increase in litter and other refuse, and the general harassment of turtles. Construction is occurring at a rapid rate and is resulting in a loss of sea turtle nesting areas. Weather events, such as storms, and seasonal

changes in current patterns can reduce or eliminate sandy beaches, degrade turtle nesting habitat, and cause barriers to adult and hatchling turtle movements on affected beaches. Hatchlings become disoriented and misdirected in the presence of artificial lights behind (landward of) their hatching site. These lights cause the hatchlings to orient inland, whereupon they fall prey to predators, are crushed by passing cars, or die of exhaustion or exposure in the morning sun. Nesting adults are also sensitive to light and can become disoriented after nesting, heading inland and then dying in the heat of the next morning, far from the sea. Introduced species can displace native dune and beach vegetation through shading and/or chemical inhibition. Dense new vegetation shades nests, potentially altering natural hatchling sex ratios. Thick root masses can also entangle eggs and hatchlings (NMFS and USFWS, 1998).

Stressor: Degradation of marine habitat (USFWS, 2016b; NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Some foraging areas exhibit high levels of contaminants and reduced seagrass communities. Other threats include marine debris ingestion, boat strikes, and red tide poisoning, which may result in a UME (USFWS, 2016b). Chemical contamination of the marine environment due to sewage, agricultural runoff, pesticides, solvents and industrial discharges is widespread along the coastal waters of the western United States, particularly near the populated inlets and bays of southern California where East Pacific green turtles are likely to be found. San Diego Bay, the only identified forage area for Chelonia in the eastern United States (Stinson 1984, Dutton and McDonald 1990a,b), is heavily polluted with heavy metals and PCBs. This contamination has been shown to cause lesions and mortality in fish and invertebrates, and small lesions have been observed in some of the turtles there (McDonald and Dutton 1990). Turtles become entangled in abandoned fishing gear, ropes and nets, and cannot submerge to feed or surface to breathe; they may lose a limb or attract predators with their struggling. Turtles will also ingest debris such as plastic bags, plastic sheets, plastic six-pack rings, tar balls, styrofoam, and other refuse. Necropsies of stranded turtles have revealed mortalities due to ingested garbage resulting in poisoning or obstruction of the esophagus. Turtles may be injured or killed by active dredging machinery. Dredging may also indirectly harm turtles by destroying forage habitat. A rise in transport traffic increases the amount of oil in the water from bilge pumping and disastrous oil spills. Oil spills resulting from blow-outs, ruptured pipelines, or tanker accidents, can kill sea turtles. The entrainment and entrapment of juvenile and adult East Pacific green turtles in the saltwater cooling intake systems of coastal power plants have been documented in southern California at San Diego Gas & Electric (SDG&E) plants in South Bay and Encina, as well as the southern California Edison Nuclear Generating Station at San Onofre (Kent Miles, SDG&E, pers. comm.; Joe Cordaro, NMFS, pers. comm.) (NMFS and USFWS, 1998).

Stressor: Harvest and fisheries bycatch (USFWS, 2016b; NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: As described by Senko et al. (2014), the direct harvest of turtles is a significant source of mortality. The legal and illegal harvest of eggs is a significant threat due to high demand and lack of enforcement of existing protections. Incidental capture in artisanal and commercial fisheries (e.g., longline, drift gill net, set gill net, and trawl fisheries) is a significant threat (USFWS, 2016b). In Central America large numbers of turtles are caught by shrimp trawlers mainly in

Costa Rica, Guatemala and El Salvador. Sea turtles can be injured or killed when struck by a boat, especially an engaged propeller (NMFS and USFWS, 1998).

Stressor: Predation (USFWS, 2016b; NMFS and USFWS, 1998)
Exposure:
Response:
Consequence:
Narrative: Predation by dogs results in egg and hatchling mortality (Ruiz-Izaguirre et al., 2015; Santidrián Tomillo et al., 2015) (USFWS, 2016b). The loss of eggs to non-human predators is a severe problem in some areas. These predators include domestic animals, such as cats, dogs and pigs, as well as wild species such as rats, mongoose, birds, monitor lizards, snakes, and crabs, ants and other invertebrates (NMFS and USFWS, 1998).

Stressor: Inadequacy of existing regulatory mechanisms (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Existing regulatory mechanisms inadequately regulate egg poaching, the destruction of nesting habitat, and fisheries bycatch (USFWS, 2016b).

Stressor: Climate change (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Climate change is likely to impact nesting and hatchling success. In a recent study, Rhodes (2015) found that females laid fewer nests in areas characterized by erosion and tidal inundation (two likely impacts of sea level rise) (USFWS, 2016b).

Stressor: Fibropapillomatosis (NMFS and USFWS, 2007)
Exposure:
Response:
Consequence:
Narrative: This disease is characterized by the presence of internal and/or external tumors that may grow large enough to hamper swimming, vision, feeding, and potential escape from predators (Herbst 1994). For unknown reasons, the frequency of FP is much higher in green turtles than in other species. The population-level impacts of this disease are not yet understood (NMFS and USFWS, 2007).

Recovery

Reclassification Criteria:
Not available

Delisting Criteria:
1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters (NMFS and USFWS, 1998).

2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years NMFS and USFWS, 1998).

3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period (NMFS and USFWS, 1998).

4. Existing foraging areas are maintained as healthy environments (NMFS and USFWS, 1998).

5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region (NMFS and USFWS, 1998).

6. All Priority #1 tasks have been implemented (NMFS and USFWS, 1998).

7. A management plan to maintain sustained populations of turtles is in place (NMFS and USFWS, 1998).

8. International agreements are in place to protect shared stocks (NMFS and USFWS, 1998).

Recovery Actions:

- Minimize boat collision mortalities, particularly within San Diego County, California (NMFS and USFWS, 1998).
- Minimize incidental mortalities of turtles by commercial fishing operations (NMFS and USFWS, 1998).
- Support the efforts of Mexico and the countries of Central America to census and protect nesting East Pacific green turtles, their eggs and nesting beaches (NMFS and USFWS, 1998).
- Determine population size and status in U.S. waters through regular surveys (NMFS and USFWS, 1998).
- Identify stock home range(s) using DNA analysis (NMFS and USFWS, 1998).
- Identify and protect primary foraging areas in U.S. jurisdiction (NMFS and USFWS, 1998).

Conservation Measures and Best Management Practices:

- Preliminary information indicates an analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the green turtle. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, and genetic studies). The Service has not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the green turtle, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy (NMFS and USFWS, 2007).
- The current "Recovery Plan for U.S. Population of Atlantic Green Turtle (Chelonia mydas)" was completed in 1991, the "Recovery Plan for U.S. Pacific Populations of the Green Turtle (Chelonia mydas)" was completed in 1998, and the "Recovery Plan for U.S. Pacific Populations of the East Pacific Green Turtle (Chelonia mydas)" was completed in 1998. The recovery criteria contained in the plans, while not strictly adhering to all elements of the 2004 NMFS Interim Recovery Planning Guidance, are a viable measure of the species status. The species biology, demographic trends, and population status information can be updated where appropriate; however, the recovery actions

identified in the plans are appropriate and properly prioritized. While some additional recovery actions can no doubt be identified, the Service believe that the current plans remain valid conservation planning tools. The recovery plans should be re-examined over the next 5 - 10 year horizon, particularly if the DPS analysis results in restructuring of the current listing. To update the plans to conform to the 2004 NMFS Interim Recovery Planning Guidance. In the near-term, additional information and data are particularly needed on genetic relationships among nesting populations, impacts of coastal and pelagic fisheries, foraging areas and identification of threats at foraging areas, and long-term population trends (NMFS and USFWS, 2007).

- Conservation initiatives include broad regional efforts and national programs, such as the National Programme for the Conservation of Marine and Continental Turtles in Colombia, which provides education, conservation, and outreach plans. Marine reserves protect green turtles and their foraging habitat (USFWS, 2016b).

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SPECIES ACCOUNT: *Chelonia mydas* (Green sea turtle (N Atlantic DPS))

Species Taxonomic and Listing Information

Listing Status: Threatened; Southeast Region (R4) (USFWS, 2015) 7/28/1978

Physical Description

A sea turtle with a brown carapace, often with radiating mottled or wavy dark markings or large dark brown blotches; 4 costal plates on each side of carapace; first costal does not contact the nuchal; one pair of prefrontal plates between the eyes; limbs are flattened flippers; young are black to dark brown above, mainly white below, with a mid-dorsal keel and two plastral keels, 4-6 cm at hatching; adult carapace length usually 90-122 cm (to 153 cm), mass 113-204 kg (to 295+ kg) (Conant and Collins 1991). LENGTH:122 WEIGHT: 200000 (NatureServe, 2015). The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter). The species was listed under the ESA on July 28, 1978 (43 FR 32800) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

Eastern Pacific populations of Chelonia are regarded by some authors as a distinct species, the black turtle, C. agassizii (King and Burke 1989); other authors (e.g., Ernst and Barbour 1989) retain agassizii as a subspecies of C. mydas (Kamezaki and Matsui 1995) or do not recognize it taxonomically at all (Crother et al. 2000). Phylogenetic analyses of mtDNA data by Bowen et al. (1992) yielded no evidence of matrilineal distinctiveness of agassizii. See Karl and Bowen (1999), Pritchard (1999), Grady and Quattro (1999), Shrader-Frechette and McCoy (1999), and Bowen and Karl (1999) for further debate about the taxonomic status of the black turtle. The Australian flatback turtle, formerly known as Chelonia depressa, has been removed to its own genus, Natator (Zangerl et al. 1988, Limpus et al. 1988). MtDNA data indicate a fundamental phylogenetic split distinguishing all green turtles in the Atlantic-Mediterranean from those in the Indian-Pacific oceans (Bowen et al. 1992). Most regional populations of Chelonia mydas are genetically distinct (Bowen et al. 1992). Florida population is characterized by unusually high mtDNA diversity (Allard et al. 1994) (NatureServe, 2015).

Historical Range

The present distribution of the breeding sites has been largely affected by historical patterns of human exploitation. Most of the substantial breeding colonies left today are those that have not been permanently inhabited by humans or have not been heavily exploited until recently (Groombridge and Luxmoore 1989, Seminoff 2004) (NMFS and USFWS, 2007).

Current Range

The range of the DPS extends from the boundary of South and Central America, north along the coast to include Panama, Costa Rica, Nicaragua, Honduras, Belize, Mexico, and the United States. It extends due east across the Atlantic Ocean at 48° N. and follows the coast south to include the northern portion of the Islamic Republic of Mauritania (Mauritania) on the African continent to 19° N. It extends west at 19° N. to the Caribbean basin to 65.1° W., then due south to 14° N., 65.1° W., then due west to 14° N., 77° W., and due south to 7.5° N., 77° W., the boundary of South and Central America. It includes Puerto Rico, the Bahamas, Cuba, Turks and Caicos Islands, Republic of Haiti, Dominican Republic, Cayman Islands, and Jamaica. The North

Atlantic DPS includes the Florida breeding population, which was originally listed as endangered under the ESA (43 FR 32800, July 28, 1978) (USFWS, 2016). he green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters. The North Atlantic DPS green turtle is found in the north Atlantic Ocean and Gulf of Mexico (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5°N, 77°W) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48°N, 77°W) in the north. The range of the DPS then extends due east along latitudes 48°N and 19°N to the western coasts of Europe and Africa. Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

Yes

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Diet includes "seagrass," macroalgae and other marine vegetation, and various invertebrates such as mollusks, sponges, crustaceans, and jellyfish. Food Habits: Invertivore (Adult, Immature), Herbivore (Adult, Immature) Turtles in the northern Gulf of California overwinter in a dormant condition. Nesting occurs generally at night. In Hawaii, green sea turtles may bask on beaches mid-morning to mid-afternoon, especially after a period of rainy weather (Whittow and Balazs 1982) (NatureServe, 2015). Feeding occurs in shallow, low-energy waters with abundant submerged vegetation, and also in convergence zones in the open ocean (NMFS and USFWS 2007). Migrations may traverse open seas. Adults are tropical in distribution, whereas juveniles range into temperate waters (e.g., see Morreale and Standora, no date). Hatchlings often float in masses of marine macroalgae (e.g., Sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. Inactive individuals may rest on the bottom in winter in the northern Gulf of California. Basking on beaches occurs in some areas (e.g., Hawaii). Nesting occurs on beaches, usually on islands but also on the mainland. Sand may be coarse to fine, has little organic content; physical characteristics vary greatly in different regions. Most nesting occurs on high energy beaches with deep sand. At least in some regions, individuals generally nest at same beach (apparently the natal beach, Meylan et al. 1990, Allard et al. 1994) in successive nestings, though individuals sometimes change to a different nesting beach within a single nesting season (has switched to beach up to several hundred kilometers away) (see Eckert et al. 1989). Beach development and illumination often make beaches unsuitable for successful nesting (NatureServe, 2015).

Reproduction Narrative

Adult: Individual reproductive females lay 1-8 clutches per season, averaging about 90-140 eggs, at about two-week intervals usually every 2-5 years. Nesting occurs March-October in Caribbean-Gulf of Mexico region, with peak in May-June; nests in Florida May-September (Ehrhart and Witherington 1992). Nesting encompasses April-October, with a peak between mid-June and early August, in Hawaii (Niethammer et al. 1997). Eggs hatch usually in 1.5-3 months. Hatchlings emerged between early July and late December (peak mid-August to early October) in Hawaii (Niethammer et al. 1997). Females mature probably at an average age of 27 years in Florida, but growth rates and hence age of maturity may vary greatly (from perhaps fewer than 20 years to 40+ years) throughout the range (slower growth in Australia, Hawaii, and Galapagos than in Florida and West Indies region).; Eggs and hatchlings typically incur high mortality from various terrestrial and aquatic predators, including both vertebrates and invertebrates (e.g., crabs). Many nests are destroyed by tidal inundation and erosion. In Costa Rica, annual survivorship of adult females was 0.61; in various areas egg survivorship was 0.40-0.86 (see Iverson [1991] for a compilation of survivorship data). Humans are the most important predators on adults. See Witherington and Ehrhart (1989) for information on cold stunning in Florida (NatureServe, 2015). Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Site Fidelity

Adult: High (NMFS, 1991)

Habitat Narrative

Adult: Feeding occurs in shallow, low-energy waters with abundant submerged vegetation, and also in convergence zones in the open ocean (NMFS and USFWS 2007). Migrations may traverse open seas. Adults are tropical in distribution, whereas juveniles range into temperate waters (e.g., see Morreale and Standora, no date). Hatchlings often float in masses of marine macroalgae (e.g., Sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. Inactive individuals may rest on the bottom in winter in the northern Gulf of California. Basking on beaches occurs in some areas (e.g., Hawaii). Nesting occurs on beaches, usually on islands but also on the mainland. Sand may be coarse to fine, has little organic content; physical characteristics vary greatly in different regions. Most nesting occurs on high energy beaches with deep sand. At least in some regions, individuals generally nest at same beach (apparently the natal beach, Meylan et al. 1990, Allard et al. 1994) in successive nestings, though individuals sometimes change to a different nesting beach within a single nesting season (has switched to beach up to several hundred kilometers away) (see Eckert et al. 1989). Beach development and illumination often make beaches unsuitable for successful nesting (NatureServe, 2015). It is generally accepted that green sea turtles return to their natal beaches. Green sea turtles do exhibit strong site fidelity in successive nesting seasons (NMFS, 1991)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: High (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Adults migrate up to about 3,000 km between nesting beaches and feeding areas (e.g., between Ascension Island and the South American coast). See Balazs (1982) for a map of documented migrations between the major nesting area in Hawaii (French Frigate Shoals) and foraging areas elsewhere in the Hawaiian Islands. See Morreale and Standora (no date) for information on movements along the east coast of the United States. Seminoff et al. (2002) documented migration between nesting area on the coast of Michoacan (Mexico; January 2000) and a feeding ground on the Sonoran coast of the Gulf of California (Mexico; September 2000). See Mortimer and Porter (1989) for information on inter-nesting movements at Ascension Island. Neonates migrate far from natal beaches to foraging areas and return to natal beach to breed/nest up to 40+ years later (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

High (NatureServe, 2015; USFWS, 1991)

Representation:

High (NatureServe, 2015; USFWS, 2015)

Redundancy:

High (NatureServe, 2015; USFWS, 2015)

Number of Populations:

81 to >300 (NatureServe, 2015)

Population Size:

100,000 to >1,000,000 individuals (NatureServe, 2015)

Resistance to Disease:

Moderate (USFWS, 1991)

Population Narrative:

Number of subpopulations and especially population size undoubtedly have undergone a major decline over the long term. Decline of 30-70% At 46 nesting areas worldwide, representing most but not all of the global population, the latest data indicate that approximately 109,000-151,000 females nest each year (NMFS and USFWS 2007). Assuming an average remigration interval of 3 years, this indicates an adult female population size of roughly 327,000-453,000. Assuming an equal number of adult males yields 654,000-906,000 adults for this subset of the global population. This species is represented by a large number of nesting occurrences (more than 150 major and minor nesting areas in more than 80 nations worldwide) (NatureServe, 2015). High resiliency, redundancy and representation are based on the overall number of individuals in the DPS and the geographic range that the species inhabits. Fibropapillomas are common on immature green sea turtles in the Indian River population (USFWS, 1991). Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population's decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to fifty years. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance: Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). Compared to other DPSs, the North Atlantic DPS exhibits the highest nester abundance, with approximately 167,424 females at 73 nesting sites, and available data indicate an increasing trend in nesting. The largest nesting site in the North Atlantic DPS is in Tortuguero, Costa Rica, which hosts 79% of nesting females for the DPS (Seminoff et al. 2015). Productivity / Population Growth Rate: For the North Atlantic DPS, the available data indicate an increasing trend in nesting. There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets of twenty-five years or more show the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9%, and the Tortuguero, Costa Rica, population growing at 4.9%. Genetic Diversity: The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the population for the DPS. Evidence from mitochondrial DNA studies indicates that there are at least four independent nesting subpopulations in Florida, Cuba, Mexico and Costa Rica (Seminoff et al. 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Beach erosion (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/Loss of nests
Narrative: Erosion of nesting beaches can result in partial or total loss of suitable nesting habitat. Erosion rates are influenced by dynamic coastal processes, including sea level rise. Man's interference with these natural processes through coastal development and associated activities has resulted in accelerated erosion rates and interruption of natural shoreline migration (USFWS, 1991).

Stressor: Beach armoring (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat

Narrative: Where beachfront development occurs, the site is often fortified to protect the property om erosion. Virtually all shoreline engineering is carried out to save structures, not dry sandy beaches, and ultimately results in environmental damage (USFWS, 1991).

Stressor: Beach nourishment (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Beach nourishment consists of pumping, trucking, or scraping sand onto the beach to rebuild what has been lost to erosion. Beach nourishment can impact turtles through direct burial of nests and by disturbance to nesting turtles if conducted during the nesting season. Sand sources may be dissimilar from native beach sediments and can affect nest site selection, digging behavior, incubation temperature (and hence sex ratios), gas exchange parameters within incubating nests, hydric environment of the nest, hatching success and hatchling emergence success (Mann, 1977; Ackerman, 1980; Mortimer, 1982b; Raymond, 1984a). Beach nourishment can result in severe compaction or concretion of the beach. Trucking of sand onto project beaches may increase the level of compaction (USFWS, 1991).

Stressor: Artificial lighting (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/misorientation
Narrative: Extensive research has demonstrated that the principal component of the sea-finding behavior of emergent hatchlings is a visual response to light (Daniel and Smith, 1947; Hendrichon, 1958; Carr and Ogren, 1960; Ehrenfeld and Carr, 1967; Dickerson and Nelson, 1989; Witherington, 1989). Artificial beachfront lighting from buildings, streetlights, dune crossovers, vehicles and other types of beachfront lights have been documented in the disorientation (loss of bearings) and misorientation (incorrect bearing) of hatchling turtles (McFarlane, 1963; Philibosian, 1976; Mann, 1977; 1980; Ehrhart, 1983). The results of misorientation are often fatal. As hatchlings head toward lights or meander along the beach their exposure to predators and likelihood of desiccation is greatly increased. Misoriented hatchlings can become entrapped in vegetation or debris, and many hatchlings are found dead on nearby roadways and in parking lots after being struck by vehicles. Hatchlings that successfully find the water may be misoriented after entering the surf zone or while in nearshore waters. Intense artificial lighting can even md raw hatchlings back out of the surf (Daniel and Smith, 1947; Carr and Ogren, 1960). During 1988 alone, 10,155 misoriented hatchlings were reported to the FDNR. An unquantifiable number of additional disorientation and misorientation events undoubtedly occurred but were not documented due to depredation, entrapment in thick vegetation, loss in storm drains, or obliteration of carcasses by vehicle tires. The problem of artificial beachfront lighting is not restricted to hatchlings. Carr et al (15)78), Mortimer [1982b), and Witherington (1986) found that adult green turtles avoided bright areas on nesting beaches. Problem lights may not be restricted to those placed directly on or in close proximity to nesting beaches. %e background glow associated with intensive inland lighting, such as that emanating from nearby large metropolitan areas, may deter nesting females and misorient hatchlings navigating the nearshore haters. Cumulatively, along the heavily developed beaches of the southeastern United States, the negative effects of artificial lights are profound (USFWS, 1991).

Stressor: Beach cleaning (USFWS, 1991)

Exposure:
Response:
Consequence: Loss of habitat/loss of nests
Narrative: Beach cleaning refers to the removal of both abiotic and biotic debris from developed beaches. There are several methods employed including mechanical raking, hand raking and hand picking up of debris. Mechanical raking can result in heavy machinery repeatedly traversing nests and potentially compacting sand above nests and also results in tire ruts along the beach which may hinder or trap emergent hatchlings. Mann (1977) suggested that mortality within nests may increase when externally applied pressure from beach cleaning machinery is common on soft beaches with large grain sands. Mechanically pulled rakes and hand rakes can penetrate the surface and disturb the sealed nest or may actually uncover pre-emergent hatchlings near the surface of the nest. In some areas collected debris is buried directly on the beach, and this can lead to excavation and destruction of incubating egg clutches. Disposal of debris near the dune line or on the high beach can cover incubating egg clutches and subsequently hinder and entrap emergent hatchlings and may alter natural nest temperatures. In some areas, mechanical beach cleaning is the sole reason for extensive nest relocation (USFWS, 1991).

Stressor: Increased human presence (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of nests/misorientation
Narrative: Residential and tourist use of developed (and developing) nesting beaches can result in negative impacts to nesting turtles, incubating egg clutches, and hatchlings. The most serious threat caused by increased human presence on the beach is the disturbance to nesting females. Night-time human activity can cause nesting females to abort nesting attempts at all stages of the behavioral process. Murphy (1985) reported that disturbance can cause turtles to shift their nesting beaches, delay egg laying and select poor nesting sites. Heavy utilization of nesting beaches by humans (pedestrian traffic) may result in lowered hatchling emergence success rates due to compaction of sand above nest (Mann, 1977), and pedestrian tracks can interfere with the ability of hatchlings to reach the ocean (Hosier et al., 198 1). Campfires and the use of flashlights on nesting beaches misorient hatchlings and can deter nesting females (Mortimer, 1979) (USFWS, 1991).

Stressor: Recreational beach equipment (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals/loss of nests
Narrative: The placement of physical obstacles (e.g., lounge chairs, cabanas, umbrellas, hobie cats, canoes, small boats, beach cycles) on nesting beaches can hamper or deter nesting attempts and interfere with incubating egg clutches and the sea approach of hatchlings. The documentation of false crawls at these obstacles is becoming increasingly common as more recreational beach equipment is left in place nightly on nesting beaches. Additionally, there are documented reports of nesting females becoming entrapped under heavy wooden lounge chairs and cabanas on south Florida nesting beaches (J. Hoover, pers. comm., S. Bass, pers. comm). The placement of recreational beach equipment directly above incubating egg clutches may hamper hatchlings during emergence and can destroy eggs through direct invasion of the nest (C. LeBuff, pers. comm.) (USFWS, 1991).

Stressor: Beach vehicular driving (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of nests/loss of individuals
Narrative: The operation of motor vehicles on nesting beaches for recreational purposes is permitted in northeast Florida (portions of Nassau, Duval, St. John's, Flagler and Volusia counties), northwest Florida (Walton and Gulf Counties), and North Carolina (Emerald Isle, Cape Lookout National Seashore, Cape Hatteras National Seashore and Currituck Banks). While some areas restrict night driving, others permit it. Driving on beaches at night during the nesting season can disrupt the nesting process and result in aborted nesting attempts. The negative impact on nesting females in the surf zone may be particularly severe. Vehicle headlights can disorient or misorient emergent hatchlings and vehicles can strike and kill hatchlings attempting to reach the ocean. The tracks or ruts left by vehicles traversing the beach interfere with the ability of hatchlings to reach the ocean. The extended period of travel required to negotiate tire tracks and ruts may increase the susceptibility of hatchlings to stress and depredation during transit to the ocean (Hosier et d., 1981; M. Evans, FDNR, pers. comm.). Driving directly above incubating egg clutches can cause sand compaction which may decrease nest success and directly kill pre-emergent hatchlings (Mann, 1977). In many areas, beach vehicular driving is the sole cause for nest relocation. Additionally, vehicle traffic on nesting beaches contributes to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune (USFWS, 1991).

Stressor: Exotic dune and beach vegetation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Non-native vegetation has invaded many coastal areas and often outcompetes native species such as sea oats, railroad vine, sea grape, dune panic grass and pennywort. The invasion of less stabilizing vegetation can lead to increased erosion and degradation of suitable nesting habitat. Exotic vegetation may also form impenetrable root mats which can prevent proper nest cavity excavation, invade and desiccate eggs or trap hatchlings (USFWS, 1991).

Stressor: Nest depredation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of nests
Narrative: A variety of natural and introduced predators such as raccoons, feral hogs, foxes, ghost crabs and ants prey on incubating eggs and hatchling sea turtles. The principal predator is the raccoon (Procyon lotor). Raccoons are particularly destructive and may take up to 96 percent of all nests deposited on a beach (Davis and Whiting, 1977; Hopkins and Murphy, 1980; Stancyk et al., 1980; Talbert et al., 1980; Schroeder, 1981; Labisky et al., 1986). Prior to hog control efforts, up to 45 percent of all sea turtle nests deposited at the Cape Canaveral Air Force Station, Florida, were depredated by feral hogs (FDNR, unpubl. data). In addition to the destruction of eggs, certain predators may take considerable numbers of hatchlings just prior to or upon emergence from the sand (USFWS, 1991).

Stressor: Nest Loss and Abiotic Factors (USFWS, 1991)
Exposure:

Response:
Consequence: Loss of nests
Narrative: Nest loss due to erosion or inundation and accretion of sand above incubating nests appear to be the principal abiotic factors which may negatively affect incubating: egg clutches. while these factors are often widely perceived as contributing significantly to nest mentality or lowering hatching success, few quantitative studies have been conducted (Mortimer, 1989). Studies on a relatively undisturbed nesting beach by Witherington (1986) indicated that excepting a late season severe storm event, erosion and inundation played a relatively minor role in destruction of incubating nests. Inundation of nests and accretion of sand above incubating nests as a result of a late season storm played a major role in destroying nests from which hatchlings had not yet emerged. Severe storm events (e.g., tropical storms, hurricanes) may result in significant nest loss, but these events are typically aperiodic rather than annual occurrences. In the southeastern United States, severe storm events are generally experienced after the peak of the hatching season and hence would not be expected to affect the majority of incubating nests. Erosion and inundation of nests is exacerbated through coastal development and shoreline engineering. These threats are discussed above under beach armoring (USFWS, 1991).

Stressor: Poaching (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: In the United States, take of nesting female green turtles is infrequent. However, in a number of areas, egg poaching and clandestine markets for eggs are not uncommon. During the period 1983 - 1989 the Florida Marine Patrol made 29 arrests for illegal possession of turtle eggs (figure: not apportioned by species) (USFWS, 1991). Illegal directed harvesting of juvenile and adult green turtles in the waters of the continental United States and U.S. Caribbean is not uncommon, but no estimates of the level of take exist. During the period 1983-1989, the Florida Marine Patrol made three arrests for illegal possession of whole turtles and 25 arrests for illegal possession of turtle parts within Florida (figures are not apportioned by species). Illegal take of green turtles in the United States Caribbean, particularly in Puerto Rican waters, is likely the most significant problem (USFWS, 1991).

Stressor: Oil and gas exploration, development and transportation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: Experimental and field results reported by Vargo pt al. (1986) indicate that marine turtles would be at substantial risk if they encountered an oil spill or large amounts of tar in the environment. Physiological experiments indicate that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of marine turtles are significantly affected (Vargo et al., 1986). Spills in the vicinity of nesting beaches are of special concern and could place nesting adults, incubating egg clutches (Fritts and McGehee, 1989) and hatchlings at significand risk. Exploration and oil development on live bottom areas may disrupt foraging grounds by smothering benthic organisms with sediments and drilling muds (Coston-Clements and Hoss, 1983). Oil and tar are also released into the marine environment during pumping of bilges on large vessels. In a review of available information on debris ingestion, Balazs (1985) reported that

tar balls were the second most prevalent type of abiotic debris ingested by marine turtles (USFWS, 1991).

Stressor: Dredging (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: The effects of dredging are evidenced through direct destruction or degradation of habitat and incidental take of marine turtles. Channelization of inshore and nearshore habitat and the disposal of dredged material in the marine environment can destroy or disrupt resting or foraging grounds (including grass beds and coral reefs) and may affect nesting distribution through the alteration of physical features in the marine environment (Hopkins and Murphy, 1980). Hopper dredges are responsible for incidental take and mortality of marine turtles during dredging operations. During a 3-month period in 1980 in the Port Canaveral, Florida, channel, dredging operations were responsible for the mortality of approximately 100 turtles. These high levels of incidental take have not been documented during dredging operations in subsequent years. Maintenance dredging of the Kings Bay, Georgia, channel during 1987-1988 resulted in the mortality of approximately 20 turtles during a 1 year period. Other types of dredges (clamshell and pipeline) have not been implicated in incidental take (USFWS, 1991).

Stressor: Marina and dock development (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: The development of marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat. Additionally, this type of development leads to increased boat and vessel traffic which may result in higher incidences of propeller- and collision-related mortality. Fueling facilities at marinas can result, in the discharge of oil and gas into sensitive estuarine habitat (USFWS, 1991).

Stressor: Pollution (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/decreased nesting success
Narrative: The effects of pollutants resulting from industrial, agricultural or residential sources are difficult to evaluate. Pesticides, heavy metals and PCB's have been detected in turtles (including eggs), but levels which result in adverse effects have not been quantified (Nelson, 1988) (USFWS, 1991).

Stressor: Seagrass bed degradation (USFWFS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Boating activities in areas of seagrass beds can result in damage through anchoring and propeller scarring. In the United States Virgin Islands, seagrasses recovered only minimally in areas damaged by anchoring even after a period of seven months (Williams, 1988), and a decline in seagrass distribution was documented over a 30-year period in selected bays. The loss of available foraging habitat resulted in a lowered carrying capacity for specific bays (Williams,

1988). Extensive die-offs of seagrass beds in Florida Bay have recently been reported, and this may have serious consequences for the green turtles which forage there. The cause(s) of that decline have not yet been identified (USFWS, 1991).

Stressor: Trawl fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Of all commercial and recreational fisheries conducted in the United States, shrimp trawling is the most damaging to the recovery of marine turtles. The estimated number of green turtles captured annually is approximately 925 of which approximately 225 die (T. Henwood, pers. comm.). Incidental capture and drowning in shrimp trawls is believed to be the largest single source of mortality on juvenile through adult stage marine turtles in the southeastern United States. The majority of these turtles are juveniles and subadults, the age/size classes most critical to the stability and recovery of marine turtle populations (Crouse et al., 1987). Quantitative estimates of turtle take by shrimp trawlers in inshore waters have not been developed, but the level of trawling effort expended in inshore waters along with increasing documentation of the utilization of inshore habitat by green turtles suggest that capture and mortality may be significant. Trawlers targeting species other than shrimp tend to use larger nets than shrimp trawlers and probably also take sea turtles, although capture levels have not been developed. These fisheries include, but are not limited to, bluefish, croaker, flounder, calico scallops, blue crab, and whelk. Of these, the bluefish, croaker, and flounder trawl fisheries likely pose the most serious threat (T. Henwood, pers. comm) (USFWS, 1991).

Stressor: Purse seine fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Several purse seine fisheries operate in Gulf of Mexico and Atlantic, including those targeting menhaden and sardines. Turtles may be taken in these fisheries, but the level of take and percent mortality is currently unquantified (USFWS, 1991).

Stressor: Hook and line fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Several thousand commercial vessels are engaged in hook and line fisheries which target various species including coastal species, reef fish, and pelagic species. In addition to commercial take, the recreational fishery is extensive. Turtle captures on hook and line gear are not uncommon, but the level of take and percent mortality are unknown. It is assumed that most turtles are released alive, although ingested hooks and entanglement in associated monofilament/steel line have been documented as the probable cause of death in some stranded turtles (USFWS, 1991).

Stressor: Gill net fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals

Narrative: Gill nets are utilized both in inshore and offshore areas for various species and may be stationary or drifting. Mesh size is dependent on the size of the fish which are targeted but the gear is considered non-selective in the species impacted (T. Henwood, pers. comm.). Trammel nets are modified gill nets set in panels of webbing of variable mesh size. Marine turtles are vulnerable to entanglement and drowning in gill and trammel nets, especially when this gear is left unattended. turtle mortalities resulting from the use of gill nets set for sturgeon in South Carolina and North Carolina have been documented (Ulrich, 1978; Crouse, 1982). In response to this documented take, the state of South Carolina has prohibited gill netting for sturgeon since 1986. Of particular concern are the gill net and trammel net fisheries off the Florida east-central coast. These fisheries, primarily targeting king mackerel, pompano, and shark have undergone recent expansion in the number of vessels and level of fishing effort (Schaefer et d., 1987). Stranding patterns of turtles in this area indicate that significant numbers of turtles may be killed incidental to these fisheries. This may be particularly detrimental to the juvenile green turtle population(s) inhabiting this coastal area. (USFWS, 1991).

Stressor: Pound net fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: York, and Rhode Island. In Virginia, pound nets have been identified as a leading cause of marine turtle mortality (Lutcavage and Musick, 1985). Mortality was principally caused by entanglement and drowning in the leader portion of the gear and was dependent on mesh size., net location, and environmental parameters. In North Carolina, most pound nets have leads constructed of small mesh (5-8"). Results of preliminary investigations indicate that mortality in these nets may be infrequent (Epperly and Veishlow, 1989). Similarly, in New York, most turtles are released alive from pound nets and entanglement in leaders appears infrequent (V. Burke, pers. comm.) (USFWS, 1991).

Stressor: Longline fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Longline fisheries have increased dramatically over the past several years. Species targeted in these fisheries include tuna, shark, and swordfish. Witzell (1987) estimated that 330 turtles were incidentally captured in the Gulf of Mexico and Atlantic by the Japanese tuna longline fleet during 1978-1981. Due to increased effort and expansion of longline fisheries in recent years, it is believed that longline fisheries may be exerting a major negative impact on marine turtle recovery (T. Henwood, pers. comm.) (USFWS, 1991).

Stressor: Trap fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Traps are commonly used in the capture of crabs, lobster, and reef fish. Traps vary in size and configuration but all are attached to a surface float by means of a line leading to the trap. Turtles can become entangled in trap lines below the surface of the water and subsequently drown. In other instances, stranded turtles have been recovered entangled in trap line with the

trap in tow. The impact of this gear on green turtle populations has not been quantified (USFWS, 1991).

Stressor: Boat collisions (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Propeller and collision injuries to marine turtles from boats and ships are not uncommon. In 1986, 1987, and 1988, respectively 5.8 percent (1 1 I), 7.3 percent (175), and 9.0 percent (179) of all stranded turtles reported in the United States Gulf of Mexico and Atlantic were documented as having sustained some type of propeller or collision injuries, although it is unknown what percentage of these injuries were post-mortem versus ante-mortem (Schroeder and Warner, 1988; Teas and Martinez, 1989). These types of injuries are recorded at higher frequencies in areas where recreational boating and vessel traffic is intense, such as south Florida, the Florida Keys and United States Virgin Islands (USFWS, 1991).

Stressor: Power plant entrapment (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: The entrainment and entrapment of turtles in saltwater cooling intake systems of coastal power plants has been documented in New Jersey, North Carolina, Florida, and Texas (Roithmayr and Henwood, 1982; Ernest et d; 1989; S. Manzella, pers. comm; T. Henson, pers. comm.; R. Schoelkopf, pers. comm.). Average annual incidental capture rates for most coastal plants from which captures have been reported amount to several turtles per plant per year. One notable exception is the St. Lucie nuclear power plant located on Hutchinson Island, Florida. During a 13-year period of operation (March 1976 - December 1988), 1,929 turtles of all species have been removed from the intake canal. The mortality rate is approximately 7.0 percent (Applied Biology, Inc., unpubl. data). Most captures have been loggerheads, though green turtles are not uncommon. (USFWS, 1991).

Stressor: Underwater explosions (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: The use of underwater explosives for the removal of abandoned oil platforms, military activities, and oil exploration can injure or kill turtles and may destroy or degrade habitat. During a 3-year period (1986-1988) observers reported one injured (or dead) turtle during the removal of 103 offshore oil structures in the Gulf of Mexico. Of eight turtles deliberately exposed to underwater explosions at distances varying between 229 m and 915 m from the detonation site, five were rendered unconscious (Klima et al; 1989) (USFWS, 1991).

Stressor: Offshore artificial lighting (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/misorientation

Narrative: The effects of offshore lighted structures on the orientation of hatchling turtles is not completely understood. These lights may attract hatchlings and interfere with proper offshore orientation, and may make them more susceptible to predation (deSilva, 1982) (USFWS, 1991).

Stressor: Entanglement (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Turtles are affected to an unknown but potentially significant degree by entanglement in persistent marine debris, including discarded or lost fishing gear (Balazs, 1985). Green turtles have been found entangled in a wide variety of materials including steel and monofilament line, synthetic and natural rope, plastic onion sacks and discarded plastic netting materials (Balazs, 1985; Plotkin and Amos, 1988). Monofilament line appears to be the principal source of entanglement for green turtles in U.S. waters. Records from Florida and the United States Virgin Islands indicate that some entanglement results from netting and monofilament line which has accumulated on both artificial and natural reefs. These areas are often heavily fished, resulting in snagging of hooks and discarding of lines. Turtles foraging and/or resting in these areas can become entangled and drown (FDNR, unpubl. data). 'The alignment of persistent marine debris along convergences, rips, and driftlines and the concentration of young sea turtles along these fronts increases the likelihood of entanglement at this life history stage (Carr, 1987) (USFWS, 1991).

Stressor: Ingestion of marine debris (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Marine turtles have been found to ingest a wide variety of abiotic debris items such as plastic bags, raw plastic pellets, plastic and styrofoam pieces, tar balls and balloons. Effects of debris ingestion can include direct obstruction of the gut, absorption of toxic byproducts and reduced absorption of nutrients across the gut wall (Balazs, 1985). Studies conducted by Lutz (in press) revealed that both loggerhead and green turtles actively ingested small pieces of latex and plastic sheeting. Physiological data indicated a possible interference in energy metabolism or gut function, even at low levels of ingestion. Persistence of the material in the gut lasted from a few days to 4 months (Lutz, in press). Of particular concern is the co-occurrence of persistent marine debris and the early life history pelagic stages of green turtles along convergences. Young turtles are dependent upon these driftlines for their food supply, and hence the likelihood of debris ingestion is increased (Carr, 1987). While quantitative data on population effects are undetermined, the impacts of debris ingestion are considered serious (USFWS, 1991).

Stressor: Disease and parasites (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: There is little information available to assess the comprehensive effects of disease and/or parasites on wild populations of green turtles. The vast majority of diseases and conditions which have been identified or diagnosed in sea turtles are described from captive stock, either turtles in experimental headstart programs or mariculture facilities (Wolke, 1989). One notable exception is the occurrence of fibropapillomas on green turtles, first described by

Smith and Coates (1938). Fibropapillomas are now common on immature green turtles in the central Indian River system of Florida, Florida Bay, and in the Florida Keys (Ehrhart et al., 1986; Witherington and Ehrhart, 1987; Schroeder, 1987a). In the central Indian River lagoon, approximately half of all green turtles captured have been found to bear papillomas of varying degree (Ehrhart et al., 1986). Recent reports from Puerto Rico and the United States Virgin Islands indicate a very low occurrence of fibropapillomas on green turtles collected in these areas (R. Boulon and J. Collazo, pers. comm.). Fibropapillomas are also commonly found on Hawaiian green turtles. These tumor like growths can result in reduced vision, disorientation, blindness, physical obstruction to normal swimming and feeding, an apparent increased susceptibility to parasitism by marine leeches, and an increased susceptibility to entanglement in monofilament fishing line (Balazs, 1986). Blood counts and serum profiles of green turtles inflicted with fibropapillomas indicate marked debilitation (Jacobson, 1987) (USFWS, 1991).

Stressor: Predation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Predation of hatchling and very young turtles is assumed to be significant and predation of subadult through adult stage turtles is assumed less common, but valid estimates of mortality due to predation at various life history stages are extremely difficult, if not impossible, to obtain and have not been determined. Hatchlings entering the surf zone and pelagic stage hatchlings may be preyed upon by a wide variety of fish species and to a lesser extent, marine birds. Stancyk (1982) in an extensive literature review reported predators of juvenile and adult turtles to include at least six species of sharks, killer whales, bass, and grouper. Tiger sharks appear to be the principal predator of subadult and adult turtles. While stranded turtles may exhibit shark inflicted injuries, caution must be exercised in attributing a cause of death as these wounds can be inflicted post-mortem (USFWS, 1991).

Recovery

Delisting Criteria:
The United States population of green turtles can be considered for delisting if, over a period of 25 years, the following conditions are met: 1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years. Nesting data must be based on standardized surveys (USFWS, 1991).

2. At least 25 percent (105 km) of all available nesting beaches (420 km) is in public ownership and encompasses at least 50 percent of the nesting activity (USFWS, 1991).

3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds (USFWS, 1991).

4. All priority one tasks have been successfully implemented (USFWS, 1991).

Recovery Actions:
- 1. Protect and manage habitats. 11. Protect and manage nesting habitat. 111. Ensure beach nourishment projects are compatible with maintaining good quality nesting habitat. (also see 215). 1111. Implement and evaluate tilling as a means of softening compacted beaches.

1112. Evaluate the relationship of sand characteristics (including aragonite) and hatch success, hatchling sex ratios, and nesting behavior. 1113. Reestablish dunes and native vegetation. 1114. Evaluate sand transfer systems as alternative to beach nourishment. 112. Prevent degradation of nesting habitat from seawalls, revetments, sand bags, sand fences, or other erosion control measures. 1121. Evaluate current laws on beach armoring and strengthen if necessary. 1122. Ensure laws regulating coastal construction and beach armoring are enforced. 1123. Ensure failed erosion control structures are removed. 1124. Develop standard requirements for sand fence construction. 113. Acquire or otherwise ensure the long-term protection of key nesting beadles. 1131. Acquire in fee title all undeveloped nesting beaches between Melbourne Beach and Wabasso Beach, Florida. 1132. Evaluate the status of the important nesting beaches on Hutchinson Island, Florida, and develop a plan for long-term protection. 114. Remove exotic vegetation and prevent spread to nesting beaches. 12. Protect marine habitat. 121. Identify important habitat. 122. Prevent degradation and improve water quality of important turtle habitat. 123. Prevent destruction of habitat from fishing gears and vessel anchoring. 124. Prevent destruction of marine habitat from oil and gas activities. 125. Prevent destruction of habitat from dredging activities. 126. Restore important foraging habitats (USFWS, 1991).

- 2. Protect and manage population. 21. Protect and manage populations on nesting beaches. 211. Monitor trends in nesting activity by means of standardized surveys. 212. Evaluate nest success and implement appropriate nest protection measures. 213. Determine influence of factors such as tidal inundation and foot traffic on hatching success. 214. Reduce effects of artificial lighting on hatchlings and nesting females. 2141. Determine hatchling orientation mechanisms in the marine environment and assess dispersal patterns from natural (dark) beaches and beaches with high levels of artificial lighting. 2142. Implement and enforce lighting ordinances. 2143. Evaluate extent of hatchling disorientation on all important regional nesting beaches. 2144. Evaluate need for Federal lighting regulations. 2145. Develop lighting plans at Kennedy Space Center, Port Canaveral, Cape Canaveral Air Force Station and Patrick Air Force Base, Florida. 2146. Prosecute individuals or entities responsible for hatchling disorientation or misorientation under the Endangered Species Act or appropriate State laws. 215. Ensure beach nourishment and coastal construction activities are planned to avoid disruption of nesting and hatching activities. 216. Ensure law enforcement activities eliminate poaching and harassment. 217. Determine natural hatchling sex ratios. 22. Protect and manage populations in the marine environment. 221. Determine green turtle distribution, abundance and status in the marine environment. 2211. Determine seasonal distribution, abundance, population characteristics, and status in bays, sounds and other important nearshore habitats. 2212. Determine adult navigation mechanisms, migratory pathways, distribution and movements between nesting seasons. 2213. Determine present or potential threats to green turtles along migratory routes and on foraging grounds. 2214. Determine breeding population origins for U.S. juvenile/subadult populations. 2215. Determine growth rates, age of sexual maturity and survivorship rates of hatchlings, juveniles, and adults. 222. Monitor and reduce mortality from commercial and recreational fisheries. 2221. Implement and enforce TED regulations in all United States waters at all times. 2222. Provide technology transfer for installation and use of TEDs. 2223. Maintain the Sea Turtle Stranding and Salvage Network. 2224. Identify and monitor other fisheries that may be causing significant mortality. 2225. Promulgate regulations to reduce fishery related mortalities. 223. Monitor and reduce mortality from dredging activities. 2231. Monitor turtle mortality on dredges. 2232. Evaluate modifications of dredge dragheads or devices to reduce turtle captures, and incorporate effective modifications or devices into future dredging operations. 2233. Determine seasonality and abundance of sea turtles at dredging localities, and ensure that dredging is restricted to time periods with the least potential for turtle mortality. 224. Monitor and prevent adverse impacts from oil and gas activities. 2241. Determine the effects of oil and oil dispersants on all life stages. 2242. Ensure that impacts to sea turtles are adequately addressed during planning of oil and gas development. 2243. Determine sea turtle distribution and seasonal use of marine habitats associated with oil and gas development areas. 224. Reduce impacts from entanglement and ingestion of persistent marine debris. 2251. Evaluate the extent of entanglement and ingestion of persistent marine debris. 2252. Evaluate the effects of ingestion of persistent marine debris on health and viability of sea turtles. 2253. Determine and implement appropriate measures to reduce or eliminate persistent marine debris in the marine environment. 226, Increase law enforcement efforts to reduce poaching in United States waters. 227, Determine etiology of fibropapillomatosis. 228. Centralize administration and coordination of tagging programs. 2281. Centralize tag series records. 2282. Centralize turtle tagging records. 229. Ensure proper care of sea turtles in captivity. 2291. Develop standards for care and maintenance including diet, water quality and tank size. 2292. Develop manual for treatment of disease and injuries. 2293. Establish catalog for all captive sea turtles to enhance utilization for research and education. 2294. Designate rehabilitation facilities (USFWS, 1991).

- 3. Information and education. 31. Provide slide programs and information leaflets on sea turtle conservation for general public. 32. Develop brochure on recommended lighting modifications or measures to reduce hatchling disorientation and misorientation. 34. Develop public service announcements regarding the sea turtle artificial lighting conflict, and disturbance of nesting activities by public nighttime beach activities. 34. Ensure facilities permitted to hold and display captive sea turtles have appropriate informational displays. 35. Post information signs at public access points on important nesting beaches (USFWS, 1991).
- 4. International cooperation. 41. Develop international agreements to ensure protection of life stages which occur in foreign waters (USFWS, 1991).

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SPECIES ACCOUNT: *Chelonia mydas* (Green sea turtle (S Atlantic DPS))

Species Taxonomic and Listing Information

Listing Status: Threatened; Southeast Region (R4) (USFWS, 2015) 7/28/1978

Physical Description

A sea turtle with a brown carapace, often with radiating mottled or wavy dark markings or large dark brown blotches; 4 costal plates on each side of carapace; first costal does not contact the nuchal; one pair of prefrontal plates between the eyes; limbs are flattened flippers; young are black to dark brown above, mainly white below, with a mid-dorsal keel and two plastral keels, 4-6 cm at hatching; adult carapace length usually 90-122 cm (to 153 cm), mass 113-204 kg (to 295+ kg) (Conant and Collins 1991). LENGTH:122 WEIGHT: 200000 (NatureServe, 2015). The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

Eastern Pacific populations of Chelonia are regarded by some authors as a distinct species, the black turtle, C. agassizii (King and Burke 1989); other authors (e.g., Ernst and Barbour 1989) retain agassizii as a subspecies of C. mydas (Kamezaki and Matsui 1995) or do not recognize it taxonomically at all (Crother et al. 2000). Phylogenetic analyses of mtDNA data by Bowen et al. (1992) yielded no evidence of matrilineal distinctiveness of agassizii. See Karl and Bowen (1999), Pritchard (1999), Grady and Quattro (1999), Shrader-Frechette and McCoy (1999), and Bowen and Karl (1999) for further debate about the taxonomic status of the black turtle. The Australian flatback turtle, formerly known as Chelonia depressa, has been removed to its own genus, Natator (Zangerl et al. 1988, Limpus et al. 1988). MtDNA data indicate a fundamental phylogenetic split distinguishing all green turtles in the Atlantic-Mediterranean from those in the Indian-Pacific oceans (Bowen et al. 1992). Most regional populations of Chelonia mydas are genetically distinct (Bowen et al. 1992). Florida population is characterized by unusually high mtDNA diversity (Allard et al. 1994) (NatureServe, 2015).

Historical Range

The present distribution of the breeding sites has been largely affected by historical patterns of human exploitation. Most of the substantial breeding colonies left today are those that have not been permanently inhabited by humans or have not been heavily exploited until recently (Groombridge and Luxmoore 1989, Seminoff 2004) (NMFS and USFWS, 2007).

Current Range

The range of the South Atlantic DPS begins at the border of Panama and Colombia at 7.5° N., 77° W., heads due north to 14° N., 77° W., then east to 14° N., 65.1° W., then north to 19° N., 65.1° W., and along 19° N. latitude to Mauritania in Africa, to include the U.S. Virgin Islands in the Caribbean. It extends along the coast of Africa to South Africa, with the southern border being 40° S. latitude (NMFS, 2016). (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). The green turtle has a circumglobal distribution, occurring throughout nearshore tropical, subtropical and, to a lesser extent, temperate waters. Nesting for the green turtle South Atlantic DPS occurs on both sides of the Atlantic Ocean, along the western coast of Africa, Ascension Island, the U.S. Virgin Islands in the Caribbean and eastern South America, from Brazil north to the Caribbean. Juveniles and adults can be found on feeding grounds in the Caribbean and the nearshore waters of Brazil, Uruguay and Argentina. In the east, South Atlantic DPS green turtles can be found on foraging grounds off the coast of west Africa, from Equatorial Guinea, Gabon, Congo, Angola and Principe Island (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

Yes

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Diet includes "seagrass," macroalgae and other marine vegetation, and various invertebrates such as mollusks, sponges, crustaceans, and jellyfish. Food Habits: Invertivore (Adult, Immature), Herbivore (Adult, Immature) Turtles in the northern Gulf of California overwinter in a dormant condition. Nesting occurs generally at night. In Hawaii, green sea turtles may bask on beaches mid-morning to mid-afternoon, especially after a period of rainy weather (Whittow and Balazs 1982) (NatureServe, 2015). Feeding occurs in shallow, low-energy waters with abundant submerged vegetation, and also in convergence zones in the open ocean (NMFS and USFWS 2007). Migrations may traverse open seas. Adults are tropical in distribution, whereas juveniles range into temperate waters (e.g., see Morreale and Standora, no date). Hatchlings often float in masses of marine macroalgae (e.g., Sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. Inactive individuals may rest on the bottom in winter in the northern Gulf of California. Basking on beaches occurs in some areas (e.g., Hawaii). Nesting occurs on beaches, usually on islands but also on the mainland. Sand may be coarse to fine, has little organic content; physical characteristics vary greatly in different regions. Most nesting occurs on high energy beaches with deep sand. At least in some regions, individuals generally nest at same beach (apparently the natal beach, Meylan et al. 1990, Allard et al. 1994) in successive nestings, though individuals sometimes change to a different nesting beach within a single nesting season (has switched to beach up to several hundred kilometers away) (see Eckert et al. 1989). Beach development and illumination often make beaches unsuitable for successful nesting (NatureServe, 2015).

Reproduction Narrative

Adult: Individual reproductive females lay 1-8 clutches per season, averaging about 90-140 eggs, at about two-week intervals usually every 2-5 years. Nesting occurs March-October in Caribbean-Gulf of Mexico region, with peak in May-June; nests in Florida May-September (Ehrhart and Witherington 1992). Nesting encompasses April-October, with a peak between mid-June and early August, in Hawaii (Niethammer et al. 1997). Eggs hatch usually in 1.5-3 months. Hatchlings emerged between early July and late December (peak mid-August to early October) in Hawaii (Niethammer et al. 1997). Females mature probably at an average age of 27 years in Florida, but growth rates and hence age of maturity may vary greatly (from perhaps fewer than 20 years to 40+ years) throughout the range (slower growth in Australia, Hawaii, and Galapagos than in Florida and West Indies region).; Eggs and hatchlings typically incur high mortality from various terrestrial and aquatic predators, including both vertebrates and invertebrates (e.g., crabs). Many nests are destroyed by tidal inundation and erosion. In Costa

Rica, annual survivorship of adult females was 0.61; in various areas egg survivorship was 0.40-0.86 (see Iverson [1991] for a compilation of survivorship data). Humans are the most important predators on adults. See Witherington and Ehrhart (1989) for information on cold stunning in Florida (NatureServe, 2015). Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of one hundred eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Site Fidelity

Adult: High (NMFS, 1991)

Habitat Narrative

Adult: Feeding occurs in shallow, low-energy waters with abundant submerged vegetation, and also in convergence zones in the open ocean (NMFS and USFWS 2007). Migrations may traverse open seas. Adults are tropical in distribution, whereas juveniles range into temperate waters (e.g., see Morreale and Standora, no date). Hatchlings often float in masses of marine macroalgae (e.g., Sargassum) in convergence zones. Coral reefs and rocky outcrops near feeding pastures often are used as resting areas. Inactive individuals may rest on the bottom in winter in the northern Gulf of California. Basking on beaches occurs in some areas (e.g., Hawaii). Nesting occurs on beaches, usually on islands but also on the mainland. Sand may be coarse to fine, has little organic content; physical characteristics vary greatly in different regions. Most nesting occurs on high energy beaches with deep sand. At least in some regions, individuals generally nest at same beach (apparently the natal beach, Meylan et al. 1990, Allard et al. 1994) in successive nestings, though individuals sometimes change to a different nesting beach within a single nesting season (has switched to beach up to several hundred kilometers away) (see Eckert et al. 1989). Beach development and illumination often make beaches unsuitable for successful nesting (NatureServe, 2015). It is generally accepted that green sea turtles return to their natal beaches. Green sea turtles do exhibit strong site fidelity in successive nesting seasons (NMFS, 1991)

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: High (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Adults migrate up to about 3,000 km between nesting beaches and feeding areas (e.g., between Ascension Island and the South American coast). See Balazs (1982) for a map of documented migrations between the major nesting area in Hawaii (French Frigate Shoals) and foraging areas elsewhere in the Hawaiian Islands. See Morreale and Standora (no date) for information on movements along the east coast of the United States. Seminoff et al. (2002) documented migration between nesting area on the coast of Michoacan (Mexico; January 2000) and a feeding ground on the Sonoran coast of the Gulf of California (Mexico; September 2000). See Mortimer and Porter (1989) for information on inter-nesting movements at Ascension Island. Neonates migrate far from natal beaches to foraging areas and return to natal beach to breed/nest up to 40+ years later (NatureServe, 2015).

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

High (NatureServe, 2015; USFWS, 1991)

Representation:

High (NatureServe, 2015; USFWS, 2015)

Redundancy:

High (NatureServe, 2015; USFWS, 2015)

Number of Populations:

81 to >300 (NatureServe, 2015)

Population Size:

100,000 to >1,000,000 individuals (NatureServe, 2015). South Atlantic DPS 63,332 nesting females (NMFS, 2016)

Resistance to Disease:

Moderate (USFWS, 1991)

Population Narrative:

Number of subpopulations and especially population size undoubtedly have undergone a major decline over the long term. Decline of 30-70% At 46 nesting areas worldwide, representing most but not all of the global population, the latest data indicate that approximately 109,000-151,000 females nest each year (NMFS and USFWS 2007). Assuming an average remigration interval of 3 years, this indicates an adult female population size of roughly 327,000-453,000. Assuming an equal number of adult males yields 654,000-906,000 adults for this subset of the global population. This species is represented by a large number of nesting occurrences (more than 150 major and minor nesting areas in more than 80 nations worldwide) (NatureServe, 2015). High resiliency, redundancy and representation are based on the overall number of individuals in the DPS and the geographic range that the species inhabits. Fibropapillomas are common on immature green sea turtles in the Indian River population (USFWS, 1991). Though there is some evidence that the South Atlantic DPS is increasing, there is a considerable amount of uncertainty over the impacts of threats to the South Atlantic DPS. The DPS is threatened by habitat degradation at nesting beaches, and mortality from fisheries bycatch remains a primary concern (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance: Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year. The South Atlantic DPS has 51 nesting sites, with an estimated nester abundance of 63,332. The largest nesting site is at Poilão, Guinea-Bissau, which hosts 46% of nesting females for the DPS (Seminoff et al. 2015). Productivity / Population Growth Rate: There are fifty-one nesting sites for the South Atlantic DPS, and many have insufficient data to determine population growth rates or trends. Of the nesting sites where data are available, such as Ascension Island, Suriname, Brazil, Venezuela, Equatorial Guinea, and Guinea-Bissau, there is evidence that population abundance is increasing (Seminoff et al. 2015). Genetic Diversity: Individuals from nesting sites in Brazil, Ascension Island, and western Africa have a shared haplotype found in high frequencies. Green turtles from rookeries in the eastern Caribbean however, are dominated by a different haplotype (Seminoff et al. 2015) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Beach erosion (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/Loss of nests
Narrative: Erosion of nesting beaches can result in partial or total loss of suitable nesting habitat. Erosion rates are influenced by dynamic coastal processes, including sea level rise. Man's interference with these natural processes through coastal development and associated activities has resulted in accelerated erosion rates and interruption of natural shoreline migration (USFWS, 1991).

Stressor: Beach armoring (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Where beachfront development occurs, the site is often fortified to protect the property om erosion. Virtually all shoreline engineering is carried out to save structures, not dry sandy beaches, and ultimately results in environmental damage (USFWS, 1991).

Stressor: Beach nourishment (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Beach nourishment consists of pumping, trucking, or scraping sand onto the beach to rebuild what has been lost to erosion. Beach nourishment can impact turtles through direct burial of nests and by disturbance to nesting turtles if conducted during the nesting season. Sand sources may be dissimilar from native beach sediments and can affect nest site selection, digging behavior, incubation temperature (and hence sex ratios), gas exchange parameters within incubating nests, hydric environment of the nest, hatching success and hatchling emergence

success (Mann, 1977; Ackerman, 1980; Mortimer, 1982b; Raymond, 1984a). Beach nourishment can result in severe compaction or concretion of the beach. Trucking of sand onto project beaches may increase the level of compaction (USFWS, 1991).

Stressor: Artificial lighting (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/misorientation
Narrative: Extensive research has demonstrated that the principal component of the sea-finding behavior of emergent hatchlings is a visual response to light (Daniel and Smith, 1947; Hendrichon, 1958; Carr and Ogren, 1960; Ehrenfeld and Carr, 1967; Dickerson and Nelson, 1989; Witherington, 1989). Artificial beachfront lighting from buildings, streetlights, dune crossovers, vehicles and other types of beachfront lights have been documented in the disorientation (loss of bearings) and misorientation (incorrect bearing) of hatchling turtles (McFarlane, 1963; Philibosian, 1976; Mann, 1977; 1980; Ehrhart, 1983). The results of misorientation are often fatal. As hatchlings head toward lights or meander along the beach their exposure to predators and likelihood of desiccation is greatly increased. Misoriented hatchlings can become entrapped in vegetation or debris, and many hatchlings are found dead on nearby roadways and in parking lots after being struck by vehicles. Hatchlings that successfully find the water may be misoriented after entering the surf zone or while in nearshore waters. Intense artificial lighting can even md raw hatchlings back out of the surf (Daniel and Smith, 1947; Carr and Ogren, 1960). During 1988 alone, 10,155 misoriented hatchlings were reported to the FDNR. An unquantifiable number of additional disorientation and misorientation events undoubtedly occurred but were not documented due to depredation, entrapment in thick vegetation, loss in storm drains, or obliteration of carcasses by vehicle tires. The problem of artificial beachfront lighting is not restricted to hatchlings. Carr et al (15)78), Mortimer [1982b), and Witherington (1986) found that adult green turtles avoided bright areas on nesting beaches. Problem lights may not be restricted to those placed directly on or in close proximity to nesting beaches. %e background glow associated with intensive inland lighting, such as that emanating from nearby large metropolitan areas, may deter nesting females and misorient hatchlings navigating the nearshore haters. Cumulatively, along the heavily developed beaches of the southeastern United States, the negative effects of artificial lights are profound (USFWS, 1991).

Stressor: Beach cleaning (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of nests
Narrative: Beach cleaning refers to the removal of both abiotic and biotic debris from developed beaches. There are several methods employed including mechanical raking, hand raking and hand picking up of debris. Mechanical raking can result in heavy machinery repeatedly traversing nests and potentially compacting sand above nests and also results in tire ruts along the beach which may hinder or trap emergent hatchlings. Mann (1977) suggested that mortality within nests may increase when externally applied pressure from beach cleaning machinery is common on soft beaches with large grain sands. Mechanically pulled rakes and hand rakes can penetrate the surface and disturb the sealed nest or may actually uncover pre-emergent hatchlings near the surface of the nest. In some areas collected debris is buried directly on the beach, and this can lead to excavation and destruction of incubating egg clutches. Disposal of debris near the dune line or on the high beach can cover incubating egg clutches and subsequently hinder and

entrap emergent hatchlings and may alter natural nest temperatures. In some areas, mechanical beach cleaning is the sole reason for extensive nest relocation (USFWS, 1991).

Stressor: Increased human presence (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of nests/misorientation
Narrative: Residential and tourist use of developed (and developing) nesting beaches can result in negative impacts to nesting turtles, incubating egg clutches, and hatchlings. The most serious threat caused by increased human presence on the beach is the disturbance to nesting females. Night-time human activity can cause nesting females to abort nesting attempts at all stages of the behavioral process. Murphy (1985) reported that disturbance can cause turtles to shift their nesting beaches, delay egg laying and select poor nesting sites. Heavy utilization of nesting beaches by humans (pedestrian traffic) may result in lowered hatchling emergence success rates due to compaction of sand above nest (Mann, 1977), and pedestrian tracks can interfere with the ability of hatchlings to reach the ocean (Hosier et al., 198 1). Campfires and the use of flashlights on nesting beaches misorient hatchlings and can deter nesting females (Mortimer, 1979) (USFWS, 1991).

Stressor: Recreational beach equipment (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals/loss of nests
Narrative: The placement of physical obstacles (e.g., lounge chairs, cabanas, umbrellas, hobie cats, canoes, small boats, beach cycles) on nesting beaches can hamper or deter nesting attempts and interfere with incubating egg clutches and the sea approach of hatchlings. The documentation of false crawls at these obstacles is becoming increasingly common as more recreational beach equipment is left in place nightly on nesting beaches. Additionally, there are documented reports of nesting females becoming entrapped under heavy wooden lounge chairs and cabanas on south Florida nesting beaches (J. Hoover, pers. comm., S. Bass, pers. comm). The placement of recreational beach equipment directly above incubating egg clutches may hamper hatchlings during emergence and can destroy eggs through direct invasion of the nest (C. LeBuff, pers. comm.) (USFWS, 1991).

Stressor: Beach vehicular driving (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of nests/loss of individuals
Narrative: The operation of motor vehicles on nesting beaches for recreational purposes is permitted in northeast Florida (portions of Nassau, Duval, St. John's, Flagler and Volusia counties), northwest Florida (Walton and Gulf Counties), and North Carolina (Emerald Isle, Cape Lookout National Seashore, Cape Hatteras National Seashore and Currituck Banks). While some areas restrict night driving, others permit it. Driving on beaches at night during the nesting season can disrupt the nesting process and result in aborted nesting attempts. The negative impact on nesting females in the surf zone may be particularly severe. Vehicle headlights can disorient or misorient emergent hatchlings and vehicles can strike and kill hatchlings attempting to reach the ocean. The tracks or ruts left by vehicles traversing the beach interfere with the ability of hatchlings to reach the ocean. The extended period of travel required to negotiate tire

tracks and ruts may increase the susceptibility of hatchlings to stress and depredation during transit to the ocean (Hosier et d., 1981; M. Evans, FDNR, pers. comm.). Driving directly above incubating egg clutches can cause sand compaction which may decrease nest success and directly kill pre-emergent hatchlings (Mann, 1977). In many areas, beach vehicular driving is the sole cause for nest relocation. Additionally, vehicle traffic on nesting beaches contributes to erosion, especially during high tides or on narrow beaches where driving is concentrated on the high beach and foredune (USFWS, 1991).

Stressor: Exotic dune and beach vegetation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Non-native vegetation has invaded many coastal areas and often outcompetes native species such as sea oats, railroad vine, sea grape, dune panic grass and pennywort. The invasion of less stabilizing vegetation can lead to increased erosion and degradation of suitable nesting habitat. Exotic vegetation may also form impenetrable root mats which can prevent proper nest cavity excavation, invade and desiccate eggs or trap hatchlings (USFWS, 1991).

Stressor: Nest depredation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of nests
Narrative: A variety of natural and introduced predators such as raccoons, feral hogs, foxes, ghost crabs and ants prey on incubating eggs and hatchling sea turtles. The principal predator is the raccoon (Procyon lotor). Raccoons are particularly destructive and may take up to 96 percent of all nests deposited on a beach (Davis and Whiting, 1977; Hopkins and Murphy, 1980; Stancyk et al., 1980; Talbert et al., 1980; Schroeder, 1981; Labisky et al., 1986). Prior to hog control efforts, up to 45 percent of all sea turtle nests deposited at the Cape Canaveral Air Force Station, Florida, were depredated by feral hogs (FDNR, unpubl. data). In addition to the destruction of eggs, certain predators may take considerable numbers of hatchlings just prior to or upon emergence from the sand (USFWS, 1991).

Stressor: Nest Loss and Abiotic Factors (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of nests
Narrative: Nest loss due to erosion or inundation and accretion of sand above incubating nests appear to be the principal abiotic factors which may negatively affect incubating: egg clutches. while these factors are often widely perceived as contributing significantly to nest mentality or lowering hatching success, few quantitative studies have been conducted (Mortimer, 1989). Studies on a relatively undisturbed nesting beach by Witherington (1986) indicated that excepting a late season severe storm event, erosion and inundation played a relatively minor role in destruction of incubating nests. Inundation of nests and accretion of sand above incubating nests as a result of a late season storm played a major role in destroying nests from which hatchlings had not yet emerged. Severe storm events (e.g., tropical storms, hurricanes) may result in significant nest loss, but these events are typically aperiodic rather than annual occurrences. In the southeastern United States, severe storm events are generally experienced after the peak of the hatching season and hence would not be expected to affect the majority of

incubating nests. Erosion and inundation of nests is exacerbated through coastal development and shoreline engineering. These threats are discussed above under beach armoring (USFWS, 1991).

Stressor: Poaching (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: In the United States, take of nesting female green turtles is infrequent. However, in a number of areas, egg poaching and clandestine markets for eggs are not uncommon. During the period 1983 - 1989 the Florida Marine Patrol made 29 arrests for illegal possession of turtle eggs (figure: not apportioned by species) (USFWS, 1991). Illegal directed harvesting of juvenile and adult green turtles in the waters of the continental United States and U.S. Caribbean is not uncommon, but no estimates of the level of take exist. During the period 1983-1989, the Florida Marine Patrol made three arrests for illegal possession of whole turtles and 25 arrests for illegal possession of turtle parts within Florida (figures are not apportioned by species). Illegal take of green turtles in the United States Caribbean, particularly in Puerto Rican waters, is likely the most significant problem (USFWS, 1991).

Stressor: Oil and gas exploration, development and transportation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: Experimental and field results reported by Vargo pt al. (1986) indicate that marine turtles would be at substantial risk if they encountered an oil spill or large amounts of tar in the environment. Physiological experiments indicate that the respiration, skin, some aspects of blood chemistry and composition, and salt gland function of marine turtles are significantly affected (Vargo et al., 1986). Spills in the vicinity of nesting beaches are of special concern and could place nesting adults, incubating egg clutches (Fritts and McGehee, 1989) and hatchlings at significand risk. Exploration and oil development on live bottom areas may disrupt foraging grounds by smothering benthic organisms with sediments and drilling muds (Coston-Clements and Hoss, 1983). Oil and tar are also released into the marine environment during pumping of bilges on large vessels. In a review of available information on debris ingestion, Balazs (1985) reported that tar balls were the second most prevalent type of abiotic debris ingested by marine turtles (USFWS, 1991).

Stressor: Dredging (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: The effects of dredging are evidenced through direct destruction or degradation of habitat and incidental take of marine turtles. Channelization of inshore and nearshore habitat and the disposal of dredged material in the marine environment can destroy or disrupt resting or foraging grounds (including grass beds and coral reefs) and may affect nesting distribution through the alteration of physical features in the marine environment (Hopkins and Murphy, 1980). Hopper dredges are responsible for incidental take and mortality of marine turtles during dredging operations. During a 3-month period in 1980 in the Port Canaveral, Florida, channel, dredging operations were responsible for the mortality of approximately 100 turtles. These high

levels of incidental take have not been documented during dredging operations in subsequent years. Maintenance dredging of the Kings Bay, Georgia, channel during 1987-1988 resulted in the mortality of approximately 20 turtles during a 1 year period. Other types of dredges (clamshell and pipeline) have not been implicated in incidental take (USFWS, 1991).

Stressor: Marina and dock development (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: The development of marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat. Additionally, this type of development leads to increased boat and vessel traffic which may result in higher incidences of propeller- and collision-related mortality. Fueling facilities at marinas can result, in the discharge of oil and gas into sensitive estuarine habitat (USFWS, 1991).

Stressor: Pollution (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/decreased nesting success
Narrative: The effects of pollutants resulting from industrial, agricultural or residential sources are difficult to evaluate. Pesticides, heavy metals and PCB's have been detected in turtles (including eggs), but levels which result in adverse effects have not been quantified (Nelson, 1988) (USFWS, 1991).

Stressor: Seagrass bed degradation (USFWFS, 1991)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Boating activities in areas of seagrass beds can result in damage through anchoring and propeller scarring. In the United States Virgin Islands, seagrasses recovered only minimally in areas damaged by anchoring even after a period of seven months (Williams, 1988), and a decline in seagrass distribution was documented over a 30-year period in selected bays. The loss of available foraging habitat resulted in a lowered carrying capacity for specific bays (Williams, 1988). Extensive die-offs of seagrass beds in Florida Bay have recently been reported, and this may have serious consequences for the green turtles which forage there. The cause(s) of that decline have not yet been identified (USFWS, 1991).

Stressor: Trawl fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Of all commercial and recreational fisheries conducted in the United States, shrimp trawling is the most damaging to the recovery of marine turtles. The estimated number of green turtles captured annually is approximately 925 of which approximately 225 die (T. Henwood, pers. comm.). Incidental capture and drowning in shrimp trawls is believed to be the largest single source of mortality on juvenile through adult stage marine turtles in the southeastern United States. The majority of these turtles are juveniles and subadults, the age/size classes most critical to the stability and recovery of marine turtle populations (Crouse et al., 1987).

Quantitative estimates of turtle take by shrimp trawlers in inshore waters have not been developed, but the level of trawling effort expended in inshore waters along with increasing documentation of the utilization of inshore habitat by green turtles suggest that capture and mortality may be significant. Trawlers targeting species other than shrimp tend to use larger nets than shrimp trawlers and probably also take sea turtles, although capture levels have not been developed. These fisheries include, but are not limited to, bluefish, croaker, flounder, calico scallops, blue crab, and whelk. Of these, the bluefish, croaker, and flounder trawl fisheries likely pose the most serious threat (T. Henwood, pers. comm) (USFWS, 1991).

Stressor: Purse seine fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Several purse seine fisheries operate in Gulf of Mexico and Atlantic, including those targeting menhaden and sardines. Turtles may be taken in these fisheries, but the level of take and percent mortality is currently unquantified (USFWS, 1991).

Stressor: Hook and line fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Several thousand commercial vessels are engaged in hook and line fisheries which target various species including coastal species, reef fish, and pelagic species. In addition to commercial take, the recreational fishery is extensive. Turtle captures on hook and line gear are not uncommon, but the level of take and percent mortality are unknown. It is assumed that most turtles are released alive, although ingested hooks and entanglement in associated monofilament/steel line have been documented as the probable cause of death in some stranded turtles (USFWS, 1991).

Stressor: Gill net fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Gill nets are utilized both in inshore and offshore areas for various species and may be stationary or drifting. Mesh size is dependent on the size of the fish which are targeted but the gear is considered non-selective in the species impacted (T. Henwood, pers. comm.). Trammel nets are modified gill nets set in panels of webbing of variable mesh size. Marine turtles are vulnerable to entanglement and drowning in gill and trammel nets, especially when this gear is left unattended. turtle mortalities resulting from the use of gill nets set for sturgeon in South Carolina and North Carolina have been documented (Ulrich, 1978; Crouse, 1982). In response to this documented take, the state of South Carolina has prohibited gill netting for sturgeon since 1986. Of particular concern are the gill net and trammel net fisheries off the Florida east-central coast. These fisheries, primarily targeting king mackerel, pompano, and shark have undergone recent expansion in the number of vessels and level of fishing effort (Schaefer et d., 1987). Stranding patterns of turtles in this area indicate that significant numbers of turtles may be killed incidental to these fisheries. This may be particularly detrimental to the juvenile green turtle population(s) inhabiting this coastal area. (USFWS, 1991).

Stressor: Pound net fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: York, and Rhode Island. In Virginia, pound nets have been identified as a leading cause of marine turtle mortality (Lutcavage and Musick, 1985). Mortality was principally caused by entanglement and drowning in the leader portion of the gear and was dependent on mesh size., net location, and environmental parameters. In North Carolina, most pound nets have leads constructed of small mesh (5-8"). Results of preliminary investigations indicate that mortality in these nets may be infrequent (Epperly and Veishlow, 1989). Similarly, in New York, most turtles are released alive from pound nets and entanglement in leaders appears infrequent (V. Burke, pers. comm.) (USFWS, 1991).

Stressor: Longline fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Longline fisheries have increased dramatically over the past several years. Species targeted in these fisheries include tuna, shark, and swordfish. Witzell (1987) estimated that 330 turtles were incidentally captured in the Gulf of Mexico and Atlantic by the Japanese tuna longline fleet during 1978-1981. Due to increased effort and expansion of longline fisheries in recent years, it is believed that longline fisheries may be exerting a major negative impact on marine turtle recovery (T. Henwood, pers. comm.) (USFWS, 1991).

Stressor: Trap fisheries (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Traps are commonly used in the capture of crabs, lobster, and reef fish. Traps vary in size and configuration but all are attached to a surface float by means of a line leading to the trap. Turtles can become entangled in trap lines below the surface of the water and subsequently drown. In other instances, stranded turtles have been recovered entangled in trap line with the trap in tow. The impact of this gear on green turtle populations has not been quantified (USFWS, 1991).

Stressor: Boat collisions (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Propeller and collision injuries to marine turtles from boats and ships are not uncommon. In 1986, 1987, and 1988, respectively 5.8 percent (1 1 I), 7.3 percent (175), and 9.0 percent (179) of all stranded turtles reported in the United States Gulf of Mexico and Atlantic were documented as having sustained some type of propeller or collision injuries, although it is unknown what percentage of these injuries were post-mortem versus ante-mortem (Schroeder and Warner, 1988; Teas and Martinez, 1989). These types of injuries are recorded at higher frequencies in areas where recreational boating and vessel traffic is intense, such as south Florida, the Florida Keys and United States Virgin Islands (USFWS, 1991).

Stressor: Power plant entrapment (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: The entrainment and entrapment of turtles in saltwater cooling intake systems of coastal power plants has been documented in New Jersey, North Carolina, Florida, and Texas (Roithmayr and Henwood, 1982; Ernest et d; 1989; S. Manzella, pers. comm; T. Henson, pers. comm.; R. Schoelkopf, pers. comm.). Average annual incidental capture rates for most coastal plants from which captures have been reported amount to several turtles per plant per year. One notable exception is the St. Lucie nuclear power plant located on Hutchinson Island, Florida. During a 13-year period of operation (March 1976 - December 1988), 1,929 turtles of all species have been removed from the intake canal. The mortality rate is approximately 7.0 percent (Applied Biology, Inc., unpubl. data). Most captures have been loggerheads, though green turtles are not uncommon. (USFWS, 1991).

Stressor: Underwater explosions (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: The use of underwater explosives for the removal of abandoned oil platforms, military activities, and oil exploration can injure or kill turtles and may destroy or degrade habitat. During a 3-year period (1986-1988) observers reported one injured (or dead) turtle during the removal of 103 offshore oil structures in the Gulf of Mexico. Of eight turtles deliberately exposed to underwater explosions at distances varying between 229 m and 915 m from the detonation site, five were rendered unconscious (Klima et al; 1989) (USFWS, 1991).

Stressor: Offshore artificial lighting (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of habitat/misorientation
Narrative: The effects of offshore lighted structures on the orientation of hatchling turtles is not completely understood. These lights may attract hatchlings and interfere with proper offshore orientation, and may make them more susceptible to predation (deSilva, 1982) (USFWS, 1991).

Stressor: Entanglement (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Turtles are affected to an unknown but potentially significant degree by entanglement in persistent marine debris, including discarded or lost fishing gear (Balazs, 1985). Green turtles have been found entangled in a wide variety of materials including steel and monofilament line, synthetic and natural rope, plastic onion sacks and discarded plastic netting materials (Balazs, 1985; Plotkin and Amos, 1988). Monofilament line appears to be the principal source of entanglement for green turtles in U.S. waters. Records from Florida and the United States Virgin Islands indicate that some entanglement results from netting and monofilament line which has accumulated on both artificial and natural reefs. These areas are often heavily fished, resulting in snagging of hooks and discarding of lines. Turtles foraging and/or resting in these areas can become entangled and drown (FDNR, unpubl. data). 'The alignment of persistent marine debris

along convergences, rips, and driftlines and the concentration of young sea turtles along these fronts increases the likelihood of entanglement at this life history stage (Carr, 1987) (USFWS, 1991).

Stressor: Ingestion of marine debris (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Marine turtles have been found to ingest a wide variety of abiotic debris items such as plastic bags, raw plastic pellets, plastic and styrofoam pieces, tar balls and balloons. Effects of debris ingestion can include direct obstruction of the gut, absorption of toxic byproducts and reduced absorption of nutrients across the gut wall (Balazs, 1985). Studies conducted by Lutz (in press) revealed that both loggerhead and green turtles actively ingested small pieces of latex and plastic sheeting. Physiological data indicated a possible interference in energy metabolism or gut function, even at low levels of ingestion. Persistence of the material in the gut lasted from a few days to 4 months (Lutz, in press). Of particular concern is the co-occurrence of persistent marine debris and the early life history pelagic stages of green turtles along convergences. Young turtles are dependent upon these driftlines for their food supply, and hence the likelihood of debris ingestion is increased (Carr, 1987). While quantitative data on population effects are undetermined, the impacts of debris ingestion are considered serious (USFWS, 1991).

Stressor: Disease and parasites (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: There is little information available to assess the comprehensive effects of disease and/or parasites on wild populations of green turtles. The vast majority of diseases and conditions which have been identified or diagnosed in sea turtles are described from captive stock, either turtles in experimental headstart programs or mariculture facilities (Wolke, 1989). One notable exception is the occurrence of fibropapillomas on green turtles, first described by Smith and Coates (1938). Fibropapillomas are now common on immature green turtles in the central Indian River system of Florida, Florida Bay, and in the Florida Keys (Ehrhart et al., 1986; Witherington and Ehrhart, 1987; Schroeder, 1987a). In the central Indian River lagoon, approximately half of all green turtles captured have been found to bear papillomas of varying degree (Ehrhart et al., 1986). Recent reports from Puerto Rico and the United States Virgin Islands indicate a very low occurrence of fibropapillomas on green turtles collected in these areas (R. Boulon and J. Collazo, pers. comm.). Fibropapillomas are also commonly found on Hawaiian green turtles. These tumor like growths can result in reduced vision, disorientation, blindness, physical obstruction to normal swimming and feeding, an apparent increased susceptibility to parasitism by marine leeches, and an increased susceptibility to entanglement in monofilament fishing line (Balazs, 1986). Blood counts and serum profiles of green turtles inflicted with fibropapillomas indicate marked debilitation (Jacobson, 1987) (USFWS, 1991).

Stressor: Predation (USFWS, 1991)
Exposure:
Response:
Consequence: Loss of individuals

Narrative: Predation of hatchling and very young turtles is assumed to be significant and predation of subadult through adult stage turtles is assumed less common, but valid estimates of mortality due to predation at various life history stages are extremely difficult, if not impossible, to obtain and have not been determined. Hatchlings entering the surf zone and pelagic stage hatchlings may be preyed upon by a wide variety of fish species and to a lesser extent, marine birds. Stancyk (1982) in an extensive literature review reported predators of juvenile and adult turtles to include at least six species of sharks, killer whales, bass, and grouper. Tiger sharks appear to be the principal predator of subadult and adult turtles. While stranded turtles may exhibit shark inflicted injuries, caution must be exercised in attributing a cause of death as these wounds can be inflicted post-mortem (USFWS, 1991).

Recovery

Delisting Criteria:
The United States population of green turtles can be considered for delisting if, over a period of 25 years, the following conditions are met: 1. The level of nesting in Florida has increased to an average of 5,000 nests per year for at least 6 years. Nesting data must be based on standardized surveys (USFWS, 1991).

2. At least 25 percent (105 km) of all available nesting beaches (420 km) is in public ownership and encompasses at least 50 percent of the nesting activity (USFWS, 1991).

3. A reduction in stage class mortality is reflected in higher counts of individuals on foraging grounds (USFWS, 1991).

4. All priority one tasks have been successfully implemented (USFWS, 1991).

Recovery Actions:

- 1. Protect and manage habitats. 11. Protect and manage nesting habitat. 111. Ensure beach nourishment projects are compatible with maintaining good quality nesting habitat. (also see 215). 1111. Implement and evaluate tilling as a means of softening compacted beaches. 1112. Evaluate the relationship of sand characteristics (including aragonite) and hatch success, hatchling sex ratios, and nesting behavior. 1113. Reestablish dunes and native vegetation. 1114. Evaluate sand transfer systems as alternative to beach nourishment. 112. Prevent degradation of nesting habitat from seawalls, revetments, sand bags, sand fences, or other erosion control measures. 1121. Evaluate current laws on beach armoring and strengthen if necessary. 1122. Ensure laws regulating coastal construction and beach armoring are enforced. 1123. Ensure failed erosion control structures are removed. 1124. Develop standard requirements for sand fence construction. 113. Acquire or otherwise ensure the long-term protection of key nesting beadles. 1131. Acquire in fee title all undeveloped nesting beaches between Melbourne Beach and Wabasso Beach, Florida. 1132. Evaluate the status of the important nesting beaches on Hutchinson Island, Florida, and develop a plan for long-term protection. 114. Remove exotic vegetation and prevent spread to nesting beaches. 12. Protect marine habitat. 121. Identify important habitat. 122. Prevent degradation and improve water quality of important turtle habitat. 123. Prevent destruction of habitat from fishing gears and vessel anchoring. 124. Prevent destruction of marine habitat from oil and gas activities. 125. Prevent destruction of habitat from dredging activities. 126. Restore important foraging habitats (USFWS, 1991).

- 2. Protect and manage population. 21. Protect and manage populations on nesting beaches. 211. Monitor trends in nesting activity by means of standardized surveys. 212. Evaluate nest success and implement appropriate nest protection measures. 213. Determine influence of factors such as tidal inundation and foot traffic on hatching success. 214. Reduce effects of artificial lighting on hatchlings and nesting females. 2141. Determine hatchling orientation mechanisms in the marine environment and assess dispersal patterns from natural (dark) beaches and beaches with high levels of artificial lighting. 2142. Implement and enforce lighting ordinances. 2143. Evaluate extent of hatchling disorientation on all important regional nesting beaches. 2144. Evaluate need for Federal lighting regulations. 2145. Develop lighting plans at Kennedy Space Center, Port Canaveral, Cape Canaveral Air Force Station and Patrick Air Force Base, Florida. 2146. Prosecute individuals or entities responsible for hatchling disorientation or misorientation under the Endangered Species Act or appropriate State laws. 215. Ensure beach nourishment and coastal construction activities are planned to avoid disruption of nesting and hatching activities. 216. Ensure law enforcement activities eliminate poaching and harassment. 217. Determine natural hatchling sex ratios. 22. Protect and manage populations in the marine environment. 221. Determine green turtle distribution, abundance and status in the marine environment. 2211. Determine seasonal distribution, abundance, population characteristics, and status in bays, sounds and other important nearshore habitats. 2212. Determine adult navigation mechanisms, migratory pathways, distribution and movements between nesting seasons. 2213. Determine present or potential threats to green turtles along migratory routes and on foraging grounds. 2214. Determine breeding population origins for U.S. juvenile/subadult populations. 2215. Determine growth rates, age of sexual maturity and survivorship rates of hatchlings, juveniles, and adults. 222. Monitor and reduce mortality from commercial and recreational fisheries. 2221. Implement and enforce TED regulations in all United States waters at all times. 2222. Provide technology transfer for installation and use of TEDs. 2223. Maintain the Sea Turtle Stranding and Salvage Network. 2224. Identify and monitor other fisheries that may be causing significant mortality. 2225. Promulgate regulations to reduce fishery related mortalities. 223. Monitor and reduce mortality from dredging activities. 2231. Monitor turtle mortality on dredges. 2232. Evaluate modifications of dredge dragheads or devices to reduce turtle captures, and incorporate effective modifications or devices into future dredging operations. 2233. Determine seasonality and abundance of sea turtles at dredging localities, and ensure that dredging is restricted to time periods with the least potential for turtle mortality. 224. Monitor and prevent adverse impacts from oil and gas activities. 2241. Determine the effects of oil and oil dispersants on all life stages. 2242. Ensure that impacts to sea turtles are adequately addressed during planning of oil and gas development. 2243. Determine sea turtle distribution and seasonal use of marine habitats associated with oil and gas development areas. 224. Reduce impacts from entanglement and ingestion of persistent marine debris. 2251. Evaluate the extent of entanglement and ingestion of persistent marine debris. 2252. Evaluate the effects of ingestion of persistent marine debris on health and viability of sea turtles. 2253. Determine and implement appropriate measures to reduce or eliminate persistent marine debris in the marine environment. 226, Increase law enforcement efforts to reduce poaching in United States waters. 227, Determine etiology of fibropapillomatosis. 228. Centralize administration and coordination of tagging programs. 2281. Centralize tag series records. 2282. Centralize turtle tagging records. 229. Ensure proper care of sea turtles in captivity. 2291. Develop standards for care and maintenance including diet, water quality and tank size. 2292. Develop manual for treatment of disease and injuries. 2293. Establish catalog for all captive sea turtles to enhance utilization for research and education. 2294. Designate rehabilitation facilities (USFWS, 1991).

- 3. Information and education. 31. Provide slide programs and information leaflets on sea turtle conservation for general public. 32. Develop brochure on recommended lighting modifications or measures to reduce hatchling disorientation and misorientation. 34. Develop public service announcements regarding the sea turtle artificial lighting conflict, and disturbance of nesting activities by public nighttime beach activities. 34. Ensure facilities permitted to hold and display captive sea turtles have appropriate informational displays. 35. Post information signs at public access points on important nesting beaches (USFWS, 1991).
- 4. International cooperation. 41. Develop international agreements to ensure protection of life stages which occur in foreign waters (USFWS, 1991).

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SPECIES ACCOUNT: *Clemmys muhlenbergii* (Bog (=Muhlenberg) turtle (Glyptemys))

Species Taxonomic and Listing Information

Listing Status: Threatened; Northeast Region (R5) (USFWS, 2015)

Physical Description

A small turtle.Carapace is light brown to black (may have yellowish or reddish areas on large scutes), strongly sculptured with growth lines, and has an inconspicuous keel; plastron is mainly dark brown to black; head is brown, with a large yellow or orange (sometimes red) blotch above and behind the tympanum (blotch may be divided); adult carapace length usually is 7.5-9 cm (up to 11.5 cm); hatchling carapace is 2.5-3.2 cm; male vent is posterior to the rear edge of the carapace and the plastron is concave (flat in female) (Ernst and Barbour 1989, Conant and Collins 1991). LENGTH:9 (NatureServe, 2015)

Taxonomy

The bog turtle was described as Testudo muhlenbergii by Schoepff (1801), from a specimen collected by Reverend Gotthilf Heinrich Ernst Muhlenberg. The type locality was “Pennsylvaniae”; the holotype was not designated and its location is unknown (Ernst and Bury 1977). Stejneger and Barbour (19 17) restricted the type locality to “Lancaster, Pennsylvania.” Fitzinger (1835) was the first to use the combination CIemmys muhlenbergii. Included in the synonymy ofC1emmy.s muhlenbergii are Emys biguttata (Say 1825), lacking a designated holotype, type locality “United States,” and restricted to the “vicinity of Philadelphia” by Schmidt (1953), and Clemmys nuchalis (Dunn 1917). The type specimen (American Museum of Natural History No. 8430) was collected by Dunn on August 17, 1916, on the “side of Yonahlossee Road, about 3 miles from Linville, North Carolina,” at an altitude of 4,200 feet (USFWS, 2001).

Current Range

Discontinuous, spotty distribution; New York (including remnant population at two sites in the Finger Lakes region), western Massachusetts, and western Connecticut southward to Pennsylvania, New Jersey, Maryland, and northern Delaware; southeastern Virginia through western and central North Carolina and extreme eastern Tennessee to western South Carolina and Georgia (Herpetol. Rev. 14:55). Large hiatus of about 250 miles between the northern populations and the southern populations. In the north, Maryland has the largest number of occurrences and turtles; only about 20 populations thought to be viable exist outside Maryland and New Jersey. In the south, most occurrences and turtles are in North Carolina and Virginia (only a few viable populations elsewhere). Sea level to 1280 m in the Appalachians; usually below 245 m in the north. Most populations occur on private property. Extirpated in western Pennsylvania and in the Lake George region of New York.

Critical Habitat Designated

No;

Life History

Feeding Narrative

Juvenile: Feeds opportunistically on insects, worms, slugs, crayfish, snails, and other small invertebrates; also amphibian larvae and fruits. Diet generally is dominated by insects. Apparently forages on land and in water (Bury 1979).; Food Habits: Invertivore (Adult, Immature)Most activity occurs from mid-April to late September in New Jersey and Pennsylvania. In some areas, including Pennsylvania and Delaware, there is an apparent peak in activity in May (see Bury 1979). Reportedly may estivate or at least reduce activity to a small area during hot summer periods (especially July-August). In North Carolina, radiotelemetry showed that turtles remained active through summer and fall whereas hand captures indicated primarily vernal activity (Herman and Fahey 1992). In Maryland, movement into and out of retreats was noted from November through March (Chase et al. 1989). Active during daylight hours, mostly from mid-morning to late afternoon or early evening. More active on cloudy days than on bright sunny days (Mitchell 1991). In early spring, activity occurs mainly at midday and in the afternoon; most active in the morning in late spring and summer (Mitchell 1991).; (NatureServe, 2015)

Adult: Feeds opportunistically on insects, worms, slugs, crayfish, snails, and other small invertebrates; also amphibian larvae and fruits. Diet generally is dominated by insects. Apparently forages on land and in water (Bury 1979).; Food Habits: Invertivore (Adult, Immature)Most activity occurs from mid-April to late September in New Jersey and Pennsylvania. In some areas, including Pennsylvania and Delaware, there is an apparent peak in activity in May (see Bury 1979). Reportedly may estivate or at least reduce activity to a small area during hot summer periods (especially July-August). In North Carolina, radiotelemetry showed that turtles remained active through summer and fall whereas hand captures indicated primarily vernal activity (Herman and Fahey 1992). In Maryland, movement into and out of retreats was noted from November through March (Chase et al. 1989). Active during daylight hours, mostly from mid-morning to late afternoon or early evening. More active on cloudy days than on bright sunny days (Mitchell 1991). In early spring, activity occurs mainly at midday and in the afternoon; most active in the morning in late spring and summer (Mitchell 1991).; (NatureServe, 2015)

Reproduction Narrative

Adult: Most researchers have reported a fairly even sex ratio. Although Klemens (1990, 1993a) found significantly more adult females than males at two of his Massachusetts study sites, subsequent fieldwork by A. Whitlock (pers. comm.) at these sites has produced more even sex ratios. J. L. Behler (pers. comm.) observed a I:2 male to female ratio at his southeastern New York study site (USFWS, 2001). Mating occurs from late April to early June. Lays clutch of 1-6 (usually 3-5) eggs in May, June, or July (occasionally August). Eggs hatch in about 6-9 weeks, late July to early September. In the north, hatchlings may not emerge from the nest until October or they may overwinter in the nest. Sexually mature in 5-8 years. Not all adult females produce clutches annually. No evidence of multiple clutches wihtin a single season.; Home range size averaged 1.3 ha in Pennsylvania, where the longest distance moved by any individual was 225 m (see Bury 1979). Home range was 0.04-ha to 0.24 ha in Maryland (Chase et al. 1989). Home range size averaged 0.52 ha (median 0.35 ha, range 0.02-2.26 ha, minimum convex polygon) in Virginia (Carter et al. 1999). Long-distance movements between wetlands were infrequently observed in southwestern Virginia (Carter et al. 2000). In North Carolina over somewhat less than 1 year, distances between relocations of radio-tagged turtles was 0-87 m (mean 24 m) for males, 0-62 m (mean 16 m) for females (Herman and Fahey 1992). Population density may exceed 110/ha in some areas (see Ernst and Barbour 1972). In Maryland, population density was 7-213/ha of wetland habitat; average was 44 individuals per site at 9 sites (Chase et al. 1989). Searches of suitable habitat in North Carolina and Delaware yielded 1 bog turtle per 1.8 to 4.2 hours of search (see Bury 1979). In Pennsylvania, patches of suitable habitat had 3 to 300 individuals, mostly around 30 (see Mitchell 1991). In the northern half of the range, other turtles most likely to occur in bog turtle habitat include the spotted turtle, painted turtle, and wood turtle. Eggs, young, and adults are preyed on by various Carnivora, opossums, and some wading birds. Juveniles are very secretive.; (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: Clumped (NatureServe, 2015)

Environmental Specificity

Adult: Narrow/specialist (NatureServe, 2015)

Habitat Narrative

Adult: Bog turtles inhabit slow, shallow, muck-bottomed rivulets of sphagnum bogs, calcareous fens, marshy/sedge-tussock meadows, spring seeps, wet cow pastures, and shrub swamps; the habitat usually contains an abundance of sedges or mossy cover. The turtles depend on a mosaic of microhabitats for foraging, nesting, basking, hibernation, and shelter (USFWS 2000). "Unfragmented riparian systems that are sufficiently dynamic to allow the natural creation of open habitat are needed to compensate for ecological succession" (USFWS 2000). Beaver, deer, and cattle may be instrumental in maintaining the essential open-canopy wetlands (USFWS 2000). Bog turtles commonly bask on tussocks in the morning in spring and early summer. They burrow into soft substrate of waterways, crawls under sedge tussocks, or enter muskrat burrows during periods of inactivity in summer (see Bury 1979). In Pennsylvania, bog turtles hibernated mainly in water and mud in muskrat burrows, and in mud bottom of marsh rivulets under 5-15 cm of water. In New Jersey, hibernacula were in subterranean rivulets or seepage areas where water flowed continuously from underground springs; turtles were under 5-55 cm of water and mud (see Ernst et al. [1989] for further details). In Maryland, larger population sizes were associated with sites with the following characteristics: circular basin with spring-fed pockets of shallow water, bottom substrate of soft mud and rock, dominant vegetation of low grasses and sedges, and interspersed wet and dry pockets; winter retreats were shallow, just below upper surface of frozen mud and/or ice (Chase et al. 1989). Studies in Maryland and Pennsylvania noted use of the lower portion of wetlands for overwintering. In Virginia, selected habitats included wet meadow, smooth alder edge, and bulrush; dry meadow and streams were avoided (Carter et al. 1999). Nests are in open and elevated ground in areas of moss, sedges, or moist earth (see Bury 1979). The turtles dig a shallow nest or lay eggs in the top of a sedge tussock.SPRING/SPRING BROOKBog/fen; HERBACEOUS WETLAND; Riparian; SCRUB-SHRUB WETLANDBurrowing in or using soil (NatureServe, 2015)

Dispersal/Migration

Motility/Mobility

Adult: Moderate (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: Low (natureServe, 2015)

Immigration/Emigration

Adult: Emigrates (USFWS, 2001)

Dispersal/Migration Narrative

Adult: May migrate about 200 m between winter hibernation site and upstream summer range in some areas (Ernst and Barbour 1972). Hibernating juveniles were found in a nesting area in New Jersey (Ernst et al. 1989).; Nonmigrant: Y; Local migrant: Y; Distant migrant: N; (NatureServe, 2015). Occasionally, individual bog turtles are found crossing roads a considerable distance from any apparently suitable habitat. These apparent long distance movements may result from emigration out of habitats declining in quality through disturbances or succession (USFWS< 2001).

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

Low (NatureServe, 2015)

Representation:

Low (NatureServe, 2015)

Redundancy:

Low (NatureServe, 2015)

Number of Populations:

81 to >300 (NatureServe, 2015)

Population Size:

2500 - 100,000 individuals (NatureServe, 2015)

Population Narrative:

Low fecundity and high mortality rate of young make populations slow to recover from population losses. Decline of 30-70% Southern population, based on known sites, has been estimated at about 2500-4000; inclusion of potential occurrences in apparently suitable habitat brings the estimate up to about 4000-6000. Most populations are small. Cryptic, hard to find even when present in good numbers; easily overlooked (Collins 1990). In the northern segment of the range, currently known from 360 sites (5 in Connecticut, 4 in Delaware, 71 in Maryland, 3 in Massachusetts, 165 in New Jersey, 37 in New York, and 75 in Pennsylvania). Some of these are parts of larger occurrences, so the number of distinct occurrences is less than the number of sites. See USFWS (1997, 2000) for information on status in each state in the northern part of the range. (NatureServe, 2015)

Threats and Stressors

Stressor: Development (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Development occurring in groundwater recharge areas results in increases in impervious surfaces and the number of wells, which can, in turn, lower water tables, affecting groundwater discharges into bog turtle habitats (in terms of both quantity and quality) and accelerating succession (Lowenstein in litt. 2000). Patterns of subsurface water flow can be altered by infrastructure construction and other development projects. Drilling under wetlands (e.g., to install utility lines or fiber optic cable) has the potential to disrupt the flow of water and even fracture bedrock and significantly impact a small wetland system (USFWS, 2001).

Stressor: Grazing (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Although light grazing may be beneficial in controlling succession, intensive pasturing adds excessive nutrient loading from fecal material, results in significant soil disturbance, (which may accelerate exotic plant invasion), destroys the unique plant community by overgrazing, and will result in bog turtles being crushed. The type and density of grazers determines the effect on the habitat. For example, horses appear to cause more damage to a pasture than cows, animal for animal. Smith (in litt. 2000) has observed that horses “graze lower to the soil, like sheep, and this coupled with their hoofs somehow appear to damage the substrate more - areas become mud holes with only a few horses whereas it would take many more cows to inflict the same amount of damage.” (USFWS, 2001)

Stressor: Succession (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Some of the most persistent and widespread problems associated with maintaining bog turtle habitat are succession of open meadows to wooded swamps, drainage and flooding of habitats through diversion or damming of feeder streams, chemical and heavy metal pollution, nutrient enrichment from fertilizer and septic runoff, and the establishment of alien plants. Disturbance of surface soils and degraded water quality may result in the establishment and spread of invasive wetland plant species such as the alien purple loosestrife (Lythrum salicaria) or native giant reed (Phrugmites australis). These aggressive species rapidly invade wetlands when areas of disturbance and/or impaired water quality are created. Favored colonization sites are the piles of excavated soil placed alongside ponds and ditches. After taking root in a disturbed microhabitat, these plants quickly spread into the adjacent wetlands, replacing a diverse botanical community with a dense monoculture. This monoculture is unsuitable for many wetland species, including bog turtles (Klemens, 1990, 1993a). Other invasive species implicated in reducing the value of bog turtle habitats include reed canary grass (Phaluris arundinucea) and multiflora rose (Rosa multiflora) (USFWS, 2001).

Stressor: Inadequacy of Existing Regulatory Mechanisms (USFWS, 2001)

Exposure:
Response:
Consequence: Loss of habitat
Narrative: Although some states have been successful in avoiding or minimizing encroachments (e.g., filling, ditching, draining, development) into bog turtle habitat, significant habitat degradation and fragmentation has resulted from indirect effects to wetlands caused by activities in the adjacent uplands. Despite the recognition of regulated upland buffers around wetlands (in all northern range states except Pennsylvania), activities that contribute to habitat loss, including development, farming, and placement of detention or storm water basins, are often allowed to proceed within the buffer. These activities can degrade water quality, accelerate succession, encourage the invasion and spread of exotic plants, and change wetland hydrology (USFWS, 2001).

Stressor: Illegal trade and collection (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Exploitation of bog turtles for commercial or private use ranks second in threats to this species, after habitat loss. Their small size, attractive shell and coloration, and rarity make the bog turtle a prize eagerly pursued by unscrupulous collectors, both in the United States and overseas, resulting in illegal collecting for an illicit pet trade. Tryon (1989), Strong (1989), and Herman (1989b) described one incident where a series of southern Appalachian study sites was decimated by a group of collectors who had specifically traveled south to capture bog turtles. Apart from removing large numbers of adults, these collectors seriously compromised at least one long-term mark and recapture study site by removing marked turtles (Herman 1989b). Klemens (1991) reviewed reports of illegal collecting activities from Delaware, Massachusetts, Maryland, New Jersey, New York, North Carolina, and Pennsylvania. In 1975, the bog turtle was added to Appendix II of the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) in order to monitor trade in the species. In 1992, the bog turtle was transferred from Appendix II to Appendix I due to the increased number of bog turtles being advertised for sale, the increased price being paid for individuals and pairs, and illegal trade not being reported under CITES (57 FR 7722, March 4, 1992). Both import and export permits are required from the importing and exporting countries before an Appendix I species can be transported, and an Appendix I species cannot be exported for primarily commercial purposes (USFWS, 2001)

Stressor: Disease and predation (USFWS, 2001)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Many of the primary predators on bog turtles and their nests are human commensals, i.e., they flourish in the presence of humans and the landscapes that they alter. This is particularly acute for species such as the bog turtle, which occurs primarily in agricultural landscapes where the presence of raccoons, skunks, opossums, and crows can pose a significant threat. How significant a threat these subsidized species pose to bog turtles is hard to determine, although in certain populations it is speculated that predation of adults and eggs is a serious problem. At present, there are no substantiated reports of disease affecting a wild population of bog turtles, although at one site in Columbia County, New York (J.L. Behler, pers. comm) the

number of dead turtles is cause for concern; eight dead bog turtles were collected during three visits to the site in 1988 and 1989 (A. Breisch, in Mt. 2000). A sick turtle removed from that population and held for several years in captivity tested positive for upper respiratory distress syndrome (URDS) upon necropsy (J. L. Behler, pers. comm.). Although this could indicate a health problem within that population, it is also possible that the turtle contracted this disease while in captivity. Disease issues have the potential to become a much larger threat to wild bog turtle populations as they are subjected to more handling by researchers or if manipulation of turtle populations is undertaken through the deliberate release into the wild of bog turtles from other areas, zoological collections, or those seized by law enforcement activities. It should be noted that thorough health screening of wild-caught bog turtles has not been a standard practice of researchers, although it may be warranted (Smith in iitt. 2001) (USFWS, 2001).

Recovery

Delisting Criteria:
Long range protection is secured for at least 185 populations distributed among five recovery units: Prairie Peninsula/Lake Plain Recovery Unit (I 0), Outer Coastal Plain Recovery Unit (S), HudsoniHousatonic Recovery Unit (40), SusquehannaA'otomac Recovery Unit (50), and Delaware Recovery Unit (80) (USFWS, 2001).

Monitoring at five-year intervals over a 25-year period shows that these 185 populations are stable or increasing (USFWS, 2001).

Illicit collection and trade no longer constitute a threat to this species' survival (USFWS, 2001).

Long-term habitat dynamics, at all relevant scales, are sufficiently understood to monitor and manage threats to both habitats and turtles, including succession, invasive wetland plants, hydrology, and predation (USFWS, 2001).

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SPECIES ACCOUNT: *Crocodylus acutus* (American crocodile)

Species Taxonomic and Listing Information

Listing Status: Threatened; Southeast Region (R4) (USFWS, 2015)

Physical Description

The American crocodile is a large greenish-gray reptile. At hatching, crocodiles are yellowish-tan to gray in color with vivid dark bands on the body and tail. As they grow older, their overall coloration becomes more pale and uniform and the dark bands fade. All adult crocodiles have a hump in front of the eye, and tough, asymmetrical armor-like scutes (scale-like plates) on their backs. The American crocodile is distinguished from the American alligator by a relatively narrow, more pointed snout and by an indentation in the upper jaw that leaves the fourth tooth of the lower jaw exposed when the mouth is closed. Moreover, alligators have two nostrils separated by a bony septum covered in skin, while American crocodiles have two nostrils that touch each other in a single depression on the tip of the snout (P. Ross, University of Florida, personal communication 2005). In Florida, the crocodile ranges in total length from 26.0 centimeters (10.3 inches) at hatching to 3.8 meters (12.5 feet [ft]) as adults (Moler 1991a). Larger specimens in Florida were reported in the 1800s (Moler 1991a) and may occur in south Florida currently, and individuals as large as 6 to 7 meters (19.7 to 23.0 ft) have been reported outside the United States (Thorbjarnarson 1989).

Taxonomy

No subspecies are recognized, although geographic variation exists among populations in Florida, Jamaica, and the Pacific coast. Populations in Florida, Jamaica, and the Dominican Republic differ from each other in their gene frequencies (Menzies and Kushlan 1991). Densmore and White (1991) used molecular data to assess phylogenetic relationships within the Crocodylia, including all species in the genus Crocodylus; the closest relative of C. acutus was C. intermedius by one analysis using rDNA, C. moreletii by another analysis that used both rDNA and mtDNA; overall, New World species of Crocodylus appeared to be more closely related to each other than to species in other parts of the world. See Ernst et al. (1999) for further taxonomic discussion. Milián-García et al. (2011) examined microsatellite loci plus DNA sequence data from nuclear (RAG-1) and mitochondrial (cytochrome b and cytochrome oxidase I) genes of Crocodylus acutus and C. rhombifer from Cuba. They found that C. acutus from Cuba is more closely related to C. rhombifer than to C. acutus from Central America. Thus current taxonomy does not appear to be an accurate reflection of evolutionary relationships. The researchers also found evidence of hybridization between the two species in Cuba. Further study is needed before taxonomic issues can be resolved. (Milián-García et al. 2011). (NatureServe, 2015)

Current Range

The present distribution of the American crocodile includes coastal wetlands and rivers of south Florida, Cuba, Jamaica, and Hispaniola (along the Caribbean coast from Venezuela north to the Yucatan peninsula, and along the pacific coast from Sinaloa, Mexico to the Rio Tumbes of Peru [Moler 1992]). Within Florida, the American crocodile historically occurred as far north as Indian River County on the east coast and Tampa Bay on the west coast, and as far south as Key West (DeSola 1935; Hornaday 1914; Kushlan and Mazzotti 1989; Allen and Neill 1952; Neill 1971). The current range of the American crocodile in Florida largely consists of coastal areas of Miami-

Dade, Monroe, Collier, and Lee Counties. Crocodiles are regularly observed in the Everglades National Park (ENP) along the shoreline of Florida Bay, in the Florida Keys (primarily on northern Key Largo, and within the Cooling Canal System (CCS) and adjancent canals and wetlands at the Florida Power and Light (FPL) Turkey Point Nuclear Power Plant. Crocodiles are still known to occur on the west coast of Florida as far north as Sanibel Island. Sightings of crocodiles are also infrequently reported north of Miami-Dade County on the east coast (a crocodile was documented in Indian River County in October 2004)). It was thought that the American crocodile no longer regularly occurred in the Keys south of Key Largo (Jacobsen 1983; P. Moler, Florida Fish and Wildlife Conservation Commission [FWC], personal communication 2002). However, confirmed sightings have been reported with increasing frequency in many of the lower Keys, and we believe that these observations may indicate that crocodiles are expanding their range back into the Keys. A small population of crocodiles (at least 21 individuals) has been observed using wetlands adjacent to the airfield at the Key West Naval Air Station on Stock Island in 2014 (Mazzotti 2014). Moreover, a crocodile was also observed as far south as Fort Jefferson in the Dry Tortugas in May 2002 (O. Bass, ENP, personal communication 2002). The breeding range of the American crocodile in Florida is still restricted relative to its reported historic range (Kushlan and Mazzotti 1989), with most breeding occurring on the mainland shore of Florida Bay between Cape Sable and Key Largo (Mazzotti et al. 2002). Nesting occurs in three primary locations: Key Largo at the Crocodile Lake National Wildlife Refuge, ENP, and the CCS of the FPL's Turkey Point Power Plant. The observed increase in nesting during the last 30 years (see below) is largely due to increased nesting at the Turkey Point Power Plant site (Tucker et al. 2004). Nesting has also been recently documented in the Keys. A crocodile nest has been observed on Lower Matecumbe Key during 2003, 2004, and 2005 (M. Cherkiss, University of Florida, personal communication 2005). In 2015, a nest was located in Virginia Key in northern Biscayne Bay (F. Mazzotti, University of Florida, personal communication 2015).

Critical Habitat Designated

Yes; 9/4/1976.

Legal Description

On September 24, 1976, the U.S. Fish and Wildlife Service designated critical habitat for the American crocodile (Crocodylus acutus) pursuant to Section 7 of the Endangered- Species Act of 1973 (41 FR 41914 - 41916). This Final Rule was corrected and augmented on September 22, 1977 (42 FR 47840 - 47845).

Critical Habitat Designation

The critical habitat designation for Crocodylus acutus includes an area in Florida.

Florida. All land and water within the following boundary: Beginning at the easternmost tip of Turkey Point, Dade County, on the coast of Biscayne Bay; thence southeastward along a straight line to Christmas Point at the southernmost tip of Elliott Key; thence southwestward along a line following the shores of the Atlantic Ocean side of Old Rhodes Key, Palo Alto Key, Angelfish Key, Key Largo, Plantation Key, Windley Key, Upper Matecumbe Key, Lower Matecumbe Key, and Long Key, to the westernmost tip of Long Key; thence northwestward along a straight line to the westernmost tip of Middle Cape: thence northward along the shore of the Gulf of Mexico to the north side of the mouth of Little Sable Creek; thence eastward along a straight line to the northernmost point of Nine-Mile Pond; thence northeastward along a straight line to the point of beginning.

Primary Constituent Elements/Physical or Biological Features

Not specified. The current population is dependent upon the included habitat of Florida Bay and associated brackish marshes, swamps, creeks, and canals.

Special Management Considerations or Protections

All of the areas delineated are considered Critical Habitat because they contain constituent elements necessary to the normal needs or survival of one of the species in question. Specifically for the American Crocodile the delineated area must be considered an absolute minimum amount of Critical Habitat in Florida. The current population of the State, with only 200 to 300 individuals, Is concentrated in this area and is de- pendent upon the included habimt of Florida Bay and associated brackish marshes, swimps. creeks, and canals. All known breeding females, of which there are less than kn in Florida. inhabit anti nest in the delineated area.

Life History

Feeding Narrative

Juvenile: Hatchlings feed largely on small fish but will also eat crabs, snakes, insects, and other invertebrates (Moler 1992).

Adult: American crocodiles are opportunistic feeders and will eat whatever they can catch and consume. Hatchlings feed largely on small fish but will also eat crabs, snakes, insects, and other invertebrates (Moler 1992). Adult crocodiles are capable of taking large prey but generally do not capture prey larger than a raccoon (Procyon lotor) or cormorant (Phalacrocorax auritus). The diet of adult crocodiles consists of snakes, fish, crabs, small mammals, turtles, and birds (Moler 1992). Crocodiles usually forage from immediately prior to sunset to just after sunrise (Lang 1975; Mazzotti 1983).

Reproduction Narrative

Adult: Female crocodiles reach sexual maturity at approximately 10 to 13 years of age (about 2.25 meters total length) (Mazzotti 1983; LeBuff 1957). The size and age that male crocodiles reach sexual maturity is not currently known (Ogden 1978). Courtship and breeding occur in late winter and early spring, and nests are usually built in late April or early May (Moler 1992). Females will only produce one clutch of eggs per year, although it is not known if a female will produce clutches in consecutive years. Nests are constructed on beaches, stream banks, and levees, and many nest sites are used recurrently. Female crocodiles may simply dig a hole at the nest site, but usually construct a nest mound at the nesting site by scraping together soil. If a mound is constructed, a hole is dug in the middle of the nest mound prior to egg laying. Approximately 20 to 50 eggs are deposited in the nest mound or nest hole. The average clutch size is about 35 eggs. Following laying, the female covers up the eggs with soil and the eggs incubate at the nest site for approximately 85 to 90 days (Moler 1992). In Florida, female crocodiles have not been observed to defend their nest during incubation (Kushlan and Mazzotti 1989). However, once the eggs begin hatching, the female usually opens the nest and carries the hatchlings to water in her mouth. Hatchlings are not able to escape the nest cavity without assistance from their mother. Crocodile hatchlings remain together in a loose aggregation for several days to several weeks following hatching. Parental care of young crocodiles has not been observed in Florida, although it has been reported in other parts of the American crocodile’s range (Moler 1992).

Habitat Narrative

Adult: The American crocodile in south Florida occurs primarily in mangrove swamps and along low-energy mangrove-lined bays, creeks and inland swamps (Kushlan and Mazzotti 1989). Deep water habitats (>1.0 meter [3.3 ft]) are also known to be an important component of crocodile habitat (Mazzotti 1983). Crocodiles exhibit seasonal differences in habitat use. For example, during the breeding and nesting season, adults outside of Key Largo and Turkey Point can be found along the shoreline of Florida Bay with males located further inland than females (L. Brandt, U.S. Fish and Wildlife Service [Service]and F. Mazzotti, University of Florida, personal communication 1998; P. Moler, FWC, personal communication 1998). During the non-nesting season, crocodiles are usually found further inland in fresh and brackish water swamps, creeks, and bays (Kushlan and Mazzoti 1989). Nesting habitat includes sites with sandy shorelines or raised marl creek banks adjacent to deep water (Service 1999). Crocodiles also nest on berms and other sites where sandy fill has been placed (J. Dixon, personnel communication 2014). Sites optimal for nesting provide appropriate soils for incubation, are generally protected from wind and wave action, and have access to deeper water (Service 1999). Relationships with other species – The American crocodile may co-occur with the American alligator (Alligator mississippiensis) in south Florida. Co-occurrence of these species is most likely during the non-nesting season or when salinities are low. Most crocodilians are known to tolerate the presence of other crocodilian species provided food and other habitat requirements are not limiting (Service 1999). However, little is known concerning the interspecific interactions that occur between crocodiles and alligators. Alligators and crocodiles both occur within the vicinity of the cooling canal system at Turkey Point Power Plant. Anecdotal evidence suggests that crocodiles may aggressively exclude alligators from using a freshwater canal favored by crocodiles known as the Interceptor Ditch (J. Wasilewski and J. Lindsay, FPL, personal communication 2004). Nevertheless, crocodiles and alligators have both been reported to construct nests on the same canal berm located in the vicinity of Marco Island in Collier County, Florida (Service 1999). American crocodiles are most susceptible to predation during incubation and as juveniles. American crocodile eggs are taken primarily by raccoons, although depredation rates of crocodile nests are typically low in south Florida. Hatchlings and subadults are known to be taken by a variety of predators including wading birds, gulls, crabs, sharks, alligators (in areas where they co-occur) and adult crocodiles (Service 1999). Adult crocodiles have no known predators other than humans.

Dispersal/Migration

Motility/Mobility

Adult: Crocodiles may make seasonal movements between freshwater and saline habitats (Gaby et al. 1985).; Nonmigrant: N; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Crocodiles may make seasonal movements between freshwater and saline habitats (Gaby et al. 1985).; Nonmigrant: N; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Dispersal

Adult: Crocodiles may make seasonal movements between freshwater and saline habitats (Gaby et al. 1985).; Nonmigrant: N; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Crocodiles may make seasonal movements between freshwater and saline habitats (Gaby et al. 1985).; Nonmigrant: N; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Additional Life History Information

Adult: Crocodiles may make seasonal movements between freshwater and saline habitats (Gaby et al. 1985).; Nonmigrant: N; Local migrant: Y; Distant migrant: N; (NatureServe, 2015)

Population Information and Trends

Population Size:

1,200 to 2,000 individuals (not including hatchlings)

Population Narrative:

The number of American crocodiles that occurred historically in south Florida is difficult to determine because many records are anecdotal and observers may have confused crocodiles with alligators. Moreover, the remoteness and inaccessibility of estuarine habitats to humans made obtaining a reliable estimate of the crocodile population problematic. The population of the American crocodile in south Florida has increased substantially during the last 40 years. The most recent population estimate suggests that the crocodile population contains 1,200 to 2,000 individuals (not including hatchlings) (P. Moler, FWC, personal communication 2005; F. Mazzotti, University of Florida, personal communication 2005). This estimate was derived using American crocodile nesting data and by applying demographic characteristics observed in other crocodilian species (i.e., Nile crocodiles [Crocodylus niloticus] and American alligators) suggesting that breeding females make up 4 to 5 percent of the non-hatchling population and about 75 percent of reproductively mature females breed and nest each year. However, Mazzotti (2015 personal communication) states that based on his recent survey work, he now believes that the crocodile population may now be beginning to decline. The Service will monitor results of crocodile surveys conducted over the next few years closely to determine if a downward trend is occurring. Nest survey data collected in south Florida also suggest that the American crocodile population has increased. Nesting effort has increased from about 20 nests per year in the late 1970s to about 91 to 94 nests in 2005 (S. Klett, Service, personal communication 2005; M. Cherkiss, University of Florida, personal communication 2005; J. Wasilewski, FPL, personal communication 2005). Surveys detect approximately 80 to 90 percent of nests (F. Mazzotti, University of Florida, personal communication 2005; J. Wasilewski, FPL, personal communication 2006) and are generally unable to distinguish those nests that contain more than one clutch of eggs from different females without excavating the nests. In some instances, surveyors are able to determine that more than one female has laid eggs at a communal nest by visiting the nest over a series of days and observing hatching of separate nests (J. Wasilewski, FPL, personal communication 2005b). Communal nests that are not distinguishable result in a possible underestimation of nests and/or females.

Threats and Stressors

Stressor: Habitat deterioration
Exposure:
Response:
Consequence:

Narrative: Modification and destruction of nesting habitat was the primary threat to the American crocodile during the 20th century. Nesting habitats that were formerly occupied (e.g., Lake Worth, Palm Beach County, central Biscayne Bay, middle and lower Keys etc.) were destroyed or degraded due to urbanization, and the crocodile has been largely extirpated from many of these areas (DeSola 1935; Service 1984). Although, observations of crocodile nesting at Chapman Field Park (J. Maquire, personal communication 1998) indicate that crocodiles may be reoccupying portions of their former range in central Biscayne Bay. However, continued habitat loss and degradation reduces the likelihood that crocodiles will be able to persist in these areas.

Stressor: Human disturbance
Exposure:
Response:
Consequence:
Narrative: Disturbance due to human encroachment into crocodile habitat may alter normal behavioral patterns of crocodiles. Observations suggest that repeated human disturbances of crocodiles may cause females to abandoned nests or relocate nest sites (Kushlan and Mazzotti 1989). The rising demand for recreational opportunities (e.g., camping, boating, and fishing) is expected to bring more people into contact with crocodiles. Pressure on Federal and State agencies to provide more recreational opportunities on public lands that provide habitat for crocodiles is also expected to increase. An increase in human disturbance due to recreational activities could adversely affect the crocodile.

Stressor: Vehicular mortality
Exposure:
Response:
Consequence:
Narrative: Crocodile mortality due to collisions with vehicles has been an ongoing problem along U.S. Highway 1 and Card Sound Road in Miami-Dade and Monroe Counties (Service 1999). This problem has been particularly acute within the segment of U.S. Highway 1 from Florida City to Key Largo. Wetlands providing habitat for crocodiles are located on both sides of the roadway. However, the only structures that allowed movement of crocodiles under the roadway were three small culverts that are usually submerged. Consequently, approximately three to four crocodiles per year were killed while attempting to cross the roadway (Mazzotti 1983; Moler 1991a). The Florida Department of Transportation reduced vehicle-related crocodile mortality along this section of U.S. Highway 1 by installing a series of wildlife underpasses consisting of large culverts, bridges, and associated fencing. The locations for these structures were determined from discussions with the Service and the FWC and were installed as part of roadway improvements constructed along U.S. Highway 1 from the C-111 Canal to the Lake Surprise Bridge.

Stressor: Climate events
Exposure:
Response:
Consequence:
Narrative: Natural climatic events also have the potential to affect the American crocodile. For example, tropical storms and hurricanes affecting south Florida can result in high winds, large waves, and tidal surges that could result in either direct mortality of adults, and/or the loss of nests, nesting habitat, and other important habitat features (Service 1999). Ogden (1978)

suggested hurricanes occurring at regular intervals may serve to regulate the American crocodile population in Florida. South Florida infrequently experiences cold fronts where ambient temperatures drop below 0°C. Such temperatures are likely lethal to crocodiles, although the effects of subfreezing temperature are not well known because crocodiles killed during freezes are rarely found (Dimock 1915; Barbour 1923; Mazzotti 1983). Moler (1991b) suggested that a decline in crocodile nesting effort observed in 1989 may be the result of adult mortality due to a hard freeze that occurred during the previous winter. In 2010, more than 200 crocodiles were estimated to have died from an extreme cold spell that affected south Florida. Drought may also adversely affect crocodiles. Mazzotti and Dunson (1984) suggest that hatchling crocodiles are susceptible to osmotic stress and require access to low salinity water. The freshwater needs of hatchlings are usually met by rainfall depositing a lens of freshwater on the water surface of estuarine environments that may last for days. Hatchlings are likely stressed and occasionally die during periods of low rainfall.

Recovery

Delisting Criteria:
Draft delisting criteria: The American crocodile will be considered for delisting when: 1. At least three of the five nesting areas defined below exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes. a) FPL's Turkey Point Power Plant Site b) North Key Largo including the Crocodile Lake National Wildlife Refuge c) Northeast Florida Bay in Everglades National Park (ENP) d) Flamingo/Cape Sable in ENP e) Other (nesting occurring North of the Turkey Point Power Plant Site, Florida Keys South of North Key Largo, and the West Coast of Florida from North of Highland Beach to Sanibel Island). 2. Threats have been addressed and/or managed to the extent that the species will remain viable into the foreseeable future. (Factor A-E) 3. When, in addition to the above criteria, it can be demonstrated that despite sea level rise and other environmental influences, sufficient suitable habitat remains for the American crocodile to remain viable for the foreseeable future. (Factor A and E) (USFWS, 2019).

Draft additional recovery actions: The following recovery actions are recommended in addition to those listed in the most current recovery plan for the American crocodile: 1. Monitor the effects of climate change and sea-level rise on American crocodile habitat in South Florida. 2. Continue to monitor and control exotic animals that may prey on American crocodiles or their eggs throughout its range (USFWS, 2019).

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SPECIES ACCOUNT: *Crotalus willardi obscurus* (New Mexican ridge-nosed rattlesnake)

Species Taxonomic and Listing Information

Listing Status: Threatened; August 4, 1978 (50 FR 34476).

Physical Description

The New Mexico ridge-nosed rattlesnake is 30 to 61 centimeters (12 to 24 inches) long, grayish-brown, and has a distinct ridge on the end of its snout. The upper surface of the snake has irregularly spaced white cross bars, edged with brown in a dull pattern (USFWS 2002). The underside is cream to white, with occasional mottling of grayish to reddish brown. Young have dark gray/black or light yellow tails.

Taxonomy

The New Mexico ridge-nosed rattlesnake was first identified by Frank C. Willard. The validity of C. w. obscurus as a subspecies distinct from C. w. silus is questioned by some herpetologists; however, the New Mexico Department of Game and Fish and the U.S. Fish and Wildlife Service recognize the taxon and state that the scientific name should be used for New Mexico ridge-nosed rattlesnake populations in the Animas and Sierra San Luis until a definitive taxonomic study of the validity of the subspecies is published. All ridge-nosed rattlesnakes are distinguished by the tip of the snout and the anterior canthus rostrals raised into a sharp inernasal ridge. The rostral and mental are absent of white vertical line, and a white flash-mark is absent in the New Mexico ridge-nosed rattlesnake (USFWS 1985).

Historical Range

The New Mexico ridge-nosed rattlesnake occurs in the Animas Mountains of southwestern New Mexico; Peloncillo Mountains in southwestern Arizona; and throughout Sierra de San Luis in Chihuahua, Mexico. This species also likely occurs in the Sonora portion of the Sierra de San Luis (NatureServe 2015; USFWS 1985).

Current Range

The New Mexico ridge-nosed rattlesnake is rare and uncommon throughout its historical range (NatureServe 2015; USFWS 1985).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 8/4/1978.

Legal Description

On August 4, 1978, the U.S. Fish and Wildlife Service designated critical habitat for Crotalus willardi obscurus under the Endangered Species Act of 1973, as amended (43 FR 34476 - 34480).

Critical Habitat Designation

Critical habitat for the New Mexican ridge-nosed rattlesnake is designated in New Mexico: Hidalgo County, at elevations between 6.200 feet and 8,532 feet in Bear, Indian, and Spring Canyons, Animas Mountains.

Primary Constituent Elements/Physical or Biological Features

Not specified: "With respect to the New Mexican ridge-nosed rattlesnake, the areas determined as critical habitat satisfy all known criteria for the evolutionary, ecological, behavioral, and physiological requirements of the species. Dens are available which provide winter and summer retreats. Vegetation provides cover, and lizards and rodents are abundant in the area and provide an adequate source of food items."

Special Management Considerations or Protections

Not available

Life History

Feeding Narrative

Adult: The New Mexico ridge-nosed rattlesnake is a venomous carnivore and inverivor that is an opportunistic hunter and scavenger, and forages more actively than other rattlesnake species that depend more on an ambush strategy. The New Mexico ridge-nosed rattlesnake has a widely distributed food resource distribution; it primarily eats lizards and secondarily eats scorpions, centipedes, small mammals, birds, and carrion. The New Mexico ridge-nosed rattlesnake is diurnal and hibernates. This snake is inactive in cold temperatures and extreme heat; the period of time when the snake is most active is during daylight hours from July through September (NatureServe 2015; USFWS 1985; USFWS 2002).

Reproduction Narrative

Adult: The New Mexico round-nosed rattlesnake is ovoviviparous. These rattlesnakes breed from July through September, and the gestation period for the New Mexico round-nosed rattlesnake is approximately 13 months. Reproduction is considered biennial by mating in one year and giving birth in the next. Females mate in summer to fall, with ovulation and fertilization occurring early the following spring. The female carries the developing eggs in her oviducts until a clutch of four to nine young hatch and are born alive in August through October. These rattlesnakes have a low parental care investment rate; they leave young to fend for themselves, though newborn rattlesnakes are found sharing the same hiding place with their mother for a few days. These snakes have a high fitness rate, and a cool hibernation period is required for the reproductive cycle. Young snakes are eaten by a variety of predators, many of which could not overpower adult snakes. Freezing temperatures and failure to secure food also contribute to their mortality (ECOS 2015, NatureServe 2015; USFWS 1985; USFWS 2002).

Geographic or Habitat Restraints or Barriers

Adult: Habitat destruction has reduced New Mexico ridge-nosed rattlesnake habitat (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

Habitat Narrative

Adult: The New Mexico ridge-nosed rattle snake typically lives in riparian communities or pine-oak woodlands in areas that are open, with scattered stands dominated by pines or oaks. The New Mexico ridge-nosed rattlesnake need areas where they can burrow, such as fallen logs and debris. Winter dens are often in talus slopes or other rocky areas, with crevices and holes that protect the snakes from frost. The New Mexico ridge-nosed rattlesnake is restricted to mountainous terrain at elevations from 610 to 2,743 m (2,000 to 9,000 ft.), but most occur around 2,226 m (7,304 ft.). The rattlesnake hides in leaf litter among cobbles and rocks, and can climb into trees. Habitat destruction has limited the geographic range and areas where these snakes can be found (ECOS 2015; NatureServe 2015; USFWS 1985; USFWS 2002).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Moderate

Immigration/Emigration

Adult: No

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: Rattlesnakes are active on the surface as early as April and as late as October, with heightened activity between July and September. Temperature and rainfall (summer monsoons) are important factors in activity levels. This species moves only relatively short distances, and moves less frequently compared to other rattlesnake species. This sedentary nature contributes to the limited area the species is known to occupy. The New Mexico round-nosed rattlesnake has a moderate rate of mobility. These snakes do not immigrate or emigrate, are nonmigratory, and have a moderate dispersal rate (NatureServe 2015; USFWS 1985).

Additional Life History Information

Adult: Rattlesnakes are active on the surface as early as April and as late as October, with heightened activity between July and September. Temperature and rainfall (summer monsoons) are important factors in activity levels. This species moves only relatively short distances, and moves less frequently compared to other rattlesnake species. This sedentary nature contributes to the limited area the species is known to occupy (ECOS 2015).

Population Information and Trends

Population Trends:
Unknown short-term trend, declining long-term trend (NatureServe 2015).

Resiliency:
Moderate

Representation:
Moderate

Redundancy:
Low

Number of Populations:
1

Population Size:
The United States population for New Mexico ridge-nosed rattle snakes was estimated at 500 snakes in the 1960s, and it is thought that collecting may have further reduced the population by one-fourth (NatureServe 2015).

Resistance to Disease:
Moderate; a variety of disease and pathogenic organisms from which they suffer have been an integral part of the evolution of the New Mexico ridge-nose population, but these are currently poorly understood (USFWS 1985).

Adaptability:
Low

Population Narrative:
The population of the New Mexico ridge-nosed rattlesnake is thought to comprise around 375 individuals in the United States. The last population estimate, made in the 1960s, was 500 snakes; it is thought that collection of snakes has reduced the populations by one-fourth. All New Mexico round-nose rattlesnakes are considered grouped into one population. The short-term population trend is unknown, but the long-term population trend is one of a species in decline. A variety of disease and pathogenic organisms from which they suffer have been an integral part of the evolution of the New Mexico ridge-nose population, but these are currently poorly understood (NatureServe 2015; USFWS 1985; USFWS 2002).

Threats and Stressors

Stressor: Habitat disturbance
Exposure: New Mexico ridge-nosed rattlesnake habitat is destroyed.

Response: See narrative.
Consequence: Reduction in population numbers, reduction of suitable habitat.
Narrative: Habitat disturbance, both past and present, such as from fires and excessive cattle grazing, have affected the habitat for the New Mexico ridge-nosed rattlesnake. In addition, new habitat stressors of concern include mining, which has been explored in some of the New Mexico ridge-nosed rattlesnake habitats for many years. Habitat destruction is also linked with the use of dynamite to blast boulders and gain access to snakes for collection (explained below). The effect of habitat disturbance, combined with snake collecting, has been especially detrimental to the New Mexico ridge-nosed rattlesnake (USFWS 1985).

Stressor: Collecting
Exposure: New Mexico ridge-nosed rattlesnake is collected.
Response: Mortality, taken out of the wild.
Consequence: Reduction in population numbers.
Narrative: The effects of collecting the New Mexico ridge-nose rattlesnake in the Naimas Mountains between 1957 and 1974 are unknown, because there are no estimates of the abundance of these snakes prior to collecting. However, collecting is thought to have negatively harmed the population, with lower numbers that can still be seen today. The physical attractiveness of this species, combined with its limited geographic range, has made it a very desirable snake for scientific and commercial purposes. Snakes could be priced higher than $175, depending on the size (USFWS 1985).

Stressor: Natural threats and stressors
Exposure: See narrative.
Response: See narrative.
Consequence: See narrative.
Narrative: Natural threats have had an unknown effect on New Mexico ridge-nosed rattlesnake populations. Natural threats include predation, starvation, and disease, all of which are potential factors that can harm the New Mexico ridge-nosed rattlesnake populations (USFWS 1985).

Recovery

Reclassification Criteria:
Even though the very restricted range of Crotalus willardi obscurus as it is presently known may preclude eventual delisting, reclassification to nonthreatened status, nonetheless, could be considered when:

All important areas of New Mexico ridge-nosed rattlesnake habitat in Mexico and New Mexico are identified.

Habitat in New Mexico is protected from adverse modification.

The continued existence of the taxon in its habitat is assured.

Delisting Criteria:
Need to develop delisting criteria.

Recovery Actions:

- Protect ridge-nose rattlesnakes and their habitat.
- Investigate status and biology of ridge-nose rattlesnakes.
- Clarify the taxonomic status of ridge-nose rattlesnake populations in the Animas Mountains and Sierra San Luis.
- Establish two or three captive populations.
- Disseminate information about New Mexico ridge-nose rattlesnakes.

Conservation Measures and Best Management Practices:

-

Additional Threshold Information:

-
-

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SPECIES ACCOUNT: *Cyclura stejnegeri* (Mona ground Iguana)

Species Taxonomic and Listing Information

Listing Status: Threatened; March 6, 1978; Southeast Region (R4)

Physical Description

The Mona ground iguana is a large bodied, heavy headed lizard about 1.22 m in length (from snout to tail) with strong legs and a vertically flattened tail (Rivero 1998). Adults average 1.2 m (4 feet) in length and weigh approximately 6.8 kg (15 pounds) (Alvarez et al. 2013). Both sexes are ornamented with protruding facial scales and a horn-like, conical scale atop the snout. Body coloration is a uniform gray, olive, or brown in adults, while hatchlings are light gray or tan with dark bands (Wiewandt and García 2000) (USFWS, 2015).

Historical Range

Mona Island (USFWS, 2015)

Current Range

Mona Island (USFWS, 2015)

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 2/3/1978.

Legal Description

On February 3, 1978, the U.S. Fish and Wildlife Service designated critical habitat for Cyclura stejnegeri (Mona ground Iguana) pursuant to Endangered Species Act of 1973, as amended (43 FR 4618 - 4621).

Critical Habitat Designation

The critical habitat is the entire island of Mona Island.

Primary Constituent Elements/Physical or Biological Features

Not available.

Life History

Feeding Narrative

<u>Adult:</u> Mona iguanas are considered omnivorous, but like most Cyclura species, are primarily herbivorous consuming leaves, flowers, berries, and fruits from different plant species (Rivero 1998) (USFWS, 2015).

Reproduction Narrative

<u>Adult:</u> Female iguanas deposit from 5 to 19 eggs, with an average of 12 (Wiewandt 1977) to 14 (Pérez-Buitrago 2000) eggs. They bury their eggs in the sand and the sunlight incubates the eggs (Schwartz 1923). They will guard the nest for several days, but provide no parental care for the

hatchlings, which hatch approximately three months later. Wiewandt (1977) and Pérez-Buitrago (2000) also studied the species hatchling size and growth rates USFWS, 2015).The breeding season begins in mid-June, when all mating occurs, and ends by November, when eggs hatch. Prior to breeding season males establish a territory that includes female retreat burrows (USFWS, 1984). Mating occurs in mid-June through the end of that month. During this period males increase territorial movements, reduce the time foraging and defend territories more aggressively (USFWS, 1984).Eggs hatch in October and November, 3 months after oviposition (USFWS, 1984).

Habitat Narrative

Juvenile: Contrasting with the predominantly terrestrial habits of adult Mona iguanas, hatchling iguanas are mostly arboreal, spending most of their time in locations above the ground (Pérez-Buitrago and Sabat 2007) (USFWS, 2015)

Adult: Mona Island is characterized by a flat plateau, a gently sloping upland surface that is terminated by higher sheer cliffs along its northern and southern perimeter and by somewhat lower, less steep cliffs that descend to coastal lowlands along its western, southwestern, and southeastern margins (USFWS, 1984).Large areas of the coastal terrace were cleared and planted with West Indian mahogany (Swietenia mahogany) and Australian pine (Casuarina equistifolia) by the Civilian Conservation Corps in the late 1930's and the 1940's. Iguanas nest in semi-open areas with and around the edges of these plantation, in exposed patches of loose sandy soil (USFWS, 1984).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS, 2015)

Dispersal

Adult: Moderate (USFWS, 2015)

Immigration/Emigration

Adult: Low (USFWS, 2015)

Dispersal/Migration Narrative

Adult: García et al. 2007 reported dispersal ranges on headstarted juvenile Mona iguanas. Mona iguanas traveled distances from 471-6396 m (mean 2844 ± 2122 m) and had a mean Minimum Complex Polygon of 10.7 ± 2.5 ha. García et al. (2008) reported that females migrated an average of 2.38 ± 2 km (range = 0.32 - 12.8) (USFWS, 2015).

Population Information and Trends

Population Trends:

Unknown (USFWS, 2015)

Resiliency:

Low (inferred from USFWS, 1984 and USFWS, 2015)

Representation:

Low (inferred from USFWS, 1984 and USFWS, 2015)

Redundancy:

Low (inferred from USFWS, 1984 and USFWS, 2015)

Population Narrative:

Pérez-Buitrago and Sabat (2000) provided size and density estimates similar to Wiewandt (1977), suggesting the population has been stable for that 23-year period. Moreno (1995) estimated the population somewhat lower than Wiewandt (1977), suggesting a population decline. However, there were differences in the methodology between the two surveys, thus any conclusion about the status of the population based on these studies is uncertain (Pérez and Sabat 2000). Wiewandt and García (2000) further noted that it is clear the Mona iguana population is abnormally small when compared to other similarly-sized iguanas in equivalent areas, which suggests a declining population. However, the low density of the population may be attributed to a lack of recruitment into adult stages due to predation of juveniles by invasive mammals and to high levels of territoriality (Pérez-Buitrago et al. 2010). The implementation of a long-term monitoring program for the Mona iguana is required to track population dynamics (Pérez-Buitrago et al. 2007). Hence, it has been difficult to determine population trends for the Mona iguana population (USFWS, 2015).Low resiliency, representation and redundancy are inferred base n species habitat and its isolated nature on Mona Island.

Threats and Stressors

Stressor: Feral Cats (USFWS, 1984)
Exposure:
Response:
Consequence: Loss of juvenile iguanas
Narrative: Feral cats are known to be a threat to juvenile iguanas as they are known to feed on them (USFWS, 1984).

Stressor: Feral pigs (USFWS, 1984)
Exposure:
Response:
Consequence: Habitat loss and loss of eggs
Narrative: Feral pigs cause habitat destruction and also dig up iguana eggs (USFWS, 1984).

Stressor: Feral goats (USFWS, 1984)
Exposure:
Response:
Consequence: Habitat loss
Narrative: Overgrazing by goats causes changes in the vegetation by reducing or eliminating the more palatable plant species and causing an increase if spiny plants or plants that contain high concentrations of toxic sap (USFWS, 1984).

Stressor: Land use (USFWS, 1984)
Exposure:
Response:
Consequence: Habitat loss/individual deaths
Narrative: Unfortunately, much of the area suitable for iguana nesting was planted with trees, altering the natural conditions of the coastal plain. This action, together with past agricultural practices, has reduced sunlit areas necessary for nesting activities. Privacy is crucial to the completion of mating and egglaying. Human activities can cause females to abandon the nest and use suboptimal sites. Trampling by humans causes destruction of nest chambers. Vehicles also have cause death of several individuals (USFWS, 1984).

Recovery

Delisting Criteria:
The population increases or stabilizes during ten consecutive years (USFWS, 2015).

Nesting sites are effectively protected from predation by pigs and goats, as well as trampling by humans, by means of enclosures (USFWS, 21015).

Feral mammals threating the species are effectively controlled, or eradicated if feasible (USFWS, 2015).

A habitat management plan to insure long-term availability of nesting areas for an expanded population is prepared and put into effect (USFWS, 2015).

Recovery Actions:

- Information for this criterion has been partially obtained. Pérez-Buitrago and Sabat (2000) provided size and density estimates similar to Wiewandt (1977), suggesting the population has been stable for that 23-year period. Moreno (1995) estimated the population somewhat lower than Wiewandt (1977), suggesting a population decline. However, there were differences in the methodology between the two surveys, thus any conclusion about the status of the population based on these studies is uncertain (Pérez and Sabat 2000). Wiewandt and García (2000) further noted that it is clear the Mona iguana population is abnormally small when compared to other similarly-sized iguanas in equivalent areas, which suggests a declining population. However, the low density of the population may be attributed to a lack of recruitment into adult stages due to predation of juveniles by invasive mammals and to high levels of territoriality (Pérez-Buitrago et al. 2010). The implementation of a long-term monitoring program for the Mona iguana is required to track population dynamics (Pérez-Buitrago et al. 2007). Hence, it has been difficult to determine population trends for the Mona iguana population (USFWS, 2015).
- This criterion has been partially met. PRDNER and volunteers installed fences along the coastal plain to protect the nesting areas from human trampling and egg predators such as pigs, which should increase hatching success (Pérez-Buitrago 2000). A fence erected by personnel from PRDNER around nesting areas between Sardinera and Uvero also reduced feral pig predation. However, other nesting areas, not included in the fencing plan, remain exposed to pig predation. Protecting these areas pose serious difficulties because of the installation and maintenance challenges in remote areas. Although the ultimate goal is to

remove the invasive pigs (Criterion 3), we need to assess the feasibility of installing fences in remote areas or other areas not originally considered (USFWS, 2015).

- This is an ongoing action. The PRDNER has been implementing a feral mammal control program since 1978. Current hunting season for pigs and goats extends from December to March. Although attempts have been made in the past for an effective cat control program, there is currently no such program and cats are rarely trapped or hunted. According to the species Recovery Plan (USFWS 1984), if eradication of cats, pigs, and goats is considered a prerequisite to consider the Mona iguana as recovered, the recovery and delisting of the species may never be achieved. Currently, there is a proposal titled: Development of the Removal Project for Invasive Mammals from Mona Island. This proposal is working towards a feasibility assessment for the removal of invasive pigs, cats and rodents from Mona Island. Based on the results of this project, we will be able to better assess and/or modify this criterion (USFWS, 2015).
- This criterion has been partially (short-term) met. A comprehensive habitat management plan to insure long-term availability of nesting areas for an expanded population of iguanas has not been prepared. However, PRDNER has conducted coastal plain habitat management through fencing to control vegetation modification. PRDNER with the help of funding from the Service's Coastal program grants has instituted actions to improve nesting habitat, such as clearing of Casuarina forest near the Sardinera area, fencing the cleared sites to exclude goats and pigs, and studying the impact of pigs and goats on native vegetation (Alvarez-Rodríguez 2001, Meléndez-Ackerman et al. 2008). Most of these projects need continual management and need to be assessed for current functionality towards iguana recovery goals (USFWS, 2015).

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SPECIES ACCOUNT: *Dermochelys coriacea* (Leatherback sea turtle (entire))

Species Taxonomic and Listing Information

Listing Status: Endangered; Southeast Region (R4) (USFWS, 2015)

Physical Description

The largest of the marine turtles. Carapace has seven prominent longitudinal ridges, plastron has five ridges; no scutes on skin-covered carapace and plastron; carapace blackish or dark bluish, often with irregular whitish or pink blotches; plastron mainly whitish; the largest turtle, with adults usually 135-178 cm (to 189 cm) in carapace length, 295-544 kg (to 916 kg); young are black and white, covered with numerous small beady scales (later shed), carapace about 6-7.5 cm at hatching (Conant and Collins 1991) (NatureServe, 2015). he leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017)

Taxonomy

Two described subspecies, D. c. coriacea (Atlantic Ocean) and D. c. schlegelii (Pacific and Indian oceans), seem to be poorly differentiated and currently are not recognized (Pritchard 1980). Should the populations in the Pacific prove to be a valid subspecies, the proper name would be D. c. angusta (Pritchard and Trebbau 1984). Brongersma (1996) determined that the source of the type material for the name schlegelii likely is Japan and not Guaymas, Mexico. Crother et al. (2008) has returned to the use of "sea turtles" (rather than "seaturtles") as part of the standard English name for marine turtles. The combined name has not been used recently in the literature (NatureServe, 2015).

Historical Range

See current range/distriubtion.

Current Range

This circumglobal species generally forages in temperate waters and nests in tropical and subtropical latitudes on beaches of the Atlantic, Indian, and Pacific Oceans. Leatherbacks appear to spend the first portion of their lives entirely in tropical waters; those less than 100 cm in carapace length occur only in waters warmer than 26oC, whereas adults may venture to high latitude waters in summer (e.g., see Goff and Lien 1988, Eckert 2002) and occur occasionally in inshore waters. Significant nesting areas include Malaysia (at least formerly), Pacific coast of Mexico and Central America, and Atlantic shore of northern South America. Largest population worldwide is in the western Atlantic (Spotila et al. 1996). In the Western Hemisphere, nesting also occurs in Florida (very rarely north to Georgia), along the shores of the Gulf of Mexico, in the West Indies, and along the Atlantic shore of Central America and the Pacific shore of northern South America. In the western Caribbean, nesting is frequent from northern Costa Rica to Colombia and in eastern French Guiana and western Surinam. Some nesting occurs along the central Brazilian coast; important colonies are in northwestern Guyana and in Trinidad. In the Antilles, most nesting occurs in the Dominican Republic and on islands close to Puerto Rico, including Culebra and St. Croix (the largest, best-studied population in U.S. waters).A general aggregation of leatherbacks is known to occur in the Pacific north of the Hawaiian Islands year-round, and in the Atlantic seasonal concentrations occur during the summer and fall months in the northeastern United States and Canada in areas such as Cape Cod Bay, the Gulf of Maine, the Scotian Shelf, and Cape Breton (NatureServe, 2015). he leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior), and lack of a hard, bony carapace. It ranges from tropical to subpolar latitudes, worldwide (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Leatherback sea turtles are distributed in oceans throughout the world. Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 3/23/1999.

Legal Description

On September 26, 1978, the U.S. Fish and Wildlife Service determined critical habitat for the leatherback sea turtle (dermochelys coriacea) in a portion of its range. This action is was taken to insure the integrity of the only major nesting beach used by leatherbacks in the United States or its territories and made all provisions of section 7 of the Endangered Species Act of 1973 available to this species. On March 23, 1979, the National Marine Fisheries Service (NMFS) determined critical habitat for the leatherback sea turtle (Dermochelys coriacea) in waters adjacent to Sandy Point Beach, St. Croix, U.S. Virgin Islands. The action was taken under Section 7 of the Endangered Species Act of 1973, as amended. 16 U.S.C. 1531 et. seq. (the “Act”) to provide protection to sea turtles using these waters for courting, breeding, and as access to and from their nesting areas on Sandy Point Beach.

Critical Habitat Designation

Critical habitat for the leatherback sea turtle is designated:

In the U.S. Virgin Islands: A strip of land 0.2 miles wide (from mean high tide inland) at sandy Point Beach on the western end of the island of St. Croix beginning at the southwest cape to the south and running 1.2 miles northwest and then northeast along the western and northern shoreline, and from the southwest cape 0.7 mile east along the southern shoreline.

The waters adjacent to Sandy Point, St. Croix, U.S. Virgin Islands, up to and inclusive of the waters from the hundred fathom curve shoreward to the level of mean high tide with boundaries at 17o42'12'' North and 64o50'00'' West.

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 meter isobath to mean high tide level between 17° 42’12” N and 65°50’00” W (44 FR 17710). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. The designated critical habitat is within the Sandy Point

National Wildlife Refuge. Leatherback nesting increased at an annual rate of 13% from 1994 to 2001; this rate has slowed according to nesting data from 2001 to 2010 (NMFS 2013b). On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback sea turtle (50 CFR 226). This designation includes approximately 43,798 square kilometers stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64,760 square kilometers stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meters depth contour. The designated areas comprise approximately 108,558 square kilometers of marine habitat and include waters from the ocean surface down to a maximum depth of 80 meters. They were designated specifically because of the occurrence of prey species, primarily scyphomedusae of the order Semaeostomeae (i.e., jellyfish), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Primary Constituent Elements/Physical or Biological Features

The constituent elements of critical habitat include, but are not limited to: Physical structures and topography, biota, climate, human activity, and the quality and chemical content of land, water, and air. Critical habitat may represent any portion of the present habitat of a listed species and may include additional areas for reasonable population expansion.

Special Management Considerations or Protections

The only activities that have been identified as possibly modifying this critical habitat of being impacted by its designation are recreational activities such as boating and swimming and sandmining. Recreational activities may result in disturbances in the water column that could affect the critical habitat but designation of this habitat will not impact private recreational activities. Sandmining may result in increased turbidity in the water column which may result in adverse modification of this habitat.

Life History

Feeding Narrative

Juvenile: Leatherbacks grow rapidly (approximately 32 cm in carapace length each year) from hatchling to juvenile size (USFWS, 2013). Immatures are invertivores (NatureServe, 2015).

Adult: Principal food is jellyfish, though other invertebrates, fishes, and seaweed sometimes are eaten. Pelagic foraging may focus on jellyfish in the deep scattering layer (Eckert 1992) (NatureServe, 2015). Because leatherbacks must consume large amounts of food to meet their energetic demands (Heaslip et al. 2012; Jones et al. 2012), it is important that they have access to areas of high productivity (USFWS, 2013).

Reproduction Narrative

Egg: Eggs hatch in 8-10 weeks. Eggs incur high rates of mortality from predation. In Malaysia, egg survivorship (to hatching) was 0.63 (see Iverson 1991) (NatureServe, 2015).

Juvenile: Hatchlings incur high rates of mortality from predation (NatureServe, 2015).

Adult: Lays up to 10+ (average 5 in Virgin Islands, 5-7 in Puerto Rico) clutches of 50-170 eggs (typically 70-90 normal eggs in the Atlantic, usually fewer than 60 in the eastern Pacific) at intervals of about 1-2 weeks; most individuals nest every 2-3 years. Nests at night, March-August in Western Hemisphere. Deposits eggs in moist sand. Nests on sloping sandy beaches backed up by vegetation, often near deep water and rough seas. Largest colonies use continental, rather than insular, beaches (CSTC 1990). Pattern of epibiont colonization in Caribbean suggests that gravid turtles do not arrive from temperate latitudes until just prior to nesting, and that they go directly to a preferred nesting beach; nesters apparently arrive asynchronously (Eckert and Eckert 1988). Limited data indicate a post-maturation longevity of up to about two decades (Pritchard 1996) (NatureServe, 2015). Age at sexual maturity based on skeletochronological data suggest that leatherbacks in the western North Atlantic Ocean may not reach maturity until 29 years of age (Avens and Goshe 2008; Avens et al. 2009). The skeletochronological data contradict other estimates (Dutton et al. 2005: 12-14 years; Jones et al. 2011: 7-16 years; Pritchard and Trebbau 1984: 2-3 years; Rhodin 1985: 3-6 years; Zug and Parham 1996: average maturity at 13-14 years for females). Age at maturity remains a very important parameter to be confirmed as it has significant implications for management and recovery of leatherback populations (USFWS, 2013). Age at maturity has been difficult to ascertain, with estimates ranging from five to twenty-nine years (Avens et al. 2009; Spotila et al. 1996). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50% worldwide (Eckert et al. 2012). Females nest every one to seven years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33% more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005; Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Environmental Specificity

Adult: Very narrow to narrow (Natureserve, 2015)

Habitat Narrative

Egg: See adult reproduction narrative.

Juvenile: See adult habitat narrative.

Adult: Marine; open ocean, often near edge of continental shelf; also seas, gulfs, bays, and estuaries. Mainly pelagic, seldom approaching land except for nesting (Eckert 1992). Concentrates in summer in waters mostly 20-40 m deep near Cape Canaveral, Florida. Dives almost continuously, to depths of up to at least several thousand meters; may linger at the surface at midday but spends most of time submerged. Utilizes near shore, pelagic, estuarine, beach environments. The environmental specfciity is very narrow to narrow. (NatureServe, 2015). No nesting occurs on beaches under U.S. jurisdiction (USFWS, 1998).

Dispersal/Migration

Motility/Mobility

Juvenile: High (inferred from USFWS, 1998).

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Juvenile: Unknown (USFWS, 1998)

Adult: High (NatureServe, 2015)

Immigration/Emigration

Juvenile: Emigrates from nest (USFWS, 1998)

Dispersal/Migration Narrative

Juvenile: Hatchlings tunnel out of the nest in a cooperative activity which takes place over several days. Emergence is typically at early evening. As with other sea turtle species, sea-finding orientation is based largely on light, specifically the brightness differential between the open ocean horizon and the darker vegetation to the landward side (Mrosovsky 1972, 1977). Nothing is known of the dispersal pattern of leatherback hatchlings from Pacific nesting beaches (USFWS, 1998).

Adult: Moves hundreds or thousands of kilometers between nesting beaches and distant marine waters; transequatorial migrations have been documented. Morreale et al. (1996) documented a migration corridor extending from the Pacific coast of Costa Rica through the vicinity of the Galapagos Islands (NatureServe, 2015).

Population Information and Trends

Population Trends:

Variable, depending on region (USFWS, 2013)

Species Trends:

Declining to stable, depending on region (USFWS, 2013)

Resiliency:

Very high (inferred from NatureServe, 2015)

Representation:

Low (inferred from USFWS, 2013)

Redundancy:

High (inferred from NatureServe, 2015)

Number of Populations:

21 - 80 (NatureServe, 2015)

Population Size:

10,000 - 1,000,000 individuals (NatureServe, 2015)

Resistance to Disease:

Unknown (USFWS, 1998)

Adaptability:

Low (inferrd from NatureServe, 2015)

Population Narrative:

Likely relatively stable in extent of occurrence, uncertain degree of decline in population size and number/condition of occurrences. Pritchard (1982) estimated 115,000 breeding females worldwide, though his estimates may have been too high, especially for Mexico. Estimated world population in the early 1990s was reported as 136,000 breeding females by Pritchard (1992). In contrast, Spotila et al. (1996) estimated the worldwide population of nesting females at 26,200-42,000, with the majority of animals occurring in the Atlantic Ocean and Caribbean Sea where the population was estimated at 27,608. An estimated 100-900 leatherbacks occur in summer in waters off the northeastern U.S. (Shoop and Kenney 1992). See Cook (1981) for information on status in Canada.Spotila et al. (2000) estimated total adult (breeding) population at 1,690 females in the eastern Pacific (down from an estimated 4,600-6,500 in 1996) and concluded leatherbacks are on the verge of extinction in the Pacific. Another estimate suggested a total of 2,300 adult females in the entire Pacific (Crowder 2000).In Florida, between 1988 and 1992, annual reported leatherback nests varied between 98 and 188 (USFWS 1998). In the 1980s and early 1990s, about 18-55 females nested each year on St. Croix in the U.S. Virgin Islands (Boulon et al. 1996); increased to 100+ in 1997. In 1997, more than 80 females nested at Culebra Island, Puerto Rico.Nest counts at the largest nesting colony in Mexico reported less than 250 in 1998-1999 (Eckert unpubl. results in Spotila et al. 2000). Spotila et al. (2000) predicted that without protection the population breeding at Playa Grande, Costa Rica (once the 4th largest nesting colony in the world), would be reduced to around 50 nesting females by 2003-2004.In the mid-1990s, few beaches had more than a few hundred nesting females (Spotila et al. 1996). Only four nesting areas presently support more than 1,000 breeding females: the Pacific coast of Mexico probably fewer than 5,000 though formerly many more; Pacific coast of French Guiana, 4,500-6,500; peninsular Malaysia, 1,000-2,000; and the Kepala Burung region of Indonesia (UNEP 2003). This species is represented by a large number of nesting occurrences, but few of them have more than a few hundred nesting females (Spotila et al. 1996, UNEP 2003). The range extent is greater than 1,000,000 square miles. The estimated total population size is 10,000 to 1,000,000 individuals, with 21 - 80 nesting occurrences. This species is highly vulnerable to current stressors (NatureServe, 2015). Leatherbacks exhibit low genetic diversity in the mitochondrial genome (Dutton et al. 1996, 1999; see Jensen et al. 2013). Leatherback nesting populations are declining dramatically in the Pacific Ocean, yet appear stable in many nesting areas of the Atlantic Ocean and South Africa in the Indian Ocean. The East Pacific and Malaysia leatherback populations have collapsed, yet Atlantic populations generally appear to be stable or increasing (USFWS, 2013). The extent to which disease contributes to disability or mortality among wild leatherbacks in the Pacific Ocean has not been studied. As far as is known, the health status of this species is good throughout its range (USFWS, 1998). The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females, and egg harvesting. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, because of sea-level rise. The species' resilience to additional perturbation is low (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance Leatherbacks are globally distributed, with nesting beaches in the Pacific, Atlantic, and Indian oceans. Detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS 2013b). Productivity / Population Growth Rate Population growth rates for leatherback sea turtles vary by ocean basin. Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation has been declining at a rate of almost six % per year since 1984 (Tapilatu et al. 2013). Leatherback subpopulations in the Atlantic Ocean, however, are showing signs of improvement. Nesting females in South Africa are increasing at an annual rate of four to 5.6%, and from nine to 13% in Florida and the U.S. Virgin Islands (TEWG 2007), believed to be a result of conservation efforts. Genetic Diversity Analyses of mitochondrial DNA from leatherback sea turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS 2013b) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Habitat destruction and modification (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Leatherbacks are increasingly threatened by natural and anthropogenic impacts to their nesting beaches and coastal and pelagic marine habitat. Accumulation of marine debris on the beach, as well as sand mining, can have a negative impact on available nesting habitat in some areas (Chacón-Chaverri 1999, Formia et al. 2003). These factors may directly, through loss of beach habitat, or indirectly, through changing thermal profiles and increasing erosion, serve to decrease the amount of nesting area available to nesting females, and may evoke a change in the natural behaviors of adults and hatchlings (Ackerman 1997; Witherington et al. 2003, 2007).

Coastal development is usually accompanied by artificial lighting, and the presence of lights on or adjacent to nesting beaches alters the behavior of nesting females and is often fatal to emerging hatchlings as they are attracted to light sources and drawn away from the water (Bourgeois et al. 2009; Cowan et al. 2002; Deem et al. 2007; Witherington 1992; Witherington and Bjorndal 1991). In the marine environment, marine debris may also serve as a source of mortality to all species of sea turtles, as small debris can be ingested and larger debris can entangle animals, leading to death. Manmade materials such as plastics, micro plastics, and derelict fishing gear (e.g., ghost nets) that may impact leatherbacks via ingestion or entanglement can reduce food intake and digestive capacity, cause distress and/or drowning, expose turtles to contaminants, and in some cases cause direct mortality (Arthur et al. 2009; Balazs 1985; Bjorndal et al. 1994; Doyle et al. 2011; Keller et al. 2004; Parker et al. 2011; Wabnitz and Nichols 2010) (USFWS, 2013).

Stressor: Climate change (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Impacts from climate change, especially due to global warming, are likely to become more apparent in future years (Intergovernmental Panel on Climate Change (IPCC) 2007a). Based on the available information, climate change is an anthropogenic factor that will affect leatherback habitat and biology. The global mean temperature has risen 0.76ºC over the last 150 years, and the linear trend over the last 50 years is nearly twice that for the last 100 years (IPCC 2007a). Based on substantial new evidence, observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. These changes include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007b), which could affect leatherback prey distribution and abundance. Global warming is expected to expand foraging habitats into higher latitude waters (James et al. 2006; McMahon and Hays 2006), and change habitat conditions on the beach (e.g., Pike 2013) (USFWS, 2013).

Stressor: Harvest (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Egg collection occurs in many countries around the world (e.g., Billes and Fretey 2004; Bräutigam and Eckert 2006; Chan and Liew 1996; Fretey et al. 2007a; Hamann et al. 2006a, 2006b; Hilterman and Goverse 2007; Kinan 2002; Maison et al. 2010; Mangubhai et al. 2012; Santidrián Tomillo et al. 2007, 2008; Troëng et al. 2007). Harvest of females remains a matter of concern on many beaches (e.g., Bräutigam and Eckert 2006; Chacón and Eckert 2007; Fretey et al. 2007a; Fournillier and Eckert 1999; Gomez et al. 2007; Hamann et al. 2006a; Kinch et al. 2012; Ordonez et al. 2007). A traditional harvest of subadult and adult leatherbacks occurs in the Kei Islands (Lawalata et al. 2006; Suarez and Starbird 1996). Leatherbacks are also used in voodoo ceremonies and traditional medicine in West African countries (Fretey et al. 2007b), as well as religious ceremonies in Taiwan (Cheng and Chen 1997) (USFWS, 2013).

Stressor: Nest relocation (USFWS, 2013)
Exposure:
Response:
Consequence:

Narrative: Many studies have found that hatching success of nests relocated to another section of the beach or to hatcheries is lower than in situ nests (reviewed by Eckert et al. 2012; Hernández et al. 2007); although another study found adequate hatching success in relocated nests at St. Croix (Eckert and Eckert 1990), which may be a factor in the increase observed in this nesting population (Dutton et al. 2005). Translocating nests into hatcheries also may skew natural sex ratios. In Playa Grande, Costa Rica, fewer females were produced in translocated nests where lower hatch success may have resulted in cooler nests due to fewer eggs producing metabolic heat (Sieg et al. 2011). Poor hatchery practices have skewed natural sex ratios, resulting in 100% females produced in some facilities (Chan and Liew 1995). The consequences of nest relocation need to be carefully evaluated (Mrosovsky 2006) (USFWS, 2013).

Stressor: Disease and predation (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: The first case of fibropapillomatosis in leatherbacks was reported from Pacific Mexico (Huerta et al. 2002). This disease is a condition likely caused by a herpesvirus (Ene et al. 2005) and is characterized by the presence of internal and external tumors (fibropapillomas) that may grow large enough to hamper swimming, vision, feeding, and potential escape from predators (Herbst 1994). Fibropapillomatosis is not as common in leatherbacks as in other sea turtle species (Huerta et al. 2002). Leatherbacks are preyed upon by a variety of predators (reviewed by Eckert et al. 2012). Predators of eggs include feral pigs and dogs, (e.g., Hamann et al. 2006a; Hitipeuw et al. 2007; Ordonez et al. 2007; Pilcher 2009; Tapilatu and Tiwari 2007), mole crickets (Maros et al. 2003), raccoons and armadillos (Engeman et al. 2003), monitor lizards (Tapilatu and Tiwari 2007), mongoose, civets, genets, and ghost crabs (Billes and Fretey 2004), jackals (Hughes 1996), dipteran larvae (Gautreau et al. 2008), and army ants (Ikaran et al. 2008). In Papua New Guinea, the Huon Coast Leatherback Turtle Conservation Program has successfully reduced dog predation by placing bamboo grids over the nests (Pilcher 2009). Predation on sea turtle hatchlings by birds and fish (see Vose and Shank 2003) has been commonly reported. Reported predation of leatherback hatchlings includes tarpons (Nellis 2000), gray snappers (Vose and Shank 2003), ghost crabs, great blue and yellow-crowned herons, and crested caracaras (Santidrián Tomillo et al. 2010). Adult leatherbacks are preyed upon by large predators, such as jaguars, tigers, killer whales, sharks, and crocodiles (reviewed by Eckert et al. 2012). Although disease and predation may pose risk at specific sites, globally they are not known to pose significant risk to leatherback sea turtles (USFWS, 2013).

Stressor: Fisheries bycatch (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: A significant factor impacting leatherback populations worldwide is incidental capture in artisanal and commercial fisheries (reviewed by Eckert et al. 2012; Lewison et al. 2004, 2013; Wallace et al. 2010a, 2013). Globally, over 85,000 sea turtles (all species combined) are estimated to be bycaught in fisheries deploying gill nets, longlines and trawls (Wallace et al. 2010a). Pelagic longlines were estimated to take more than 50,000 leatherbacks worldwide in 2000 (Lewison et al. 2004). Small-scale coastal fisheries are a major component of the global bycatch. Of the estimated 51 million people employed in fisheries worldwide, over 99% operate in non-industrial coastal fisheries (Peckham et al. 2007). Small-scale fisheries are reported to

have significant ecological impacts due to their high bycatch discards and benthic habitat destruction (Shester and Micheli 2011). To date, the highest sea turtle bycatch rates and levels of observed effort exist in the East Pacific, Northwest and Southwest Atlantic, and Mediterranean regions, but there also exists significant data gaps around Africa, in the Indian Ocean, and Southeast Asia where high bycatch rates have also been documented in coastal trawl, net and longline fisheries (Wallace et al. 2013). Coastal artisanal fisheries are a major concern for bycatch of sea turtles as well as ecological impacts to the marine environment (USFWS, 2013).

Stressor:
Exposure:
Response:
Consequence:
Narrative:

Stressor: Contaminants (USFWS, 2013)
Exposure:
Response:
Consequence:
Narrative: Increased exposure to heavy metals and other contaminants in the marine environment also affect leatherbacks, albeit perhaps not as globally significant as those mentioned above. Organochlorine contaminants, perfluoroalkyl compounds, cadmium, copper, zinc, and toxic metals have been identified in leatherbacks, but it is difficult to interpret their effect on the health of this endangered species (Caurant et al. 1999; Godley et al. 1998; Keller et al. 2012; McKenzie et al. 1999; Orós et al. 2009; Poppi et al. 2012; Storelli and Marcotrigiano 2003). Guirlet (2005) found high levels of organochloride pesticides in the sand of a French Guiana nesting beach, which may explain low hatching success on this beach (Girondot et al. 2007). Keller (2013) reviewed the studies on persistent organic pollutants (i.e., is carbon-based and persist for long periods in the environment) and clearly demonstrated that sea turtles are exposed to these pollutants depending on the species and location. Across all studies and species, classes of polychlorinated biphenyls had the highest concentrations and classes of hexachlorobenzene and hexachlorohexanes had the lowest concentrations in samples taken from sea turtles (reviewed by Keller 2013). Contaminants have been found to pass from nesting females to their eggs, which partially may explain poor hatching and emergence success, a characteristic of the species (reviewed by Eckert et al. 2012; Guirlet et al. 2008, 2010; Perrault et al. 2011; Stewart et al. 2008, 2011b). Nesting females transferred selenium and mercury to their offspring in nests laid in Florida (Perrault et al. 2011). Hatchlings were found to have heart and skeletal degeneration indicative of seleniumdeficient mothers. Selenium deficiency can result from ingestion of high levels of mercury, which is detoxified through the liver by formation of a mercury-selenium compound. Exposure to mercury, over time, decreases the liver's ability to detoxify the mercury. Perrault et al. (2011) found that hatching and emergence success was greater for hatchlings with elevated liver selenium and mercury-selenium compounds. Mercury and selenium concentrations increase in leatherbacks as they age (Perrault 2013). Mercury and selenium concentrations in the blood vary between females nesting in Florida and those nesting at Sandy Point National Wildlife Refuge. These differences may be attributed to divergent migratory routes to foraging grounds (Perrault et al. 2011, 2013) (USFWS, 2013).

Recovery

Reclassification Criteria:
Not available

See the 1998 and 1991 Recovery Plans for the U.S. Pacific and U.S Caribbean, Gulf of Mexico and Atlantic leatherback sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top five recovery actions identified to support in the Leatherback Five Year Action Plan: 19. Reduce fisheries interactions 20. Improve nesting beach protection and increase reproductive output 21. International cooperation 22. Monitoring and research 23. Public engagement (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017)

Delisting Criteria:
1. The adult female population increases over the next 25 years, as evidenced by a statistically significant trend in the number of nests at Culebra, Puerto Rico, St. Croix, U.S. Virgin Islands, and along the east coast of Florida (U.S. Caribbean, Atlantic, and Gulf of Mexico Recovery Plan) (USFWS, 2013).

2. Nesting habitat encompassing at least 75 percent of nesting activity in USVI, Puerto Rico, and Florida is in public ownership (U.S. Caribbean, Atlantic, and Gulf of Mexico Recovery Plan) (USFWS, 2013).

3. All priority one tasks have been successfully implemented (U.S. Caribbean, Atlantic, and Gulf of Mexico Recovery Plan) (USFWS, 2013).

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters (U.S. Pacific Recovery Plan) (USFWS, 2013).

2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually (FENA) over six years (U.S. Pacific Recovery Plan) (USFWS, 2013).

3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period (U.S. Pacific Recovery Plan) (USFWS, 2013).

4. Existing foraging areas are maintained as healthy environments (U.S. Pacific Recovery Plan) (USFWS, 2013).

5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region (U.S. Pacific Recovery Plan) (USFWS, 2013).

6. A management plan designed to maintain sustained populations of turtles is in place (U.S. Pacific Recovery Plan) (USFWS, 2013).

7. All priority #1 tasks have been implemented (U.S. Pacific Recovery Plan) (USFWS, 2013).

Recovery Actions:
- Eliminate incidental take of leatherbacks in U.S. and international commercial fisheries (USFWS, 1998).

- Support the efforts of Mexico and the countries of Central America to census and protect nesting leatherbacks, their eggs, and nesting beaches (USFWS, 1998).
- Determine movement patterns, habitat needs and primary foraging areas for the species throughout its range (USFWS, 1998).
- Determine population size and status in U.S. waters through regular aerial or on-water surveys (USFWS, 1998).
- Identify stock home ranges using DNA analysis (USFWS, 1998).
- Provide long-term habitat protection for important nesting beaches (USFWS, 1992).
- Ensure at least 60 percent hatch success on major nesting beaches (USFWS, 1992).
- Determine distribution and seasonal movements for all life stages in marine environment (USFWS, 1992).
- Reduce threat from marine pollution (USFWS, 1992).
- Reduce incidental capture by commercial fisheries (USFWS, 1992).

Conservation Measures and Best Management Practices:

- An analysis and review of the species should be conducted in the future to determine the application of the DPS policy to the leatherback. Since the species' listing, a substantial amount of information has become available on population structure (through genetic studies) and distribution (through telemetry, tagging, stable isotope, and genetic studies). The Services have not yet fully assembled or analyzed this new information; however, at a minimum, these data appear to indicate a possible separation of populations by ocean basins. To determine the application of the DPS policy to the leatherback, the Services intend to fully assemble and analyze this new information in accordance with the DPS policy (USFWS, 2013).
- The Services recommend the recovery plans be re-examined over the next 5-year horizon, particularly if the DPS analysis results in restructuring of the current listing, to update the plans to conform to current recovery planning guidance. The current "Recovery Plan for Leatherback Turtles (Dermochelys coriacea) in the U.S. Caribbean, Atlantic, and Gulf of Mexico" was signed in 1992 and the "Recovery Plan for U.S. Pacific Populations of the Leatherback Turtle (Dermochelys coriacea)" was signed in 1998. The recovery plans are dated and do not address a major, emerging threat—climate change. Actions to protect nesting beaches and foraging habitat and to preserve natural sex ratios should be understood in terms of impacts from climate change. Those plans should conform to the Services' Interim Recovery Planning Guidance (http://www.nmfs.noaa.gov/pr/pdfs/recovery/guidance.pdf) and comprehensively examine the threat of climate change and develop local actions, if possible, to minimize the impacts (USFWS, 2013).
- The Services recommend that research continue and be made a priority, which provides information on long-term population trends based on both nesting and in-water population monitoring (National Research Council 2010), hatchling and juvenile dispersal, genetic relationships among nesting populations, impacts of and bycatch reduction from coastal and pelagic fisheries, impacts of climate change, and identification of and threats at foraging areas (USFWS, 2013).
- The Services recommend that federal grant programs, relevant to sea turtle conservation and protection, continue to support efforts in the Atlantic Ocean and prioritize support for conservation and protection programs that would most benefit leatherback populations in the Pacific Ocean (USFWS, 2013).

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SPECIES ACCOUNT: *Drymarchon corais couperi* (Eastern indigo snake)

Species Taxonomic and Listing Information

Listing Status: Threatened; 3/3/1978; Southeast Region (R4) (USFWS, 2016)

Physical Description

The longest of North American snakes; heavy-bodied and shiny blue-black overall; chin, throat, and sides of head variably suffused with cream, orange, or red; scales unkeeled (males may have partial keel on scales of the middorsal 3-5 scale rows); anal undivided; 17 scale rows at mid-body; 1 preocular; third from last upper labial distinctly narrowed at the top; adult total length usually 152-213 cm (to 263 cm), about 43-61 cm at hatching (Conant and Collins, Smith and Brodie 1982) (NatureServe, 2015).

Taxonomy

Drymarchon couperi was proposed as a distinct species by Collins (1991), based on previously published (but unspecified) morphological differences and application of the evolutionary species concept. Crother et al. 2008, citing Wuster et al. (2001) listed couperi as a species. Subspecies couperi was proposed as a distinct species by Collins (1991), based on previously published (but unspecified) morphological differences and application of the evolutionary species concept. Crother et al. 2008, citing Wuster et al. (2001) listed couperi as a species. This database accepts Drymarchon couperi as a species, however, further study is warranted (NatureServe, 2015).

Historical Range

Historical range extended throughout the lower Coastal Plain of the southeastern United States, from southern South Carolina through Georgia and Florida to the Florida Keys, and west to southern Alabama and perhaps southeastern Mississippi (NatureServe, 2015).

Current Range

Current range includes southern Georgia (most common in the southeast; see Diemer and Speake 1983) and Florida (widely distributed throughout the state, south to the Keys, though perhaps very localized in the panhandle; Moler 1985, 1992; see also Ballard 1992). The species is apparently very rare or extirpated in Alabama, Mississippi, and South Carolina. Recent reintroductions have been made in Florida, Alabama, Georgia, South Carolina, and Mississippi. One reintroduced population may be thriving in Covington County, Alabama (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Eats small mammals, birds, frogs, snakes, lizards, and other vertebrates of appropriate size. Rossi (1994, Herpetol. Rev. 25:123-124) reported a juvenile that had eaten a large slug. Active forager; often searches along edges of wetlands (Moler 1992) (NatureServe, 2015).

Reproduction Narrative

Adult: Copulation occurs primarily in fall and winter. Eggs are laid in May-June (also reportedly as early as April). Clutch size usually is 5-10. Hatchlings appear from late July through October. Females can lay fertile eggs after several years of isolation (Behler and King 1979, Moler 1992) (NatureServe, 2015).Reported sex ratios of eggs 1:1, but adult sex ratios favor males 1.54: 1 (USFWS, 2008).

Spatial Arrangements of the Population

Adult: Clumped (inferred from NatureServe, 2015)

Tolerance Ranges/Thresholds

Adult: Low (inferred from NatureServe, 2015)

Dependency on Other Individuals or Species for Habitat

Adult: Gopher tortoises (NatureServe, 2015)

Habitat Narrative

Adult: Habitat includes sandhill regions dominated by mature longleaf pines, turkey oaks, and wiregrass; flatwoods; most types of hammocks; coastal scrub; dry glades; palmetto flats; prairie; brushy riparian and canal corridors; and wet fields (Matthews and Moseley 1990, Tennant 1997, Ernst and Ernst 2003). Occupied sites are often near wetlands and frequently are in association with gopher tortoise burrows. Pineland habitat is maintained by periodic fires. Viable populations of this species require relatively large tracts of suitable habitat. Refuges include tortoise burrows, stump holes, land crab burrows, armadillo burrows, or similar sites. Eggs may be laid in gopher (Geomys) burrows (Ashton and Ashton 1981). See USFWS (1998) for further information (NatureServe, 2015).Clumped spatial arrangement of the population and low tolerance range are inferred from NatureServe, 2015 habitat and population information.

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2008)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (USFWS, 2008)

Dispersal/Migration Narrative

Adult: USFWS (2008) notes that theses snakes can move considerable distances in a short time (2.2 miles in 42 days). Snakes return to their home dens to winter dens.Most snakes are not known to be migratory.

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

Moderate (inferred from NatureServe, 2015)

Representation:

Low (inferred from NatureServe, 2015)

Redundancy:

High (inferred from NatureServe, 2015)

Number of Populations:

81-300 (NatureServe, 2015)

Population Size:

10,000-100,000

Population Narrative:

Short-term Trend Comments: USFWS (1990) categorized the status as "declining." Based on current rates of habitat destruction and degradation, USFWS (1998) surmised that the range-wide population is declining, although the rate of decline is uncertain (NatureServe, 2015).Long-term Trend Comments: Number of occurrences and range have been reduced significantly in the past 40 years; the species underwent a population decline in the 1960s and 1970s (NatureServe, 2015).Moderate resiliency is inferred based on population numbers and numbers of individuals. Low representation is inferred based on specific habitat factors this species needs. High redundancy is inferred based on the highly dispersed geographic nature of the populations which make it unlikely that a catastrophic event would affect the entire species (NatureServe, 2015).

Threats and Stressors

Stressor: Habitat Loss (USFWS, 1982)
Exposure:
Response:
Consequence: Population decline
Narrative: In addition to the total loss of habitat when land is converted to row crops or housing developments, much of the forested sandhill habitat in south Georgia and parts of Florida is being degraded so that its value as Eastern indigo snake habitat is greatly reduced. These areas are being protected from fire and allowed to grow an overstory that is to dense (USFWS, 1982).

Stressor: Killing/Collection (USFWS, 1982)
Exposure:
Response:
Consequence: Population decline/reduction in individuals

Narrative: This large, slow snake is an easy mark for those that kill snakes on site. In addition, the docile nature and handsome appearance of this nonvenomous snake give it a high value in the pet trade (USFWS, 1982).

Stressor: Loss of Gopher tortoise (USFWS, 1982)
Exposure:
Response:
Consequence: Population decline
Narrative: There is a serious concern that gassing of gopher tortoise burrows by rattlesnake hunters is likely to kill the eastern indigo snake (USFWS, 1982).

Recovery

Reclassification Criteria:
Maintain and protect existing populations (USFWS, 2008).

Reestablish populations where feasible (USFWS, 2008)

Improve public attitude and behavior towards the eastern indigo snake (USFWS, 2008)

Delisting Criteria:
The eastern indigo snake should be considered for removal from the List of Endangered and Threatened Wildlife when: 1) At least fourteen (14) populations exhibit a stable or increasing trend evidenced by natural recruitment, and multiple age classes (Addresses Factors A, C, and E). 2) Populations (as defined in criteria 1) are distributed across at least 12 Conservation Focus Areas (CFAs) (see Appendix A) with at least 2 populations within each of the 4 representative regions (North Florida; Panhandle; Peninsular Florida; Southeast Georgia) (Addresses Factors A, C, and E). 3) Populations within the North Florida, Peninsular Florida, and Southeast Georgia regions naturally maintain their genetic and ecological diversity (Addresses Factors A, C, and E). 4) Conservation measures (e.g., habitat protection and management) and commitments are in place to manage threats of habitat loss, degradation and fragmentation such that sufficient habitat quantity and quality exists for the species to remain viable into the foreseeable future (Addresses Factors A, C, D and E) (USFWS, 2019).

Recovery Actions:
- The viability of existing populations is unknown. Sites with historical and/or current populations are considered to be supporting populations of the snake. Protection needs to be pursued for populations occurring on privately owned land (USFWS, 2008).
- Initial efforts to establish populations have been deemed unsuccessful. Current efforts will be focused on one site in Alabama and will involve a soft release of juveniles into pens incorporating both wetland and upland habitat (USFWS, 2008).
- Meetings and other forms of public outreach have been developed to help inform the public of the beneficial nature of snakes in the environment. In addition many developers in Florida have designed programs for workers to help protect eastern indigo snakes that may be encountered on construction sites (USFWS, 2008).
- 1. Protect existing eastern indigo snake populations via land protection and appropriate habitat management and conservation techniques identified in site-specific management plans. 2. Monitor known eastern indigo snake populations and the habitat that supports

them. 3. Expand knowledge of basic ecology and demography of eastern indigo snakes. 4. Repatriate populations within habitat historically occupied by eastern indigo snakes where feasible. 5. Develop range-wide habitat suitability models incorporating pertinent results from a Population Viability Analysis (PVA). 6. Establish a centralized range-wide Geographic Information System (GIS) database for data storage, analyses, and recovery review. 7. Develop and distribute public educational materials and outreach programs supporting eastern indigo snake recovery. 8. Coordinate all recovery activities, evaluate success, and revised recovery plan as appropriate (USFWS, 2019).

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SPECIES ACCOUNT: *Emoia slevini* (Slevin's skink)

Species Taxonomic and Listing Information

Listing Status: Endangered; Pacific Region (R1) (USFWS, 2016)

Physical Description

Slevin's skink measures 3 in (77 mm) from snout to cloaca vent (the opening for reproductive and excretory ducts), although length can vary slightly (Vogt and Williams 2004, p. 65). Fossil remains indicate its prehistoric size was much larger, up to 4.3 in (110 mm) in length (Rodda 2010, p. 3). Slevin's skink is darkly colored, from olive to brown, with darker flecks in a checkerboard pattern, and a light orange to bright yellow underside (Vogt and Williams 2004, p. 65). Their skin tends to be shiny, and is very durable and tough. Juveniles may appear cream-colored (Vogt and Williams 2004, p. 65; Rodda 2010, p. 3) (USFWS, 2014).

Taxonomy

Slevin's skink (Emoia slevini, guali'ek halom tano) is a small lizard in the reptile family Scincidae, the largest lizard family in number of worldwide species. Slevin's skink was first described in 1972 by Walter C. Brown and Marjorie V.C. Falanruw, which is the most recent and accepted taxonomy (Brown and Falanruw 1972, p. 107) (USFWS, 2014).

Historical Range

See current range/distribution.

Current Range

Slevin's skink previously occurred on the southern Mariana Islands (Guam, Cocos Island, Rota, Tinian, and Aguiguan), where it is now extirpated, except from Cocos Island off of Guam, where it was recently rediscovered (Fritts and Rodda 1993, p. 2; Steadman 1999; Lardner 2013, in litt.) (USFWS, 2014).

Critical Habitat Designated

No;

Life History

Reproduction Narrative

Adult: The females carry their eggs internally and give birth to live young (Brown 1991, pp. 14–15). Other specific life-history or habitat requirements of Slevin's skink are not well documented (Rodda 2002, p. 3) (USFWS, 2014).

Habitat Narrative

Adult: Based on both older and more recent observations, the species occurs in the forest ecosystem, with most individuals observed on the forest floor using leaf litter as cover (Brown and Falanruw 1972, p. 110; GDAWR 2006, p. 107; Cruz et al. 2000, p. 21; Lardner 2013, in litt.). Occasionally, individuals were observed in low hollows of tree trunks (Brown and Falanruw 1972, p. 110) (USFWS, 2014).

Dispersal/Migration

Population Information and Trends

Population Trends:

Decreasing (USFWS, 2014)

Population Narrative:

Once widespread, the remaining known populations of Slevin's skink are made up of a few individuals on Cocos Island, and occurrences of undetermined numbers of individuals on Alamagan and Sarigan. Populations of Slevin's skink are decreasing from initial numbers observed on Cocos Island, Alamagan, Pagan, and Asuncion, and it has not been reobserved on Guam, Rota, Tinian, and Aguiguan; the species has been lost from 90 percent of its former range (USFWS, 2014).

Threats and Stressors

Stressor: Agriculture and urban development (USFWS, 2015)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Agriculture and urban development are listed as threats to this species (USFWS, 2014).

Stressor: Nonnative plants (USFWS, 2014)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Nonnative plants are listed as a threat to this species habitat (USFWS, 2014).

Stressor: Typhoons (USFWS, 2014)
Exposure:
Response:
Consequence: Loss of habitat/loss of individuals
Narrative: Typhoons are listed as a threat to this species habitat (USFWS, 2014).

Stressor: Predation (USFWS, 2014)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Predation by rats, brown tree snakes and monitor lizards are listed as a threat to this species (USFWS, 2014).

Stressor:
Exposure:
Response:
Consequence:
Narrative:

Recovery

Recovery Actions:

- A recovery plan has not been completed for this species.

References

U.S. Fish and Wildlife Service. 2014. Endangered and Threatened Wildlife and Plants

Proposed Endangered Status for 21 Species and Proposed Threatened Status for 2 Species in Guam and the Commonwealth of the Northern Mariana Islands

Proposed Rule. FR Vol. 79, No. 190. Pages 59364-59413. USFWS. 2016. Environmental Conservation Online System (ECOS) – Species Profile. http://ecos.fws.gov/ecp0/. Accessed August 2016.

SPECIES ACCOUNT: *Epicrates (=Chilabothrus) inornatus* (Puerto Rican boa (=Chilabothrus))

Species Taxonomic and Listing Information

Listing Status: Endangered; Southeast Region (R4) (USFWS, 2015) 10/13/1970

Physical Description

The color is somewhat variable but usually ranges from pale to dark brown, sometimes grayish, with 70 to 80 darker colored blotches along the back from neck to vent. These dorsal blotches are generally dark-bordered with the centers of a lighter hue. Maximum size is approximately 6 and a half feet (USFWS, 2015).

Taxonomy

The species was first described by Reinhardt (1843) as Boa Inornata and subsequently re-assigned to the neotrpoical genus Epicrates (Boulenger, 1893). This species is believed to be an early derivative of the ancestral continental stock that resembled E. angulifer of Cuba and gave rise to both E. inornatus and E. subflavus of Jamiaca (Sheplan & Shwartz, 1974) (USFWS, 1986).

Historical Range

Schwartz & Thomas (1975) give the distribution of E. inornatus as Puerto Rico, where it is endemic. It is not known from the small islands of Puerto Rico (USFWS, 1986).

Current Range

The PR boa has a widespread distribution and is more common in the karst region of the north-northwest portion of the Island (USFWS, 2011).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: In general, movement of boas during a fix was observed significantly more often at night than during daylight hours (USFWS, 2011). In captivity, E. inornatus eats birds, mice, rats and lizards which are killed by constriction and swallowed head first. Rodriguez & Reagan (1984) describe and incident of bat predation in a cave entrance. Boas suspend their bodies from overhanging branches and seize bats as they emerge at dusk (USFWS, 1986).

Reproduction Narrative

Adult: Gravid females of the PR boa are known to use exposed terrestrial debris piles for thermoregulation (Tolson and Henderson 1993), which may contribute to greater use of ground sites by females. A 153-176 gestation period (Huff 1978) supports the observations of Grant (1932) and Reagan (1984) on the birth of young boas during September-October and a mating period between April-May (USFWS, 2011). E. inornatus is ovoviparous. Rivero (1978) reported two gravid females containing 32 and 17 embryos and Perez-Rivera & Velez (1978) reported two other females giving birth to 23 and 26 young. Captive-bred individuals breed annually or biennially; age at first reproduction is between six and seven years; mates on branches (USFWS, 1986).

Geographic or Habitat Restraints or Barriers

Adult: Occurs < 1,000 m elevation (USFWS, 2011)

Environmental Specificity

Adult: Broad (inferred from USFWS, 2011)

Site Fidelity

Adult: Low (USFWS, 2011)

Habitat Narrative

Adult: The PR boa appears to be widely distributed throughout Puerto Rico and utilizes a wide variety of habitats, ranging from mature forest to plantations and disturbed areas. According to the status survey of the PR boa conducted by Bird-Picó (1994), the species has a wide distribution in a variety of habitats including wooded areas, open pastures, shrubs, and cave entrances and interiors. Vines are important for gaining access to trees from either the ground or from other trees or shrubs and provide dense cover for foraging and resting (Wunderle et al. 2004). Tree cavities may be used by boas for resting or prey location. Gould et al. (2008) stated that the PR boa predicted habitat model includes the following land cover types: moist and wet forest, woodland and shrubland mangrove, Pterocarpus, mature dry forest, and dry forest near water bodies, at or below 1,000 m of elevation. Fidelity to a specific site was usually low, as boas only revisited a small percentage of the sites in the home range during the approximate one year each boa was studied. Besides rocks and trees in forested areas, light gaps provided by forest openings and forest edge situations are frequently used for basking by boas (Reagan 1984). The species has also been reported to be very common along streams on tree branches (Schwartz and Henderson 1991) (USFWS, 2011). The habitat types range from wet montane to subtropical dry forest (Rivero, 1978) (USFWS, 1986).

Dispersal/Migration

Motility/Mobility

Adult: Moderate (inferred from USFWS, 2011)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from USFWS, 2011)

Dispersal

Adult: Low to moderate (inferred from USFWS, 2011)

Dispersal/Migration Narrative

Adult: Home range areas varied from 138.9 m2 (1,495 ft2) to 18,380 m 2 (197,840.7 ft2). Monitored boas moved an average of 12.9 m (42.3ft) daily between fixes (fix= telemetry relocation). Wunderle et al. (2004) also provided detailed information on immobility in addition to daily and monthly movements of boas. According to their findings, boas moved an average of 26.4 m (86.6 ft) daily per move. However, most of the time boas were immobile as evidenced in a mean of 10.2 consecutive days without movement between fixes (USFWS, 2011).

Population Information and Trends

Population Trends:
Declining (USFWS, 1986)

Species Trends:
Stable (USFWS, 2011)

Resiliency:
Moderate (inferred from USFWS, 2011)

Population Size:
Unkonwn (USFWS, 2011)

Population Narrative:
The species status is stable; although current population estimates are not available, based on the information collected the species' distribution is broader than previously thought and seems to be more abundant than what was known (USFWS, 2011). Available data seems to suggest a historical decline in numbers (USFWS, 1986).

Threats and Stressors

Stressor: Habitat modification and destruction (USFWS, 2011)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Despite the above conservation efforts and additional proposals to protect the northern karst region of Puerto Rico by non-government organizations, part of this area is still in private ownership. This region has been previously affected by deforestation and land movement for agricultural purposes, commercial, industrial, highway, and urban development. At present, habitat modification is still occurring within the region, transforming the karst landscape by removing haystacks ("mogotes"), filling sinkholes and caves, filling wetlands, and paving over surfaces to facilitate intense uses of the land (Lugo et al. 2001). The Service has identified that riparian areas along streams are prone to direct and indirect impacts by poor development practices during and after project construction. Joglar et al. (2007) discussed how habitat loss and landscape fragmentation have become another concern in the conservation of the PR boa. The authors explained that habitat destruction is increasing and may disrupt natural population dispersal and gene flow (USFWS, 2011).

Stressor: Hunting (USFWS, 2011)
Exposure:
Response:
Consequence: Loss of individuals

Narrative: Illegal hunting of boas for oil and meat is reported in the literature. The hunt of PR boas to extract its fat was reported in the 1930s by Grant (1933) and supported by Rivero (1998), indicating that snake "oil" is used as a medicinal remedy. Illegal hunting has been identified as a factor contributing to the species' decline (Pérez-Rivera and Vélez 1978). More recent authors, after conducting interviews with local people during their investigations, agree that this practice still continues to date (Reagan 1984, Puente-Rolón 1999, Joglar 2005). The extent or effect of illegal hunting is not known. Throughout the years, various researchers have interviewed people in immediate areas of their research sites corroborating that killing boas due to innate fear, religious prejudice and ignorance persists (Bird-Picó 1994, Puente-Rolón and Bird-Picó 2004, Joglar 2005). Boas are also being killed because they regularly eat poultry and their eggs (Wiley 2003). Boas are also accidentally killed by vehicles each year while crossing roads within the Caribbean National Forest and elsewhere in the island (Reagan and Zucca 1982, Wiley 2003) (USFWS, 2011).

Recovery

Reclassification Criteria:
Not specified

Delisting Criteria:
The amended delisting criteria for the PR boa are as follows: 1. At least three (3) PR boa populations (moist limestone, wet limestone, and montane forest regions) occupy at least 50% of its suitable habitat, and populations are distributed island wide (addresses Factors A, C and E). 2. Populations show a stable or increasing population trend, evidenced by natural recruitment and multiple age classes (addresses Factors A, C and E). 3. Threat reduction and management activities have been implemented to a degree that the species will remain viable for the foreseeable future (addresses Factor E) (USFWS, 2019).

Recovery Actions:
- Determine status of present population (USFWS, 1986).
- Conduct basic ecological studies (USFWS, 1986).
- Update Recovery Plan (USFWS, 1986).
- Determine degree of human persecution (USFWS, 1986).
- Protect remaining population (USFWS, 1986).
- Protect remaining population (USFWS, 1986).
- ADDITIONAL SITE SPECIFIC RECOVERY ACTIONS: 1. Develop and implement monitoring protocols to ensure that the species' populations remain stable or with an increasing trend, and to have evidence of natural recruitment and multiple age classes. This action relates to recovery task 1: Determine status of present population. 2. Develop prime or suitable habitat maps to include specific translocations guidance as part of the conservation measures for the Puerto Rican boa. This action relates to recovery task 2: Conduct basic ecological studies. 3. Conduct a landscape analysis focusing on caves with resident populations and the connections of these caves with forested habitat. This action relates to recovery task 2: Conduct basic ecological studies. 4. Ensure that properties where the PR boa's cave-associated populations have been identified and their adjacent prime habitats are protected by long-term conservation mechanisms. This action relates to recovery task 5: Protect remaining populations (USFWS, 2019).

Conservation Measures and Best Management Practices:

- Conduct quantitative efforts to estimate the relative abundance of the PR boa (USFWS, 2011).
- Revise and update the PR boa Recovery Plan with current information on the species and establish delisting criteria (USFWS, 2011).
- Investigate the effect habitat loss fragmentation on the PR boa (USFWS, 2011).
- Refine habitat description and suitability habitat models for the PR boa based on GAP analysis and other geographical related tools (USFWS, 2011).
- Investigate if translocation is an effective tool for protecting the PR boa when jeopardized by habitat destruction (USFWS, 2011).
- Promote research on the PR boa through the academia (USFWS, 2011).
- Develop public education and outreach programs aimed at reducing the public prejudice against the PR boa (USFWS, 2011).
- Develop more cooperative agreements with local partners (i.e., federal and Commonwealth agencies, NGOs, and private landowners) for the conservation and protection of more habitat for the PR boa (USFWS, 2011).

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SPECIES ACCOUNT: *Epicrates (=Chilabothrus) monensis granti* (Virgin Islands tree boa (=Chilabothrus))

Species Taxonomic and Listing Information

Commonly-used Acronym: VI Boa

Listing Status: Endangered; Proposed reclassification to threatened

Physical Description

The Virgin Islands tree boa is not easily confused with other snakes within its range. The adult body color is light plumbeous brown with darker brown blotches partially edged with black. The dorsal blotches are angulate and frequently reach the ventral scales. The dorsal surface has a general blue-purple iridescence. The ventral surface is greyish-brown speckled with darker spots. In contrast with the adult coloration, neonate E. m. granti dorsal ground color is light grey punctuated with black blotches. An ontogenetic color change is common to most members of the genus Epicrates (USFWS, 1986).

Taxonomy

Note Genus has changed from Epicrates to Chilabothrus (ITITS, 2016). The Virgin Islands tree boa belongs to the Family Boidae of the Suborder Serpentes. The genus Epicrates is distributed throughout Central America, northern South America, and the Greater Antilles. This taxon was erroneously thought to be a subspecies of the Puerto Rican boa, Epicrates inornatus, (Stull, 1933) until Sheplan and Schwartz (1974) demonstrated its affinities with Epicrates monensis, Thus Epicrates monensis demonstrates a disjunct range, with one subspecies (monensis) endemic to Isla de Mona and the other (granti) distributed on several islands of the Puerto Rico Bank east of Puerto Rico (including Cayo Diablo, Eastern St. Thomas, Tortola, Guana, Greater Camanoe, Necker Cay, and Virgin Gorda (Nellis et al., 1983)) (USFWS, 1986).

Historical Range

The historical distribution of the VI boa suggests that this species was widely distributed throughout Puerto Rico and the Virgin islands, including the northeastern side of Puerto Rico, the offshore cay of Cayo Diablo, Culebra Island, St. Thomas in USVI; Tortola, and Virgin Gorda in British Virgin Islands (BVI) (Grant 1932; Sheplan and Schwartz 1974; Nellis et al. 1983; Tolson and Piñero 1985; USFWS 1986; Mayer and Lazell 1988; Tolson 1989) (USFWS, 2009).

Current Range

The available data suggests that VI boa currently exhibits a fragmented distribution within its range and is restricted to few islands within the region (USFWS 1986; Tolson 1986b; García 1992; Tolson 1996; Tolson 2004a). Tolson (1996) hypothesizes that the current distribution is the result of a long history of species decline and local extirpations. Surveys to locate additional VI boa populations were conducted on several islands and cays of Puerto Rico and Virgin Islands. Cornish (1986) searched for the VI boa at nine locations at the eastern side of the St. Thomas Island previously considered by Nellis et al. (1983) as boa habitat. However, he did not find VI boas during his surveys but reported one shed skin of the VI boa at Turtle Cove. Tolson (1991) searched for the VI boa from 1986 to 1989 in 10 locations in Puerto Rico and 10 small islands in

USVI. García (1992) and Puente-Rolón (2001) also surveyed additional areas in Puerto Rico (USFWS, 2009).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: The bulk of my diet seems to consist of Anolis cristatellus. Limited observations indicate that E. m. granti feeds by gliding slowly along branches seeking sleeping lizards. In Cayo Diablo, a small boa pursued an Anolis 3 m up in a Coccobola tree (Nellis, per sobs.). Schmidt (1928) reported finding the tail of Anolis cristatellus (= A. monensis) in the stomach of a preserved specimen of E. m. monensis. Tolson and Pinero (1985) found the greatest concentration of E. m. granti capture sites in areas where Anolis cristatellus populations are most dense. Captive specimens refused to eat dead mice but consumed Sphearodactylus macrolepis and Anolis cristatellus (Nellis et al., 1983). Sheplan and Schwartz (1974) reported taking a house mouse (Mus musculus) from the stomach of a preserved specimen (WPM 1569) captured on St. Thomas. Epicrates monensis granti, like other species of Epicrates probably opportunistically consumes nestlings of smaller bird species (USFWS, 1986).

Reproduction Narrative

Adult: The Recovery Plan (USFWS 1986) explains that the VI boa has a longevity that can exceed 10 years with an annual reproductive cycle. However, Tolson (1986a) found that the VI boa had a biannual reproductive cycle and found that the longevity of this species may exceed 20 years (Tolson 1996). Consequently, a female VI boa has the potential to produce 50-75 offspring during her lifetime (USFWS, 2009).The Plan (USFWS 1986) suggests that the growth and size class data indicate that the species can reach reproductive maturity in as little as three years. However, Tolson (1986a) reports one marked and released female that reached the size close to sexual maturity in only one year. According to Tolson (1986a), the smallest gravid female reported in the wild was an individual with a mass of 84g (3 oz) and snout-vent lengths of 521mm (20.5 in) in the Cayo Diablo population and she gave birth to 4 young boas while in captivity (USFWS, 2009).In the genus Epicrates, courtship and copulation usually take place from February through May, with parturition in late August through October (Tolson, 1984). Epicrates monensis granti follows this pattern of reproductive timing on Cayo Diablo (Tolson and Pinero, 1985) (USFWS, 1986).

Spatial Arrangements of the Population

Adult: Uniform (inferred from USSFWS, 1986)

Environmental Specificity

Adult: Broad (inferred from USFWS, 1986)

Tolerance Ranges/Thresholds

Adult: Low (inferred from USFWS, 1986)

Site Fidelity

Adult: High (inferred from USFWS, 1986)

Habitat Narrative

Adult: On St. Thomas, the Virgin Islands tree boa is found in xeric forest habitat characterized by step slopes with poor rocky soils (Nellis et al., 1983). Vegetation is second growth open woodland…Grant (1932b) remarked that the boa 'inhabits rocky cliffs on Tortola and Guana Island' (USFWS, 1986)).The boa is also found on low profile islets. Cayo Diablo is a cemented dune (fossilized sand dune) islet with a maximum elevation of 15 m and an extremely simple vegetational profile, the tallest vegetation is an open stand of sea grape, which borders the northwest corner of the island. The grove reaches a height of 5 m in the densest sections. Snakes are most abundant in Coccobola stands, but are also found in every type of vegetation except very low succulent cover close to the high tide line (USFWS, 1986). During the day, snakes seek concealment, often on the ground (USFWS, 1986). Uniform spataila arrangement, broad environmental specificity, high ecological integrity, low tolerance range and high site fidelity are inferred form this species habitat information found in USFWS, 1986).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 1986)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from USFWS, 1986)

Dispersal

Adult: Low (inferred from USFWS, 1986)

Immigration/Emigration

Adult: Unlikely (inferred from USFWS, 1986)

Dispersal/Migration Narrative

Adult: Most snakes are highly mobile and non-migratory. Low dispersal is inferred based on the low number of known populations and the fact that an island snake species would find it difficult to disperse beyond the island.

Population Information and Trends

Population Trends:

Stable (USFWS, 2009)

Species Trends:

Increasing (USFWS, 2009)

Resiliency:

Low (inferred from USFWS, 2009)

Representation:
Low (inferred from USFWS, 2009)

Redundancy:
Low (inferred from USFWS, 2009)

Population Size:
1,300 - 1,500 (U.S. jurisdiction) (USFWS, 2009)

Population Narrative:
USFWS (2009) notes that the species status is stable.The population of the VI boa on Cayo Diablo and Cayo Ratones (cays off the northeast coast of Puerto Rico) were last surveyed in 2004. Miguel García and Alberto Puente-Rolón with the Puerto Rico Department of Natural and Environmental Resources (DNER) conducted a rapid assessment in 2007 providing a snapshot of the species habitat at these cays and suggested that the VI boa should be considered stable (García 2008 pers. comm.). Rats were eradicated from these cays and food source species (i.e., Anolis lizards) were abundant (García 2008 pers. comm.). Surveys of reintroduced VI boa on Steven Key (between St. Thomas and St. John) in 2004 indicated that this population was thriving and stable. The population was composed mostly of adult boas; indicative of substantial food sources (primarily young Iguana iguana) and low predation pressure from yellowcrowned night herons. Rats were also eradicated from this cay (Tolson 2004b). Other populations in Puerto Rico and the U.S. Virgin Islands have not been surveyed (USFWS, 2009).Low resiliency, representation and redundancy are inferred based on low population numbers and low genetic diversity.Currently, the abundance of the species in its range within the US jurisdiction isestimated to be at approximately 1,300 - 1,500 boas, an 18 to 20 fold increase from theknown population after 22 years (USFWS, 2009).

Threats and Stressors

Stressor: Habitat destruction (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: VI boa habitat occurs in subtropical dry forest and subtropical moist forest. Today, we know that the VI boa apparently uses less than 0.05% of this suitable habitat available in PR and USVI. In contrast, in Tortola, BVI the species is common and found in habitats ranging from mangrove to moist mountain forest at elevations less than 300 m (984.25 ft) (i.e. Sage Mountain 290m (951.44 ft)). In Puerto Rico and the USVI, some of the locations where the species has been described are threatened by habitat modification and habitat fragmentation by urban developments. Some VI boa habitat within the island of St. Thomas, and the municipality of Río Grande and Culebra in Puerto Rico is threatened with urban development pressure. (Tolson 2008 in litt; Puente-Rolón 2001; Kojis 2008 in litt; and Platenberg 2008 unpublished data). In St. Thomas, habitat may be declining due to the development for resorts, condos, and related infrastructure; becoming more constricted and isolated (Tolson 2008 in litt; Platenberg 2006 unpub. data). However, most offshore cays are part of the Territorial government and / or protected as wildlife refuges. In Culebra Island, the VI boa habitat in privately owned land is currently under pressure for urban and tourism development and habitat modification by deforestation. However, more than 1000 acres of VI boa suitable habitat is protected within the

Service's Culebra National Wildlife Refuge. The Service is providing technical assistance to project developers to modify project plans to avoid destruction of suitable VI boa habitat and ensure conservation of these areas. It is important to note that 65% of known boas occur in small offshore islets managed for conservation. Cayo Ratones and Cayo Diablo are included as part of DNER La Cordillera Natural Reserve and Steven Key in USVI is managed and protected by the DPNR. The protection of these islets is ensured by local laws and regulations, and ultimately by the ESA. We believe that the imminence of this threat is low because the majority of the currently known populations are in islands managed for conservation; some VI boa occur in lands in a National Wildlife Refuge; and federally funded or permitted projects on private lands may require ESA section 7 consultation (USFWS, 2009).

Stressor: Predation (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Based on the information mentioned above, predation by cats should be considered as a current threat to the species. Since rat control projects have been conducted in the islands where the species is present, rats are not to be considered a threat at these areas. Documented predation by cats has been limited. Hence, the Service considers predation by cats and rats to be reduced at this time (USFWS, 2009).

Stressor: Intentional Killing (Human) (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Intentional killing of genus Epicrates due to innate fear or superstitious beliefs is well documented in the literature (Bird-Picó 1994; Puente-Rolón and Bird-Picó 2004; Joglar 2005). According to USVI DPNR-DFW (Platenberg 2006 unpub. data), about ten percent (N=13 individuals) of the VI boa records in St Thomas are from dead boas killed by humans on their properties. Likewise, the first report for Culebra Island and Humacao was from dead boa killed by a local. However, most of those records came from anecdotal reports. No systematic studies have been conducted to determine the effects of intentional killing on the VI boa. The Service is not aware of a law enforcement case related to VI boa in PR or the USVI (USFWS, 2009).

Stressor: Climate change (USFWS, 2009)
Exposure:
Response:
Consequence:
Narrative: Climate change and sea level rise is a possible threat for the VI boa in the future. Increase in sea level may affect the species and its habitat in coastal areas and offshore islets. New information reveals that 65% (N=920 individuals) of the known population occurs on offshore islets (less than 2 acres) with a maximum elevation of 15 meters (42 ft). However, because the change in sea level is a long term process and may occur a long period of time, this threat should be considered as very low and non-imminent (USFWS, 2009).

Stressor: Fire (Human caused) (USFWS, 2008)
Exposure:
Response:

Consequence:
Narrative: The habitat where the species have been found in PR and USVI is mostly coastal dry forest. This type of forest is susceptible to human-related catastrophic events such as fires. The rapid growth of grass can increase fuel build-up that may further the impact of fire. In Culebra Island, Cayo Ratones and Cayo Diablo, the VI boa occurs in areas with easy public access and a high potential of being negatively impacted by human activities such as intentional fire. In Cayo Ratones and Cayo Diablo, DNER personnel implement a management and educational program during the dry season to prevent fires. In Culebra Island, the Culebra National Wildlife Refuge and DNER implements a fireprevention and management program during the dry season. Because the Service and the DNER implement a fire-prevention and management program during the dry season, this factor should be considered as a threat, but low and non-imminent (USFWS, 2009).

Recovery

Reclassification Criteria:
Need a final, approved recovery plan containing objective, measurable criteria (USFWS, 2009)?

Adequacy of recovery criteria (USFWS, 2009)

Interim goal: Reclassify from Endangered to Threatened (USFWS, 2009)

Delisting Criteria:
The amended delisting criteria for the VI boa are: I. Existing two (2) VI boa populations with the highest resiliency (Cayo Diablo and USVI Cay) exhibit a stable or increasing trend, evidenced by natural recruitment and multiple age classes (addresses Factor A, C, and E). 2. Establish three (3) additional populations that show a stable or increasing trend, evidenced by natural recruitment and multiple age classes (addresses Factor A, C, and E). 3. Threats are reduced or eliminated to the degree that the species is viable for the foreseeable future (addresses Factor A, and C and E) (USFWS, 2019).

Recovery Actions:
- The VI boa has a final recovery plan, but it is outdated and does not contain measurable criteria. The Plan describes the recovery objective as to attain a population level at which point the species can be delisted. It only describes a objective to reduce the classification of the species from endangered to threatened within a 10 year period. No quantitative recovery level was defined due to the absence of information on population sizes and limiting factors. The Plan recommends conducting comprehensive status surveys and ecological studies of the species before determining specific recovery levels for the VI boa (USFWS, 2009).
- The 5 listing factors have not been addressed and recovery criteria no longer reflect the best and most up to date biology and habitat information (USFWS, 2009).
- Based on the information we gathered for this review, the interim reclassification criteria have been accomplished as follows: a) At present, the populations of the VI boa at Cayo Diablo, Cayo Ratones and Steven Key are considered stable because of the age distribution and population composition (Tolson 2004a; Tolson et al. 2008). According to the information summarized in this review (Table 1), the population in these three cays and St. Thomas is at around 1,300 boas, an 18 fold increase from the 1985 population levels. Although the number of individuals at Río Grande (PR) and Culebra Island (PR) has not been

determined, individuals have been sighted (Puentes-Rolón 2008 pers. comm.). Similarly, the species has been sighted in St. Thomas and the population estimated by Tolson (1991) is about 400 individuals. b) Two populations of the VI boa were successfully established by the reintroduction of the species from captive breeding programs in mongoose and rat-free habitat. The first population was established in Cayo Ratones (PR) in 1993 and the second was established in Steven Cay (USVI) in 2002. These two populations are considered by Tolson et al. (2008) as thriving populations. c) In 1985, a rat control program was started in Cayo Ratones (PR), Congo Key and Steven Key, (USVI) which was identified as potentially suitable for the reintroduction of the species. Rats have been eliminated on Cayo Ratones and on Steven Key in USVI (Tolson et al. 2008) and VI boas are established at Cayo Ratones and Steven Key (USFWS, 2009).

Conservation Measures and Best Management Practices:

- Revise the recovery plan to include new information on the biology of the species and the development of measurable criteria for delisting the species (USFWS, 2009).
- Develop a Population Viability Analysis (PVA) for the VI boa to determine the minimum viable population size needed to sustain the species over 50 years (USFWS, 2009).
- Conduct quantitative efforts to estimate relative abundance of the species at Rio Grande and Culebra Island in PR; and at St. Thomas in USVI (USFWS, 2009).
- Conduct additional surveys in traditional and nontraditional areas with suitable habitat for the species in PR and USVI, which include Vieques and St. John, to determine density and distribution (USFWS, 2009).
- Refine habitat description and suitability based on GAP analysis and other geographical related mechanisms (USFWS, 2009).
- Assess VI boa predator/prey relationships on non-islet environments (USFWS, 2009).
- Conduct comparative DNA analysis within populations distinct and between other populations, including that of Tortola, BVI to determine possible genetic differences or possible genetic threats (USFWS, 2009).
- Continue to support predator eradication (cats and rats) from offshore cays and other VI boa habitat (USFWS, 2009).
- Reinitiate the captive breeding program and reintroduction program of the species in protected and predator-free areas. Captive breeding and release activities were conducted in the 1990’s. At the present time, VI boas are still in captivity (USFWS, 2009).
- Develop public education and outreach programs for the VI boa at Rio Grande and Culebra Island in PR, and at St. Thomas, USVI (USFWS, 2009).
- Develop cooperative agreements with local jurisdictions and private landholders for the conservation and protection of suitable habitat for the VI boa in PR and USVI (USFWS, 2009).

References

U.S. Fish and Wildlife Service. 1986. Virgin Islands Tree Boa Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 26 pp

U.S. Fish and Wildlife Service. 2009. Virgin Islands Tree Boa (Epicrates monensis granti) 5-Year Review: Summary and Evaluation U.S. Fish and Wildlife Service Southeast Region Caribbean Ecological Services Field Office Boqueron, Puerto Rico.

U.S. Fish and Wildlife Service. 2019. Amendment 1 to the Virgin Island Tree Boa Recovery Plan (Chilabothrus granti, formerly Epicrates monensis granti).

USFWS. 2009. Virgin Islands Tree Boa (Epicrates monensis granti) 5-Year Review: Summary and Evaluation. U.S. Fish and Wildlife Service Southeast Region Ecological Services Boquerón, Puerto Rico.

SPECIES ACCOUNT: *Epicrates (=Chilabothrus) monensis monensis* (Mona boa (=Chilabothrus))

Species Taxonomic and Listing Information

Listing Status: Threatened; March 6, 1978; Southeast Region (R4)

Physical Description

The Mona boa is a non-venomous snake about one meter (m) in length; light brown dorsally with a series of darker brown dorsal irregular blotches bordered in black and white ventral parts with scattered brown stippling (Campbell 1978). Immature individuals are light yellowish-brown with dark brownish markings dorsally and creamy undersides (Rivero et al. 1982) (USFWS, 2014; USFWS, 1984).

Taxonomy

Note Genus has changed from Epicrates to Chilabothrus (ITIS, 2016). The Mona boa belongs to the family Boidae of the suborder Serpentes. The genus Epicrates is distributed throughout Central America, northern South America, and the Greater Antilles, Epicrates monensis, described form Mona Island by Zenneck in 1898, was thought to be endemic to that island. However, E. inornatus granti, described by Stull (1933) from Tortola, was transferred to E. monensis by Sheplan and Schwartz (1974). Thus, the taxon from Mona is considered an endemic subspecies, E. monensis monensis Zenneck (USFWS, 1984).

Historical Range

Mona Island, Puerto Rico (USFWS, 2014).

Current Range

Mona Island, Puerto Rico (USFWS, 2014).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 2/3/1978.

Legal Description

On February 3, 1978, the U.S. Fish and Wildlife Service designated critical habitat for Epicrates monensis monensis (Mona boa) pursuant to the Endangered Species Act of 1973 (43 FR 4618 - 4621).

Critical Habitat Designation

Critical habitat for the Mona boa is designated on the entire Mona Island, Common Wealth of Puerto Rico.

Primary Constituent Elements/Physical or Biological Features

Not available

Special Management Considerations or Protections

Not available

Life History

Feeding Narrative

Juvenile: Juvenile and subadult snakes prey primarily upon the Mona island anole, Anolis monensis (Tolson 2000) and Mona island coqui (Eleutherodactylus monensis) (Tolson et al. 2007) (USFWS, 2014).

Adult: The Mona boa apparently preys largely on lizards of the genus Anolis. The greatest concentrations of Mona boas are in areas with high prey densities, particularly of sleeping Anolis cristatellus lizards (Tolson 1988; Chandler and Tolson 1990), and with higher Anolis perch height (Tolson 1988). High densities of the diurnal Ameiva exsul are also a common component of localities with high densities of boas (Tolson 1991). Due to their large size, adult Mona boas are able to feed on rats and small birds such as the yellow warbler (Dendroica petechia) (USFWS, 2014).

Reproduction Narrative

Adult: Little is known about the about the reproductive biology of the Mona boa. Members of the genus Epicrates usually have 8 to 30 young, born alive, Rivero (1978) reported an E. inornatus with 32 embryos. The only data available on E. monensis are those of Rivero et al. (1982). They reported that an adult specimen collected in 1979 aborted 4 young while in captivity (USFWS, 1984).Low parental care is inferred based on taxonomy.

Tolerance Ranges/Thresholds

Adult: Low (inferred from USFWS, 2014)

Site Fidelity

Adult: High (inferred from USFWS, 2014)

Habitat Narrative

Adult: The Mona boa is observed in subtropical dry forest habitat of Mona island (Figure 1), characterized by small deciduous trees with small leaves, coriaceus or succulent leaves and thorns, spines, and secondary defensive compounds (Tolson 1988; Tolson 2000). Within this habitat, boas may be found at heights over six meters in large trees, or at ground level crawling on limestone boulders (Tolson 2000). Plant species used by the Mona boa include Antirhea acutata (quina), Bursera simaruba (almácigo), Capparis cynophallophora (bejuco inglés), Clusia rosea (cupey), Coccoloba uvifera (uvero de playa), Eugenia axillaris (grajo), Erythroxylum areolatum (cocaína falsa), Ficus citrifolia (jagüey), and Tillandsia utriculata (Tolson et al. 2007) (USFWS, 2014). Low tolerance is inferred based on habitat requirements as is high site fidelity.

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2014)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS, 2014)

Dispersal

Adult: Low (inferred from USFWS, 2014)

Immigration/Emigration

Adult: Unlikely (inferred from USFWS, 2014)

Dispersal/Migration Narrative

Adult: Most snakes are highly mobile and non-migratory. Low dispersal is inferred based on the low number of known populations and the fact that an island snake species would find it difficult to disperse beyond the island.

Population Information and Trends

Population Trends:

Stable (USFWS, 2014)

Population Narrative:

USFWS (2014) notes that the species status is stable.

Threats and Stressors

Stressor: Feral cats (USFWS, 1984)
Exposure:
Response:
Consequence: Decrease food supply and feed on Mona Boa
Narrative: Feral cats are known to consume the same prey as the Mona boa and are thought to also prey on the boa (USFWS, 1984)

Stressor: Reduction of bat population (USFWS, 1984)
Exposure:
Response:
Consequence: Decrease food supply
Narrative: It has been suggested that a reduction in the bat population of Mona island due to mining of guano from 1877 to 1922 could possibly have caused the decline of the Mona boa population, as other Epicrates species feed on bats (USFWS 1984; USFWS, 2014).

Stressor: Major Storms (USFWS 1984; USFWS, 2014).
Exposure:
Response:
Consequence: Decrease population
Narrative: Studies indicate that major storms may have a significant impact on Mona boas (Tolson 2000). Following the passage of Hurricane Georges in 1998, virtually every large Clusia tree in the Playa Sardinera area was broken off at the lower trunk, which made Mona boas easily observable and easily discovered, with capture rates slightly exceeding capture success in previous years (Tolson 2000). However, the discovery of four neonates indicates that there was

successful reproduction in 1999; although the lack of capture success for subadult snakes and male snakes was unusual and unexplained (Tolson 2000) USFWS, 2014).

Recovery

Delisting Criteria:
Determine the status of the present population (USFWS, 1984).

Conduct natural history studies (USFWS, 1984).

Determine and control threats from introduces animals (USFWS, 1984).

Continue protection of the present population by enforcing current regulations on Mona island (USFWS, 1984).

Recovery Actions:
- Criterion has been partially met. The only population estimates conducted to date by Tolson (2000), indicate the Mona boa may be more abundant that previously thought. However, further monitoring is required to determine a true population trends. This species is highly secretive and hard to detect, thus robust population estimates will be very difficult to obtain (USFWS, 2014).
- A complete study of the natural history should be conducted. This information will aid in making sound decisions concerning the actual status, management needs and final delisting of the species (USFWS, 1984).
- Criterion has been partially implemented. An annual hunting season of feral goats and pigs is ongoing on Mona island since the 1980s with the goal to control these two species. In addition, the Puerto Rico Department of Natural and Environmental Resources (PRDNER) conducted a short-term control program of feral cats to test different trapping and control methods (M. García, PRDNER, pers. comm., 2014). According to Tolson (2000), the number of exotic predators, specifically cats, observed on Mona island is alarming, and suggested that the effectiveness of control mechanisms was limited. In order for the control programs to be effective, the efforts must be continuous. Therefore, the PRDNER signed a Memorandum of Understanding (MOU) with Island Conservation, to conduct a feasibility study on Mona island to begin implementing an effective cat eradication program on the Island (M. García, PRDNER, pers. comm., 2014) (USFWS, 2014).
- Enforcement work and associated visitor orientation should be continued at the present level, which reflects the needs of all species and activities on the island (USFWS, 1984).

References

U.S. Fish and Wildlife Service. 1984. Mona boa Recovery Plan. U.S. Fish and Wildlife Service, Atlanta, Georgia. 14 pp

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U.S. Fish and Wildlife Service. 1978. Final Determination of Threatened Status and Critical Habitat for the Mona Boa and Mona Ground Iguana. Final rule. 43 FR 4618 - 4621 (February 3, 1978)

U.S. Fish and Wildlife service. 1977. Proposed Determination of Threatened Status for Three Species of Reptiles From Mona Island, P.R., With a Proposal for Critical Habitat.

SPECIES ACCOUNT: *Eretmochelys imbricata* (Hawksbill sea turtle (entire))

Species Taxonomic and Listing Information

Listing Status: Endangered; Southeast Region (R4) (USFWS, 2015)

Physical Description

The Hawksbill Sea Turtle is one of seven species of sea turtles found throughout the world. One of the smaller sea turtles, it has overlapping scutes (plates) that are thicker than those of other sea turtles. This protects them from being battered against sharp coral and rocks during storm events. Adults range in size from 30 to 36 inches (0.8-1.0 meters) carapace length, and weigh 100 to 200 pounds (45-90 kilograms). Its carapace (upper shell) is an attractive dark brown with faint yellow streaks and blotches and a yellow plastron (under shell). The name "hawksbill" refers to the turtle's prominent hooked beak. The hawksbill sea turtle has a sharp, curved, beak-like mouth and a “tortoiseshell” pattern on its carapace, with radiating streaks of brown, black, and amber (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

Shell size and shape are variable throughout the range, and distinct population demes apparently exist; further analysis is needed. Two subspecies, E. i. imbricata (Atlantic) and E. i. bissa (Pacific), are recognized; additional study is needed to determine if these subspecies are valid, and whether other populations warrant subspecific recognition (Ernst and Barbour 1989). Genetic analyses in the Atlantic and Indo-Pacific indicate that nesting populations comprise separate and identifiable stocks that should be treated as separate management units (Bass et al. 1996, Bowen et al. 1996, Bowen et al. 2007). Crother et al. (2008) has returned to the use of "sea turtles" (rather than "seaturtles") as part of the standard English name for marine turtles. The combined name has not been used recently in the literature. (NatureServe, 2015)

Historical Range

See Current

Current Range

Hawksbill Sea Turtles are highly migratory and use a wide range of broadly separated localities and habitats during their lifetimes (Musick and Limpus 1997, Plotkin 2003). The dispersed nesting observed today it believed to be the result of overexploitation of large colonies (Limpus 1995, Meylan and Donelly 1999). Circumtropical in distribution, they generally occur from 30°N to 30°S latitude within the Atlantic, Pacific, and Indian Oceans and associated bodies of water (NMFS-USFWS 1998b). Along the eastern Pacific Rim, Hawksbill Sea Turtles were apparently common to abundant as recently as 50 years ago in nearshore waters from Mexico to Ecuador, particularly the east coast of Baja California Sur in the vicinity of Concepción Bay and Paz Bay, Mexico (Cliffton et al. 1982). Today, the Hawksbill Sea Turtle is rare to nonexistent in most of those localities; there are no known nesting beaches remaining on the Pacific coast of Mexico (Cliffton et al. 1982). Within the Central Pacific, nesting is widely distributed but scattered and in low numbers (NMFS-USFWS 1998b). Foraging Hawksbill Sea Turtles have been reported from virtually all of the islands of Oceania, from the Galapagos Islands in the eastern Pacific to the Republic of Palau in the western Pacific (Pritchard 1982a, b, Witzell 1983). The hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbills can be found in Sargassum mats; post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Bjorndal and Bolten 2010; Musick and Limpus 1997) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 3/23/1999.

Legal Description

On September 2, 1998, the National Marine Fisheries Service (NMFS) designated critical habitat for the endangered hawksbill sea turtle (Eretmochelys imbricata) to include coastal waters surrounding Mona and Monito Islands, Puerto Rico.

Critical Habitat Designation

Critical habitat for listed hawksbill turtles includes waters extending seaward 3 nm (5.6 km) from the mean high water line of Mona and Monito Islands, Puerto Rico. Mona Island lies approximately 39 nm (72 km) west of the southwest coast of mainland Puerto Rico. The area in general is bounded north to south by 18°13' North to 18°00' North and east to west by 67°48' West and 68°01' West.

On September 2, 1998, NMFS established critical habitat for hawksbill sea turtles around Mona and Monito Islands, Puerto Rico (63 FR 46693). Aspects of these areas that are important for hawksbill sea turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill sea turtle prey (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Primary Constituent Elements/Physical or Biological Features

Not specified. Habitat requirements include:

Coral reefs, like those found in the waters surrounding Mona and Monito Islands, are widely recognized as the primary foraging habitat of juvenile, subadult, and adult hawksbill turtles. This habitat association is directly related to the species' highly specific diet of sponges (Meylan, 1988). Gut content analysis conducted on hawksbills collected from the Caribbean suggests that a few types of sponges make up the major component of their diet, despite the prevalence of other sponges on the coral reefs where hawksbills are found (Meylan, 1984). Vicente (1993) observed similar feeding habits in hawksbills foraging specifically in Puerto Rico.

Additionally, the ledges and caves of the reef provide shelter for resting and refuge from predators.

Hawksbills utilize both low- and highenergy nesting beaches in tropical oceans of the world. Both insular and mainland nesting sites are known. Hawksbills will nest on small pocket beaches and, because of their small body size and great agility, can traverse fringing reefs that limit access to other species.

Special Management Considerations or Protections

Activities that may require special management considerations for listed green and hawksbill turtle foraging and developmental habitats include, but are not limited to, the following:

(1) Vessel traffic—Propeller dredging and anchor mooring severely disrupt benthic habitats by crushing coral, breaking seagrass root systems, and severing rhizomes. Propeller dredging and anchor mooring in shallow areas are major disturbances to even the most robust seagrasses. Trampling of seagrass beds and live bottom, a secondary effect of recreational boating, also disturbs seagrasses and coral.

(2) Coastal construction—The development of marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat. Additionally, this type of development leads to increased boat and vessel traffic, which may result in higher incidences of propeller- and collision-related mortality.

(3) Point and non-point source pollution—Highly colored, low salinity sewage discharges may provoke physiological stress upon seagrass beds and coral communities and may reduce the amount of sunlight below levels necessary for photosynthesis. Nutrient over-enrichment caused by inorganic and organic nitrogen and phosphorous from urban and agricultural run-off and sewage can also stimulate algal growth that can smother corals and seagrasses, shade rooted vegetation, and diminish the oxygen content of the water.

(4) Fishing activities—Incidental catch during commercial and recreational fishing operations is a significant source of sea turtle mortality. Additionally, the increased vessel traffic associated with fishing activities can result in the destruction of habitat due to propeller dredging and anchor mooring.

(5) Dredge and fill activities— Dredging activities result in direct destruction or degradation of habitat as well as incidental take of turtles. Channelization of inshore and nearshore habitat and the disposal of dredged material in the marine environment can destroy or disturb seagrass beds and coral reefs.

(6) Habitat restoration—Habitat restoration may be required to mitigate the destruction or degradation of habitat that can occur as a result of the activities previously discussed. Additionally, habitat degradation resulting from such episodic natural stresses as hurricanes and tropical storms may require special mitigation measures.

Life History

Feeding Narrative

<u>Adult:</u> Diet consist primarily of invertebrates (crabs, sea urchins, shellfish, jellyfish, etc.) but also includes plant material and fishes. This species generally has been regarded as a generalist, but recent research indicates specialization on demosponges in Florida and the Caribbean. Foraging microhabitats include the bottom and reef faces, close to shore (NatureServe, 2015). Hawksbill Sea Turtles utilize a variety of food items depending on their developmental stage and their

location. Food items include sponges, other types of invertebrates, and algae (NMFS-USFWS 2007b).

Reproduction Narrative

Adult: Flipper tagging of nesting females has shown that females have a strong fidelity in their choice of nesting sites (Witzell 1983). Genetic studies have demonstrated natal homing of nesting female hawksbills in Atlantic and Pacific populations (Bass 1999, Broderick et al. 1994). Hawksbill Sea Turtles nest on insular and mainland sandy beaches throughout the tropics and subtropics and females prefer to nest under beach vegetation (Horrocks and Scott 1991, Mortimer 1982, NMFS-USFWS 2007b). They are nocturnal in nesting behavior and normally lay between 3-5 clutches of eggs in a nesting season (Beggs et al. 2007, Mortimer and Bresson 1999, Richardson et al. 1999). Based on data from a number of studies, consistent with slow growth, age-to-maturity is long and has been estimated as 20 or more years in the Caribbean and Western Atlantic and a minimum of 30-35 years in the indo-Pacific (Boulon 1983, 1994, Chaloupka and Musick 1997, Diez and van Dam 2002, Limpus 1992, Mortimer et al. 2002, 2003, NMFS-USFWS 2007b). The present distribution of breeding sites has been largely affected by historical patterns of human exploitation, such that the most significant rookeries remaining today are at sites that have not been permanently inhabited by humans or have not been heavily exploited until recently (Groombridge and Luxmoore 1989). In Hawai`i, nesting activity has been monitored since 1989 on Hawai`i Island where 3 to 18 females nest per year while only a few Hawksbill Sea Turtles nest on Maui and Moloka`i (NMFS-USFWS 2013). Hawksbill sea turtles reach sexual maturity at twenty to forty years of age. Females return to their natal beaches every two to five years to nest and nest an average of three to five times per season. Clutch sizes are large (up to 250 eggs). Sex determination is temperature dependent, with warmer incubation producing more females. Hatchlings migrate to and remain in pelagic habitats until they reach approximately twenty two to twenty five centimeters in straight carapace length. As juveniles, they take up residency in coastal waters to forage and grow. As adults, hawksbills use their sharp beak-like mouths to feed on sponges and corals. Hawksbill sea turtles are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Satellite tagged turtles have shown significant variation in movement and migration patterns. Distance traveled between nesting and foraging locations ranges from a few hundred to a few thousand kilometers (Horrocks et al. 2001; Miller et al. 1998) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Habitat Narrative

Juvenile: Neonate hawksbills are believed to enter an oceanic phase (living in the open ocean beyond 200 meters in depth) and are potentially carried great distances by surface gyres (NMFS-USFWS 2007b). The oceanic phase of neonate juveniles remains one of the most poorly understood aspects of the life history of this species (NMFS-USFWS 2007b). Early juveniles have been found associated with brown algae, Sargassum spp. (Musick and Limpus 1997). Larger juveniles exhibit a neritic (found at or near the sea floor) foraging habit and some may associate with the same feeding locality for more than a decade, while others apparently migrate from one site to another (Musick and Limpus 1997; Mortimer et al. 2003, unpublished data, cited in NMFS-USFWS 2007b).

Adult: Hawksbill adults, once considered to be relatively nonmigratory, have been revealed by post-nesting tagging, satellite telemetry, and genetic studies, to be highly mobile, traveling hundreds to thousands of kilometers between nesting beaches and foraging areas (review by

Plotkin 2003). Shorter overall migration distances are documented for hawksbills nesting on isolated islands (NMFS-USFWS 2013). In Hawai`i, post-nesting distances ranged from 90 to 345 km (Parker et al. 2009).

Dispersal/Migration

Motility/Mobility

Adult: Adults may migrate hundreds or thousands of kilometers between nesting beaches and marine feeding areas (Plotkin 2003). In the Caribbean region, 19 adults traveled minimum distances of 110-1,936 kilometers, 9 immatures 46-900 kilometers; recapture of immatures suggest long-term residency in developmental habitats (Meylan 1999). Adult females that nested in Barbados traveled 200-435 kilometers (straight-line distance) over 7-18 days to foraging areas in Dominica, Grenada, Trinidad, and Venezuela (Horrocks et al. 2001). A female tagged on a nesting beach at Buck Island Reef National Monument near St. Croix, U.S. Virgin Islands, was recovered at Miskito Cays, Nicaragua (Hillis, 1995, Park Science 15(2):25). A feeding population at Isla Mona (Puerto Rico) included individuals from nesting populations throughout the Caribbean region (Bowen et al. 1996).MtDNA data from the Caribbean region indicate that a natal homing mechanism predominates and that nesting populations should be considered separate stocks; foraging populations evidently are composed of cohorts from multiple regional nesting colonies (Bass 1999).Foraging home range sizes of individuals in the West Indies were 1.96-49.5 square kilometers and were positively correlated with average water depth (Horrocks et al. 2001).; Nonmigrant: N; Local migrant: Y; Distant migrant: Y; (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Adults may migrate hundreds or thousands of kilometers between nesting beaches and marine feeding areas (Plotkin 2003). In the Caribbean region, 19 adults traveled minimum distances of 110-1,936 kilometers, 9 immatures 46-900 kilometers; recapture of immatures suggest long-term residency in developmental habitats (Meylan 1999). Adult females that nested in Barbados traveled 200-435 kilometers (straight-line distance) over 7-18 days to foraging areas in Dominica, Grenada, Trinidad, and Venezuela (Horrocks et al. 2001). A female tagged on a nesting beach at Buck Island Reef National Monument near St. Croix, U.S. Virgin Islands, was recovered at Miskito Cays, Nicaragua (Hillis, 1995, Park Science 15(2):25). A feeding population at Isla Mona (Puerto Rico) included individuals from nesting populations throughout the Caribbean region (Bowen et al. 1996).MtDNA data from the Caribbean region indicate that a natal homing mechanism predominates and that nesting populations should be considered separate stocks; foraging populations evidently are composed of cohorts from multiple regional nesting colonies (Bass 1999).Foraging home range sizes of individuals in the West Indies were 1.96-49.5 square kilometers and were positively correlated with average water depth (Horrocks et al. 2001).; Nonmigrant: N; Local migrant: Y; Distant migrant: Y; (NatureServe, 2015)

Dispersal

Adult: Adults may migrate hundreds or thousands of kilometers between nesting beaches and marine feeding areas (Plotkin 2003). In the Caribbean region, 19 adults traveled minimum distances of 110-1,936 kilometers, 9 immatures 46-900 kilometers; recapture of immatures suggest long-term residency in developmental habitats (Meylan 1999). Adult females that nested in Barbados traveled 200-435 kilometers (straight-line distance) over 7-18 days to foraging areas in Dominica, Grenada, Trinidad, and Venezuela (Horrocks et al. 2001). A female tagged on a nesting beach at Buck Island Reef National Monument near St. Croix, U.S. Virgin

Islands, was recovered at Miskito Cays, Nicaragua (Hillis, 1995, Park Science 15(2):25). A feeding population at Isla Mona (Puerto Rico) included individuals from nesting populations throughout the Caribbean region (Bowen et al. 1996).MtDNA data from the Caribbean region indicate that a natal homing mechanism predominates and that nesting populations should be considered separate stocks; foraging populations evidently are composed of cohorts from multiple regional nesting colonies (Bass 1999).Foraging home range sizes of individuals in the West Indies were 1.96-49.5 square kilometers and were positively correlated with average water depth (Horrocks et al. 2001).; Nonmigrant: N; Local migrant: Y; Distant migrant: Y;   (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Adults may migrate hundreds or thousands of kilometers between nesting beaches and marine feeding areas (Plotkin 2003). In the Caribbean region, 19 adults traveled minimum distances of 110-1,936 kilometers, 9 immatures 46-900 kilometers; recapture of immatures suggest long-term residency in developmental habitats (Meylan 1999). Adult females that nested in Barbados traveled 200-435 kilometers (straight-line distance) over 7-18 days to foraging areas in Dominica, Grenada, Trinidad, and Venezuela (Horrocks et al. 2001). A female tagged on a nesting beach at Buck Island Reef National Monument near St. Croix, U.S. Virgin Islands, was recovered at Miskito Cays, Nicaragua (Hillis, 1995, Park Science 15(2):25). A feeding population at Isla Mona (Puerto Rico) included individuals from nesting populations throughout the Caribbean region (Bowen et al. 1996).MtDNA data from the Caribbean region indicate that a natal homing mechanism predominates and that nesting populations should be considered separate stocks; foraging populations evidently are composed of cohorts from multiple regional nesting colonies (Bass 1999).Foraging home range sizes of individuals in the West Indies were 1.96-49.5 square kilometers and were positively correlated with average water depth (Horrocks et al. 2001).; Nonmigrant: N; Local migrant: Y; Distant migrant: Y;   (NatureServe, 2015)

Additional Life History Information

Adult: Adults may migrate hundreds or thousands of kilometers between nesting beaches and marine feeding areas (Plotkin 2003). In the Caribbean region, 19 adults traveled minimum distances of 110-1,936 kilometers, 9 immatures 46-900 kilometers; recapture of immatures suggest long-term residency in developmental habitats (Meylan 1999). Adult females that nested in Barbados traveled 200-435 kilometers (straight-line distance) over 7-18 days to foraging areas in Dominica, Grenada, Trinidad, and Venezuela (Horrocks et al. 2001). A female tagged on a nesting beach at Buck Island Reef National Monument near St. Croix, U.S. Virgin Islands, was recovered at Miskito Cays, Nicaragua (Hillis, 1995, Park Science 15(2):25). A feeding population at Isla Mona (Puerto Rico) included individuals from nesting populations throughout the Caribbean region (Bowen et al. 1996).MtDNA data from the Caribbean region indicate that a natal homing mechanism predominates and that nesting populations should be considered separate stocks; foraging populations evidently are composed of cohorts from multiple regional nesting colonies (Bass 1999).Foraging home range sizes of individuals in the West Indies were 1.96-49.5 square kilometers and were positively correlated with average water depth (Horrocks et al. 2001).; Nonmigrant: N; Local migrant: Y; Distant migrant: Y;   (NatureServe, 2015)

Population Information and Trends

Number of Populations:

81 - 300 (NatureServe, 2015)

Population Size:

10,000 - 100,000 individuals (NatureServe, 2015)

Population Narrative:

Extent of occurrence has been reduced to a small degree over the long term, but much larger reductions have occurred in population size and condition of occurrences (NMFS & USFWS 2007). For 58 sites rangewide for which long-term trend (>20 to 100 years) could be assessed, all showed a declining trend (NMFS and USFWS 2007). Decline of 50-90% Better data are needed, though clearly this species is not as abundant as Caretta or Chelonia. For a sample of 83 nesting concentrations for which recent data were available, NMFS and USFWS (2007) estimated the number of females nesting per year at 3,072-5,603 in the Atlantic Ocean, fewer than 8,130 to as many as 10,052 in the Indian Ocean, and 10,010-12,483 in the Pacific Ocean, for a total of fewer than 21,212 to as many as 28,138. This includes most major nesting concentrations. Relatively few populations remain with more than 1,000 females nesting annually (none in the Atlantic) (Meylan and Donnelly 1999, NMFS and USFWS 2007). Number of distinct occurrences based on nesting areas is unknown but likely falls within the indicated range. NMFS and USFWS (2007) mapped 83 nesting concentrations for which data were available; these nesting areas are a subset of the global total but include most major nesting areas. Nesting occurs in at least 70 nations (NMFS and USFWS 2007). Many occurrences include only a very few individuals. (NatureServe, 2015) Long-term data on the hawksbill sea turtle indicate that sixty-three sites have declined over the past 20 to 100 years (historic trends are unknown for the remaining 25 sites). Recently, 28 sites (68%) have experienced nesting declines, 10 have experienced increases, three have remained stable, and 47 have unknown trends. The greatest threats to hawksbill sea turtles are overharvesting of turtles and eggs, degradation of nesting habitat, and fisheries interactions. Adult hawksbills are harvested for their meat and carapace, which is sold as tortoiseshell. Eggs are taken at high levels, especially in southeast Asia where collection approaches 100% in some areas. In addition, lights on or adjacent to nesting beaches are often fatal to emerging hatchlings and alters the behavior of nesting adults. The species’ resilience to additional perturbation is low (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance Surveys at eighty eight nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS 2013a). In general, hawksbills are doing better in the Atlantic and Indian Ocean than in the Pacific Ocean, where despite greater overall abundance, a greater proportion of the nesting sites are declining. Productivity / Population Growth Rate From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2013a). Genetic Diversity Populations are distinguished generally by ocean basin and more specifically by nesting location. Our understanding of population structure is relatively poor. Genetic analysis of hawksbill sea turtles foraging off the Cape Verde Islands identified three closelyrelated haplotypes in a large majority of individuals sampled that did not match those of any known nesting population in the western Atlantic, where the vast majority of nesting has been documented (McClellan et al. 2010; Monzon-Arguello et al. 2010). Hawksbills in the Caribbean seem to have dispersed into separate populations (rookeries) after a bottleneck roughly 100,000 to 300,000 years ago (Leroux et al. 2012) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Human harvest
Exposure:
Response:
Consequence:
Narrative: Hawksbill Sea Turtle populations have declined dramatically in the Pacific Islands (NMFS-USFWS 1998b). By far, the most serious threat to the survival of this species is harvest by humans for commercial and subsistence use, including the tortoiseshell trade, egg exploitation, exploitation of females on nesting beaches, and directed hunting of hawksbills in foraging grounds (NMFS-USFWS 1998b, NMFS-USFWS 2007b). Within the last 100 years, more than one million hawksbill turtles have been killed for their shells (NMFS-USFWS 2007b).

Stressor:
Exposure:
Response:
Consequence:
Narrative: Other significant threats to the continued existence of this species include beach erosion and coastal construction, fisheries bycatch, dredging, clearing of dune vegetation, artificial lighting on nesting beaches, contamination from herbicides, pesticides, oil spills and other chemicals, loss of coral habitat, disease, predation of eggs, inadequacy of existing regulatory mechanism (including the lack of comprehensive and effective monitoring and bycatch reduction efforts), hybridization, and climate change and sea level rise (NMFS-USFWS 2007b, 2013).

Recovery

Reclassification Criteria:
See the 1992 and 1998 Recovery Plans for the U.S. Caribbean, Atlantic and Gulf of Mexico and U.S. Pacific populations of hawksbill sea turtles, respectively, for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top recovery actions identified to support in the Recovery Plans: 1. Identify important nesting beaches 2. Ensure long-term protection and management of important nesting beaches 3. Protect and manage nesting habitat; prevent the degradation of nesting habitat caused by seawalls, revetments, sand bags, other erosion-control measures, jetties and breakwaters 4. Identify important marine habitats; protect and manage populations in marine habitat 5. Protect and manage marine habitat; prevent the degradation or destruction of important [marine] habitats caused by upland and coastal erosion 6. Prevent the degradation of reef habitat caused by sewage and other pollutants 7. Monitor nesting activity on important nesting beaches with standardized index surveys 8. Evaluate nest success and implement appropriate nest-protection on important nesting beaches 9. Ensure that law-enforcement activities prevent the illegal exploitation and harassment of sea turtles and increase law-enforcement efforts to reduce illegal exploitation 10. Determine nesting beach origins for juveniles and subadult populations (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Delisting Criteria:
The hawksbill recovery criteria for delisting identified for the Pacific Ocean are: (1) All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters; (2) Each stock must average 1,000 females estimated to nest annually (FENA) (or a biologically reasonable estimate based on the goal of maintaining a stable

population in perpetuity) over 6 years; (3) All females estimated to nest annually (FENA) at source beaches are either stable or increasing for 25 years; (4) Existing foraging areas are maintained as healthy environments; (5) Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region; and (6) All priority #1 tasks have been implemented (e.g., protect and manage turtles on nesting beaches; protect and manage nesting habitat).

Recovery Actions:

- The recovery plans are dated (1998) and do not address a major, emerging threat—climate change. Actions to protect nesting beaches and foraging habitat and to preserve natural sex ratios should be comprehensively examined in the context of the threat of climate change. These plans should also conform to current Services' recovery planning guidance. Thus, the existing recovery plans should be updated. In addition to impacts from climate change, additional information and data are particularly needed on long-term population trends based on both nesting and in-water population monitoring (National Research Council 2010). Numerous gaps remain in our understanding of hawksbill biology. Sufficient information is lacking on basic demography such as growth and age-to-maturity for the vast majority of global populations. Information on annual reproductive output is similarly scant for many sites. In the marine environment, the oceanic juvenile phase remains one of the most poorly understood aspects of hawksbill life history, both in terms of where turtles occur and how long they remain oceanic. At-sea mortality in fisheries is also an area for which few data are available. The paucity of information regarding these aspects continues to inhibit effective modeling of populations, development and assessment of conservation recovery actions and prevents a full understanding of which populations are most at risk. The Services should consider and support, where appropriate, research that would address these data gaps.

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SPECIES ACCOUNT: *Eumeces egregius lividus* (Bluetail mole skink)

Species Taxonomic and Listing Information

Listing Status: Threatened; Southeast Region (R4) (USFWS, 2015)

Physical Description

The mole skink (Eumeces egregius) is a small, fossorial lizard that occupies xeric upland habitats of Florida, Alabama, and Georgia (Mount 1963). Five subspecies have been described (Mount 1965), but only the blue-tailed mole skink (Eumeces egregius lividus) is federally listed. It requires open, sandy patches interspersed with sclerophyllous vegetation (Service 1999). The historic and anticipated future modification and destruction of xeric upland communities in central Florida were primary considerations in listing the blue-tailed mole skink as threatened under the Act in 1987 (52 FR 42662 Mount (1965) described the blue-tailed mole skink largely on the basis of a bright blue tail in juveniles and restricted this subspecies to the southern Lake Wales Ridge (LWR) in Polk and Highlands Counties. Christman (1978b) limited the range of blue-tailed mole skinks to these two counties, but later added Osceola County to the range, based on the collection of a single juvenile of the subspecies just north of the Polk County line on the LWR (Christman 1992, FNAI records). Analysis of mtDNA (Branch et al. 2003) supports Mount's (1965) hypotheses that blue-tailed mole skinks from the lower LWR represent the ancestral stock with radiation from there. Genetic analysis also indicates high population structure with limited dispersal in mole skinks among sandy habitats (Branch et al. 2003). The blue-tailed mole skink reaches a maximum length of about 5 inches, and the tail makes up about half the body length. The body is shiny, and brownish to pink in color, with lighter paired dorsolateral stripes diverging posteriorly (Christman 1978b). Males develop a colorful orange pattern on the sides of the body during breeding season. Juveniles usually have a blue tail (Christman 1992; P. Moler, FWC, personal communication 1998). Regenerated tails and the tails of older individuals are typically pinkish. The legs are somewhat reduced in size and used only for surface locomotion and not for "swimming" through the sand (Christman 1992).

Taxonomy

North of range, this subspecies is replaced by or intergrades with E. e. onocrepis. (NatureServe, 2015)

Historical Range

See Current

Current Range

The historic and anticipated future modification and destruction of xeric upland communities in central Florida were primary considerations in listing the blue-tailed mole skink as threatened under the Act in 1987 (52 FR 42662). Almost 90 percent of the xeric upland communities on the LWR have already been lost because of habitat destruction and degradation due to residential development and conversion to agriculture, primarily citrus groves (Turner et al. 2006). Remaining xeric habitat on private lands is especially vulnerable because projections of future human population growth suggest additional demands for residential development within the range of the blue-tailed mole skink. Campbell and Christman (1982) characterized blue-tailed mole skinks as colonizers of a patchy, early successional, or disturbed habitat type, which occurs throughout the sandhill, sand pine scrub, and xeric hammock vegetative associations as a result of biological or catastrophic factors. Susceptibility of mature sand pine to wind-throw may be an important factor in maintaining bare, sandy microhabitats required by blue-tailed mole skinks and other scrub endemics (Myers 1990). At the time of Federal listing, there were 20 locality records for the blue-tailed mole skink. Currently, 43 sites are known. The increase in locality records is largely the result of more intensive sampling of scrub habitats in recent years and does not imply that this species is more widespread than originally supposed. Of the known locations, only 13 occur on public land or on private land protected under conservation easement. Turner et al. (2006) suggested blue-tailed mole skinks may be under-represented in the reserve network of protected public lands, but could not determine if their absence is a result of exclusion or sampling effort. It is likely continued residential and agricultural development of xeric upland habitat in central Florida has destroyed or degraded extensive tracts of habitat containing the blue-tailed mole skink. Estimates of habitat loss range from 60 to 90 percent, depending on the xeric community type (Christman 1988; Christman and Judd 1990; Kautz 1993; Center for Plant Conservation 1995). Blue-tailed mole skinks are known to be present on sites which total 52.4 percent of the 21,597 acres (8,740 ha) of Florida scrub and high pine that is currently protected (Turner et al. 2006). However, the extent of potential habitat that is actually occupied is unknown, as is their total population size. As noted above, this species appears to be patchily distributed, even in occupied habitat (Mount 1963; Christman 1992). Unlike sand skinks, their tracks cannot be easily detected in the sand, and most of the extant scrub sites on the LWR have not been adequately surveyed for blue-tailed mole skinks, including protected sites. A density study of blue-tailed mole and sand skinks was conducted in 2004-2005 by Christman (2005). Only two blue-tailed mole skinks were observed in the enclosures (mean density = 3.3/hectare, 1.3/acre) relative to at least 84 sand skinks (ratio = 1:41). Christman (1992) suggested only 1 blue-tailed mole skink is encountered for every 20 sand skinks. Other range-wide pitfall trap data on the LWR revealed a blue-tailed mole skink to sand skink ratio of 1:1.89 based on 54 total skinks captured in six trap arrays (Christman 1988), 1:4.3 based on 332 total skinks in 58 trap arrays (Mushinsky and McCoy 1991), and 1:2.7 based on 49 total skinks in 31,640 pitfall trap-days (Meshaka and Lane 2002). Mushinsky and McCoy (1991) confirmed that detection rates for blue-tailed mole skinks increased with sampling effort.

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Sand skinks and blue-tailed mole skinks generally partition rather than compete with one another for resources. Sand skinks are primarily fossorial; they move or "swim" below the surface of the ground in sandy soils and take prey below the surface. Blue-tailed mole skinks are semi-fossorial; they hunt primarily at the soil surface or at shallow depths to 2 inches and consume mostly terrestrial arthropods (Smith 1977, Service 1993b). Foraging activities usually occur during the morning or evening. Roaches, crickets, and spiders make up the bulk of the diet (Mount 1963). Their diet is more generalized than that of the fossorial sand skink, which probably reflects their tendency to feed at the surface (Smith 1982). Like sand skinks, mole skinks show an activity peak in spring (Mount 1963, Smith 1982).

Reproduction Narrative

Adult: Lays clutch of 2-9 eggs, April-June. Female attends eggs. Eggs hatch in about 4-7 weeks. Female attends eggs during incubation (Fitch 1970). Probably sexually mature in first year.; (NatureServe, 2015). The reproductive biology of the blue-tailed mole skink is poorly known. Reproduction is presumably very much like that of the peninsula mole skink, E. e. onocrepis, where mating occurs in the fall or winter. In the peninsula mole skink, two to nine eggs are laid in a shallow nest cavity less than 12 inches below the surface. The eggs incubate for 31 to 51 days, during which time the female tends the nest. Individuals probably become reproductively active at 1 year of age (Mount 1963, Christman 1978a). No data are available on blue-tailed mole skink home ranges or dispersal.

Habitat Narrative

Adult: A variety of xeric upland communities provide habitat for the blue-tailed mole skink, including rosemary and oak-dominated scrub, turkey oak barrens, high pine, and xeric hammocks. Areas with few plant roots, open canopies, scattered shrub vegetation, and patches of bare, loose sand provide optimal habitats (Christman 1988, 1992). Within these habitat types, blue-tailed mole skinks are typically found under leaves, logs, palmetto fronds, and other ground debris. Shaded areas presumably provide suitable microhabitat conditions for thermoregulation, egg incubation, and foraging (Mount 1963). Blue-tailed mole skinks tend to be clumped in distribution with variable densities that may approach 25 adults per acre (Christman 1992). The distribution of blue-tailed mole skinks appears to be closely linked to the distribution of surface litter and, in turn, suitable microhabitat sites. Specific physical structures of habitat that sustain sand skink populations, and likely blue-tailed mole skink populations as well, include a well-defined leaf litter layer on the ground surface and shade from either a tree canopy or a shrub layer, but not both. Leaf litter likely provides important skink foraging opportunities. Shade provided by a tree canopy or a shrub layer likely helps skinks regulate body temperature to prevent overheating. However, having both a tree canopy and a shrub layer appears to be detrimental to skinks (McCoy 2011, University of South Florida, pers. comm.). Either natural fires started by lightning or prescribed burns are necessary to maintain habitat in natural scrub ecosystems. However, if fire occurs too frequently, leaf litter might not build up sufficiently to support skink populations. At Archbold Biological Station (ABS), sand skinks appear to be most abundant after 10 years of leaf litter development. The ideal fire frequency to maintain optimal leaf litter development for skinks likely varies by site and other environmental conditions (Mushinsky 2011, University of South Florida, pers. comm.).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Population Information and Trends

Number of Populations:

21 - 80 (NatureServe, 2015)

Population Size:

2500 to >1,000,000 individuals (NatureServe, 2015)

Population Narrative:

Small size leads to susceptibility to predation. During the last few decades, about 65% of the skink's habitat has been lost to agriculture (citrus) and residential development (USFWS 1990). Over an even longer period, the percent loss would have been far greater. Decline of >70% Number of individuals is unknown, though it does not seem to be abundant at any site (seems to be much less common than the sand skink [P. reynoldsi] according to S. Christman). Known from more than 20 scrubs, but most are small and isolated (NatureServe, 2015). The Service has little information on the population dynamics of blue-tailed mole skinks within their extant ranges. The skinks' diminutive size and secretive habits make their study difficult. Blue-tailed mole skinks often seem absent or rare on the same LWR study sites where sand skinks are common, and when present, are patchily distributed (Christman 1988, 1992; Mushinsky and McCoy 1995). Mount (1963) noted peninsula mole skinks also are patchily distributed and mostly occurred on xeric sites greater than 100 acres (40 ha) in size. Early maturity (1 year in laboratory) and a large clutch size (maximum = nine eggs) of relatively small eggs (Mount 1963) suggest the population dynamics of mole skinks are different from sand skinks.

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: Habitat loss, fragmentation, and changes in land use continue to threaten these skinks. In conversion of rural lands to urban use in central Florida where skinks occur is projected to continue over the next 50 years. Overutilization for commercial, recreational and scientific, or educational purposes is not considered to be a threat to this species. Disease and predation were not identified as potential threats in the original listing package, and recent studies have confirmed this determination. In addition, fire suppression, improper stand management, invasion by exotic plant species, and loss of genetic diversity continue to threaten the existence of the bluetail mole skink and sand skink. Due to the above continued threats, this species continues to meet the definition of threatened under the Act.

Recovery

Recovery Actions:

- The protection and recovery of blue-tailed mole skinks will require habitat loss be stopped and unoccupied but potentially suitable habitat be restored. The existing protection of the blue-tailed mole skink includes a number of private and public preserves within the LWR. Current efforts to expand the system of protected xeric upland habitats on the LWR, in concert with implementation of aggressive land management practices, represent the most likely opportunity for securing the future of this species. Comprehensive land acquisitions that protect areas occupied by the blue-tailed mole skink include the Service's LWR National Wildlife Refuge, and the State of Florida's Conservation and Recreation Lands (CARL) LWR Ecosystem Project (Service 1993a). In summary, little information is available to adequately assess the status and population dynamics of the blue-tailed mole skink. This subspecies is endemic to central Florida and is a habitat specialist that relies on early successional xeric scrub habitat for its continuing existence. Estimates of habitat loss range from 60 to 90 percent, depending on the xeric community type (Christman 1988, Christman and Judd 1990, Kautz 1993, Center for Plant Conservation 1995). Furthermore, the implementation of favorable management practices can create and maintain suitable habitat conditions for both sand and blue-tailed mole skinks, as well as other xeric upland-dependent species. A number of actions over the last 20 years have resulted in conservation benefits to xeric uplands within the extant range of both species. The State of Florida has acquired xeric upland habitat through the CARL, Save Our Rivers, and other P-2000 acquisition programs. Combined, these land acquisition programs have protected 10,000 acres of xeric uplands (Florida Department of Environmental Protection 1998, South Florida Water Management District 1998). The Service has also acquired portions of several small tracts totaling 800 acres as a component of the LWR National Wildlife Refuge. Finally, private organizations, such as The Nature Conservancy and ABS have bought and currently manage xeric uplands within the LWR.

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SPECIES ACCOUNT: *Gambelia silus* (Blunt-nosed leopard lizard)

Species Taxonomic and Listing Information

Commonly-used Acronym: BNLL

Listing Status: Endangered; March 11, 1967 (32 FR 4001).

Physical Description

The blunt-nosed leopard lizard (Gambelia sila) is a relatively large lizard in the Iguanidae family. It has a long, regenerative tail, long, powerful hind limbs, and a short, blunt snout. Adult males are slightly larger than females, ranging in size from 8.7 to 12.0 centimeters (cm) (3.4 to 4.7 inches [in.]) in length (snout to vent), excluding tail. Females are 8.6 to 11.2 cm (3.4 to 4.4 in.) long. Males weigh 36.9 to 42.5 grams (g) (1.3 to 1.5 ounces [oz.]), females weigh 22.7 to 34.0 g (0.8 to 1.2 oz.). Males are distinguished from females by their enlarged postanal scales, femoral pores (visible pores on the underside of the thigh), temporal and mandibular muscles (muscles on the skull that close the jaws), and tail base (USFWS 1998). Although blunt-nosed leopard lizards are darker than other leopard lizards, they exhibit tremendous variation in color and pattern on their backs. Their background color ranges from yellowish or light gray-brown to dark brown, depending on the surrounding soil color and vegetation. Their undersides are uniformly white. They have rows of dark spots across their backs, alternating with white, cream-colored or yellow bands (USFWS 1998). The color pattern on the back consists of longitudinal rows of dark spots interrupted by a series of from seven to ten white, cream-colored, or yellow transverse bands. The cross bands are much broader and more distinct in the blunt-nosed leopard lizard than in other leopard lizards, and extend from the lateral folds on each side to the middle of the back, where they meet or alternate along the midline of the back. With increasing age, the cross bands may fade and the spots may become smaller and more numerous, particularly in males. Similarly colored bands or rows of transverse spots produce a banded appearance to the tail. Juveniles have blood-red spots on the back that darken with age, becoming brown when sexual maturity is reached, although a few adults retain reddish centers to the spots (USFWS 1998).

Taxonomy

The blunt-nosed leopard lizard was described and named in 1890 by Stejneger as Crotaphytus silus, from a specimen collected in Fresno, California. In 1900, however, Cope considered the blunt-nosed leopard lizard to be a subspecies of the long-nosed leopard lizard (C. wislizenii), and listed it as C. w. silus. Under this arrangement, leopard lizards and collared lizards were placed in the same genus. In 1946, Smith separated the collared from the leopard lizards, placing the latter in the genus Gambelia. The bases for separation were differences in head shape, presence or absence of gular (throat area) folds, and differences in bony plates on the head. The subspecific status of G. w. silus was retained by Smith in 1946. This generic split was not universally agreed upon; the status of the lizards, both generic and specific, remained controversial until 1970, when Montanucci presented a solid argument for specific status based on the study of hybrids between the long-nosed and blunt-nosed leopard lizards. In 1975, Montanucci et al. again separated Gambelia from Crotaphytus, resulting in the name Gambelia silus. Most recently, the specific spelling was changed to sila to properly agree in gender with the genus Gambelia (USFWS 1998; USFWS 2010). The blunt-nosed leopard lizard can be distinguished from the long-nosed leopard lizard by its color pattern; truncated snout; and short, broad, triangular head. The blunt-nosed leopard lizard has dark blotches on the throat instead of the parallel streaks of the long-nosed leopard lizard. Other distinguishing characteristics are a significantly smaller number of maxillary and premaxillary teeth (this may be directly related to the shortened snout) and a smaller variation in the number of femoral pores. In general, blunt-nosed leopard lizards can be distinguished from all other leopard lizards by their retention into adulthood of the primitive color pattern shared by all young leopard lizards (absence of ornamentation around the dorsal spots; retention of wide, distinct cross bands; presence of gular blotches; and fewer spots arranged in longitudinal rows) (USFWS 1998).

Historical Range

The blunt-nosed leopard lizard is endemic to the San Joaquin Valley of central California. It occurred in arid lands throughout much of the San Joaquin Valley and adjacent foothills, ranging from San Joaquin County in the north, to the Tehachapi Mountains in the south, as well as in the Carrizo Plain and Cuyama Valley (USFWS 2010). Except where their range extends into the Carrizo Plain and Cuyama Valley west of the southwestern end of the San Joaquin Valley, the eastern and western boundaries of its distribution is defined by the foothills of the Sierra Nevada and Coast Range Mountains, respectively. The blunt-nosed leopard lizard is not found above 800 meters (m) (2,600 feet [ft.]) in elevation. The blunt-nosed leopard lizard hybridizes with the long-nosed leopard lizard (G. wislizenii) where their ranges meet in Ballinger Canyon and others (Santa Barbara and Ventura counties) in the Cuyama River watershed (USFWS 1998).

Current Range

Due to widespread agricultural development of natural habitat in the San Joaquin Valley, the current distribution of blunt-nosed leopard lizards is restricted to less than 15 percent of its historic range. In the remaining habitat that exists, blunt-nosed leopard lizards occur in alkali sink scrub, saltbush scrub, and native and nonnative grasslands on the Valley floor and in the surrounding foothills areas. It has been reported that the contemporary range was confined to a few areas scattered from southern Merced County to southern Kern County (USFWS 2010). Blunt-nosed leopard lizards have been found near Firebaugh and Madera, Ciervo, Tumey, Panoche Hills, Anticline Ridge, Pleasant Valley, Lone Tree, Sandy Mush Road, Whimesbridge, Horse Pasture, and Kettleman Hills Essential Habitat Areas. Blunt-nosed leopard lizards had been also recently been observed on the Madera Ranch in western Madera County from surveys conducted for the Madera Irrigation District (USFWS 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Blunt-nosed leopard lizards are opportunistic carnivores, insectivores, and omnivores. They feed primarily on insects (mostly grasshoppers, crickets, and moths) and other lizards; they eat some plant material rarely, perhaps unintentionally consumed it with animal prey. They appear to feed opportunistically on animals, eating whatever is available in the size range the can overcome and swallow. Which lizards are eaten is largely determined by the size and behavior of the prey. Lizard species taken as prey include side-blotched lizards (Uta stansburiana), coast horned lizards (Phrynosoma coronatum), California whiptails (Cnemidophorus tigris), and spiny lizards (Sceloporus spp.). Young of its own species also are eaten (USFWS 1998).The species is diurnal and crepuscular during the summer; seasonal above-ground activity is correlated with weather conditions, primarily temperature. Optimal activity occurs when air temperatures are between 23.5 degrees and 40.0 degrees Celsius (°C) (74 and 104 degrees Fahrenheit [°F]) and ground temperatures are between 22 degrees and 36 °C (72 and 97 °F). Because diurnal activity is temperature-dependent, blunt-nosed leopard lizards are most likely to be observed in the morning and late afternoon during the hotter days. Because they have similar diets, interspecific competition probably occurs between the blunt-nosed leopard lizard and California whiptail (Aspidoscelis tigris munda) (USFWS 1998).Before their first winter, young leopard lizards may grow to 88 mm (3.5 in.) in snout-vent length. The species depends on the availability of insects and other small lizards as a food source, and on sparsely vegetated open areas. Potential predators of blunt-nosed leopard lizards include whipsnakes, gopher snakes, glossy snakes (Arizona elegans), western long-nosed snakes (Rhinocheilus lecontei), common king snakes, western rattlesnakes, loggerhead shrikes (Lanius ludovicianus), American kestrels (Falco sparverius), burrowing owls, greater roadrunners (Geococcyx californianus), golden eagles (Aquila chrysaetos), hawks, California ground squirrels, spotted skunks (Spilogale putorius), striped skunks (Mephitis mephitis), American badgers, coyotes, and San Joaquin kit foxes (USFWS 1998).

Reproduction Narrative

Adult: Breeding activity begins within a month of emergence from dormancy and lasts from the end of April through the beginning of June, and in some years to near the end of June. During this period, and for a month or more afterward, the adults often are seen in pairs and frequently occupy the same burrow systems. Male territories may overlap those of several females, and a given male may mate with several females. Copulation may occur as late as June (USFWS 1998).Females typically produce only one clutch of eggs per year, but some may produce three or more under favorable environmental conditions (i.e., greater prey abundance). Females lay two to six eggs, averaging 15.6 by 25.8 mm (0.6 by 1.0 in.), in June and July; their numbers are correlated with the size of the female. In several populations, and during most of the year, males appear to outnumber females by a ratio of 2:1. Hatchling sex rations vary between 1:5:1 and 2.5: 1 (male:female). Blunt-nosed leopard lizards reproduce through oviparity; after about 2 months of incubation in the burrow chamber, young hatch from July through early August, rarely to September, and range in size from 42 to 48 mm (1.7 to 1.9 in.) snout-vent length (USFWS 1998; USFWS 2010).The lizards leave their young to fend for themselves. Sexual maturity is reached from 9 to 21 months, depending on the sex and environmental conditions. Females tend to become sexually mature earlier than males, breeding for the first time after the second dormancy; males usually do not breed until later. Based on estimates, maximum longevity would be 8 to 9 years, with an annual survivorship of about 50 percent. The species requires friable soil substrate to dig nests. and eggs are laid in a chamber either excavated specifically for a nest or already existing in the burrow system (USFWS 1998).

Geographic or Habitat Restraints or Barriers

Adult: Not found above 800 m (2,600 ft.) in elevation. In general, absent from areas of steep slope, dense vegetation, or areas subject to seasonal flooding (USFWS 1998).

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Narrow/specialist.

Tolerance Ranges/Thresholds

Adult: High

Site Fidelity

Adult: High

Dependency on Other Individuals or Species for Habitat

Adult: Blunt-nosed leopard lizards use small rodent burrows for shelter from predators and temperature extremes. Blunt-nosed leopard lizards are highly combative in establishing and maintaining territories (USFWS 1998).

Habitat Narrative

Adult: Blunt-nosed leopard lizards are found in open, sparsely vegetated areas of low relief on the San Joaquin Valley floor and in gently sloping alluvial fans of the surrounding foothills that are not more than 800 m (2,600 ft.) in elevation. On the valley floor, they are most commonly found in nonnative grassland and valley sink scrub community. The valley sink scrub is dominated by low, alkali-tolerant shrubs of the family Chenopodiaceae, such as iodine brush, and seepweeds. The soils are saline and alkaline lake bed or playa clays that often form a white salty crust and are occasionally covered by introduced annual grasses. Valley needlegrass grassland, nonnative (annual) grassland, and alkali playa also provide suitable habitat for the lizard on the valley floor. This species also inhabits valley saltbush scrub, a low shrubland with an annual grassland understory, which occurs on the gently sloping alluvial fans of the foothills of the southern San Joaquin Valley and adjacent Carrizo Plain (USFWS 1998).Leopard lizards use small rodent burrows for shelter from predators and temperature extremes. Blunt-nosed leopard lizards are highly combative in establishing and maintaining territories. Leopard lizards require friable soil that can be used for digging burrows (either by rodents or the lizards themselves). In areas of low mammal burrow density, lizards will construct shallow, simple tunnels in earth berms or under rocks. While foraging, immature lizards also take cover under shrubs and rocks. Each lizard uses several burrows without preference, but will avoid those occupied by predators or other leopard lizards. In general, leopard lizards are absent from areas of steep slope or dense vegetation, or areas subject to seasonal flooding (USFWS 1998).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: The average male home range size was 4.24 hectares (ha) (10.48 acres [ac.]), and the average female home range size was 2.02 ha (4.99 ac.). Female home ranges and core areas were overlapped extensively by male ranges at an average of 79.8 percent and 50.3 percent, respectively (USFWS 2010).

Immigration/Emigration

Adult: Uses corridors to disperse between populations (USFWS 2010).

Dispersal/Migration Narrative

Adult: Blunt-nosed leopard lizards are nonmigratory; however, they are mobile when active and will disperse between populations if adequate, open corridors are present. The average male home range size was 4.24 ha (10.48 ac.), and the average female home range size was 2.02 ha (4.99 ac.). Female home ranges and core areas were overlapped extensively by male ranges at an average of 79.8 percent and 50.3 percent, respectively. Female home ranges were found to overlap the ranges of up to four other males, but were not observed to overlap with other females (USFWS 2010). Dispersal characteristics are unknown, but these lizards appear to be capable of making extensive movements. Barriers to dispersal include busy highways or highways with obstructions that lizards rarely if ever cross successfully; major rivers, lakes, ponds, or deep marshes; and urbanized areas dominated by buildings and pavement (NatureServe 2015).

Additional Life History Information

Adult: Female home ranges were found to overlap the ranges of up to four other males, but were not observed to overlap with other females (USFWS 2010).

Population Information and Trends

Population Trends:

Short-term trend: decline of 10 to 30 percent. Long-term Trend: decline of greater than 90 percent (NatureServe 2015). Long-term studies show population instability, especially during years of above-average precipitation (USFWS 1998; USFWS 2010).

Species Trends:

Decreasing (USFWS 2010)

Resiliency:

Low

Representation:

Medium

Redundancy:

Low

Number of Populations:

There are 21 to 80 occurrences of blunt-nosed leopard lizards; the exact number of occurrences is unknown due to large-scale, continuous extirpation of populations (NatureServe 2015).

Population Size:

2,500 to 10,000 individuals (NatureServe 2015).

Adaptability:

Low

Additional Population-level Information:

The largest and most stable population of blunt-nosed leopard lizards on the valley floor is thought to be at Semitropic Ridge Preserve. However, the number of all lizards at Semitropic Ridge Preserve has been decreasing since 2003 for unknown reasons (USFWS 2010).Blunt-nosed leopard lizards and long nosed leopard lizards (G. wislizenii) from the San Joaquin Valley and Mojave Desert, respectively, hybridize in the upper Cuyama Valley near the Santa Barbara – San Luis Obispo County line (USFWS 2010).

Population Narrative:

Long-term studies show instability in populations of blunt-nosed leopard lizards, especially during years of above-average precipitation. The relative proportions of the three age groups (adult, subadult, and hatchling or young-of-the-year) change through the seasons because young are added to the population only in August or later, and entry into dormancy and differential mortality affects the proportions in age groups above ground. Based on population instability and ongoing modification and conversion of existing habitat for agricultural use, residential or commercial developments, and petroleum and mineral extraction activities, overall species abundance is considered to be decreasing across its range. There are approximately 21 to 80 occurrences, with a total population somewhere between 2,500 and 10,000 individuals; the exact number of occurrences is unknown due to large-scale, continuous extirpation of populations. Overall, the population is estimated to have declined by 10 to 30 percent over the last decade (USFWS 1998; USFWS 2010; NatureServe 2015).The largest and most stable population of blunt-nosed leopard lizards on the valley floor is thought to be at Semitropic Ridge Preserve. However, the number of all lizards at Semitropic Ridge Preserve has been decreasing since 2003 for unknown reasons. The blunt-nosed leopard lizard and long-nosed leopard lizard (G. wislizenii) from the San Joaquin Valley and Mojave Desert, respectively, hybridize in the upper Cuyama Valley near the Santa Barbara – San Luis Obispo County line (USFWS 1998; USFWS 2010; NatureServe 2015).

Threats and Stressors

Stressor: Habitat degradation/loss
Exposure: Loss and modification of habitat due to agricultural and urban development.
Response: Reduction and loss of available food sources and habitat.
Consequence: Population decline and extirpation.
Narrative: Conversion of land for agricultural purposes continues to be the most critical threat to the blunt-nosed leopard lizard. Although the increment of habitat loss attributable to urban development appears to be increasing, this activity remains less significant than agriculture for this species. Collective habitat loss has caused the reduction and fragmentation of populations and decline of blunt-nosed leopard lizards. Land conversions contribute to declines in blunt-nosed leopard lizard abundance directly and indirectly by increasing mortalities from sources, including displacement and habitat fragmentation; reducing feeding, breeding, and sheltering sites; and reducing the carrying capacity and prey populations for occupied sites (USFWS 2010).Agricultural conversion is generally not subject to any environmental review, and is not directly monitored or regulated. Conversion of privately owned habitat without use of federally

supplied water typically does not result in Section 7 consultation with the U.S. Fish and Wildlife Service (USFWS), nor is it common for there to be an application for a Section 10 incidental take permit (which would include a habitat conservation plan to reduce the effects of the take on the species). In addition, Central Valley Project water is used for groundwater recharge by some districts in the San Joaquin Valley. Such recharge may allow nearby landowners to pump groundwater for uses that may affect listed and proposed species. The conversion of blunt-nosed leopard lizard habitat into agricultural fields continues to be a threat to blunt-nosed leopard lizard on private lands on the valley floor. Between 1970 and 2000, the human population of the San Joaquin Valley doubled in size; it is expected to more than double again by 2040. The increasing population, combined with the concurrent high demand for limited supplies of land, water, and other resources, has been identified as a principal underlying cause of habitat loss and degradation (USFWS 2010).

Stressor: Oil and gas development
Exposure: Oil and gas exploration.
Response: Vehicle strikes, entombment in burrows, temporary loss or degradation of their habitat, and harassment from noise and vibration.
Consequence: Mortality, injury, population decline, and extirpation.
Narrative: Oil and natural gas exploration activities continue to degrade blunt-nosed leopard lizard habitat in western Kern, Kings, and Fresno counties. The construction of facilities related to oil and natural gas production—such as well pads, wells, storage tanks, sumps, pipelines, and their associated service roads—degrade habitat and cause direct mortality to blunt-nosed leopard lizards. Leakage of oil from pumps and transport pipes, storage facilities, surface mining, and off-road vehicle use also degrade blunt-nosed leopard lizard habitat (USFWS 2010).Disturbances associated with seismic activities are predominantly temporary and are dispersed across large land areas, but nonetheless have the potential to impact blunt-nosed leopard lizards or adversely affect their habitat. It is anticipated that blunt-nosed leopard lizards are likely to be adversely affected by vehicle strikes, entombment in burrows, temporary loss or degradation of their habitat, and harassment from noise and vibration. Some blunt-nosed leopard lizards may escape direct injury if burrows are destroyed, but become displaced into adjacent areas. They may be vulnerable to increased predation, exposure, or stress through disorientation, loss of foraging and food base, or loss of shelter (USFWS 2010).

Stressor: Water banking facilities
Exposure: Urban and rural water facilities.
Response: Vehicle strikes, degradation or loss of suitable habitat, and augmented conversion of native lands to agriculture.
Consequence: Injury, mortality, population decline, and extirpation.
Narrative: The ongoing need to provide and secure water supplies for continued urban and rural use throughout California has increased the demand for new construction of water banking facilities. Water bank projects potentially threaten the blunt-nosed leopard lizard by directly removing habitat (through flooding or the establishment of infrastructure); changing habitat quality (vegetation structure, higher predation, reduced prey, etc.); and increasing the incidence of take through vehicle strikes. Groundwater recharge projects could result in significant effects to this species, beyond the flooding of suitable habitat; these effects would be attributable to the permanent conversion of habitat to water bank infrastructure, including the construction of access roads, powerlines, pipeline and canal conveyance systems, and numerous water extraction well pads. Water extraction projects are also likely to result in the permanent

conversion of habitat to water bank infrastructure, including construction of access roads, powerlines, pipeline and canal conveyance systems, and water extraction well pads. Moreover, they will likely augment the conversion of native lands to agriculture by increasing water supply availability in the southern San Joaquin Valley (USFWS 2010).

Stressor: Solar power development
Exposure: Solar power developments.
Response: Loss, fragmentation, and degradation of habitat; vehicle strikes.
Consequence: Injury, mortality, population decline, and extirpation.
Narrative: Solar power development projects pose potential threats to blunt-nosed leopard lizards and may impact vast amounts of habitat. These projects can destroy, fragment, or impact blunt-nosed leopard lizard habitat by altering landscape topography, vegetation, and drainage patterns; increasing vehicle-strike mortality; and reducing habitat quality by intercepting solar energy that would normally reach the ground surface, affecting ambient air temperatures through habitat shading, and altering soil moisture regimes. Moreover, recently proposed solar projects tend to be large contiguous blocks of disturbance in undeveloped habitat lands, ranging from hundreds to several thousand acres. Currently, eight solar power farms have been proposed (USFWS 2010).

Stressor: Predation
Exposure: Wide variety of predators.
Response: Individuals removed from the population due to predation.
Consequence: Unknown
Narrative: The following animals are currently known to prey on blunt-nosed leopard lizards: whip snakes, gopher snakes, glossy snakes (Arizona elegans), western long-nosed snakes (Rhinocheilus lecontei), northern Pacific rattlesnakes (Crotalus viridis oreganus), common king snakes, western rattlesnakes, loggerhead shrikes (Lanius ludovicianus), American kestrels (Falco sparverius), prairie falcons (Falco mexicanus), burrowing owls (Athene cunicularia), greater roadrunners (Geococcyx californianus), golden eagles (Aquila chrysaetos), red-tailed hawks (Buteo jamaicensis), California ground squirrels, spotted skunks (Spilogale putorius), striped skunks (Mephitis mephitis), American badgers (Taxidea taxus), coyotes (Canis latrans), and San Joaquin kit foxes. This list is likely not exhaustive for all incidences of predation that occur across the range of the blunt-nosed leopard lizard, nor has the magnitude of effects derived by predation on population trend and stability been researched at this time. Therefore, it remains unknown as to whether predation is a major threat to the survival and recovery of this species (USFWS 2010).Without mammal burrows, blunt-nosed leopard lizards are more susceptible to predation. The construction of artificial perches (i.e., fence posts) for burrowing owls and other predators increases the risk of predation on blunt-nosed leopard lizards. Additionally, the territorial behavior of blunt-nosed leopard lizard males may expose them to higher rates of predation than if they were secretive (USFWS 2010).

Stressor: Disease
Exposure: See narrative.
Response: See narrative.
Consequence: Unknown
Narrative: There are no known diseases in blunt-nosed leopard lizards, but endoparasites (nematodes) and ectoparasites (mites and harvest mites) have been reported. The overall effect of the parasites on the blunt-nosed leopard lizard is not currently known (USFWS 2010).

Stressor: Regulatory mechanisms
Exposure: Inadequacy of existing regulatory mechanisms.
Response: See narrative.
Consequence: Limited ability to protect the species.
Narrative: There are several state and federal laws and regulations that are pertinent to federally listed species, each of which may contribute in varying degrees to the conservation of federally listed and nonlisted species. These laws, most of which have been enacted in the past 30 to 40 years, have greatly reduced or eliminated the threat of wholesale habitat destruction, although the extent to which they prevent the conversion of natural lands to agriculture is less clear. In summary, the Endangered Species Act (ESA) is the primary federal law that provides protection for this species since its listing as endangered in 1967. Other federal and state regulatory mechanisms provide discretionary protections for the species based on current management direction, but do not guarantee protection for the species absent its status under ESA. Therefore, we continue to believe other laws and regulations have limited ability to protect the species in absence of ESA (USFWS 2010).

Stressor: Altered vegetation
Exposure: Altered vegetation communities due to grazing, exotic grasses, and wildfire regimes.
Response: Habitat degradation and loss.
Consequence: Reduction in population, and extirpation.
Narrative: The southern San Joaquin Valley of California has been invaded by nonnative plant species since European cattle were brought to the region in the 1500s. Research has reported that the exponential increase in exotic plants has paralleled the increase in human population growth in California. A number of exotic species are frequently observed in blunt-nosed leopard lizard habitat, and have adversely affected the species. Additionally, an overabundance of residual thatch from the previous year's nonnative grass production can have similar adverse effects by shading out or obstructing native seedlings. Vegetation changes include levels of biomass, cover, density, community structure, or soil characteristics. Changes have generally been attributed to the negative effects of off-highway vehicle use, overgrazing by domestic livestock, agriculture, urbanization, construction of roads and utility corridors, air pollution, military training exercises, and other activities. It has also been reported that secondary contributions to degradation include the proliferation of exotic plant species, higher frequency of anthropogenic fire events, and increased nitrogen deposition. Effects of these impacts include alteration or destruction of macro- and micro-vegetation elements, establishment of annual plant communities dominated by exotic species, destruction of soil stabilizers, soil compaction, and increased erosion. Overgrazing may negatively affect blunt-nosed leopard lizards by soil compaction, damaging rodent burrows on which the lizards depend for cover, and stripping away vegetative cover used by both the lizard and its prey. However, the cessation of grazing is likely to be even more detrimental to blunt-nosed leopard lizard due to the dense growth of exotic grasses, as discussed below (USFWS 2010).

Stressor: Vehicles
Exposure: Vehicle-induced mortality (from both roadway traffic and off-road vehicles).
Response: Individuals removed from the population due to being struck or run over by vehicles, harassment, and disruption of foraging and breeding habitat.
Consequence: Injury, mortality, and population decline.

Narrative: Blunt-nosed leopard lizard mortality is known to occur as a result of regular automobile traffic and off-road vehicle use. Roads typically surround and often bisect remaining fragments of habitat, increasing the risk of mortality by vehicles and further isolating populations. The blunt-nosed leopard lizard's preference for open areas, such as roads, makes them especially vulnerable to mortality from vehicle strikes. During habitat conversion activities, individuals could be killed or injured by operation of heavy equipment (crushing, burial by earthmoving equipment, discing, grading, or mowing) or flooding of habitat. Individuals could be harassed during construction by noise, ground vibrations, compaction of burrows, construction lighting, and disruption of foraging and breeding behavior. Individuals not killed directly by operation of equipment would probably find themselves in suboptimal habitat with a decreased carrying capacity, due to lower availability of foraging and breeding habitat and greater vulnerability to predation. If individuals were displaced from converted lands into nearby native habitat population densities, intraspecific competition and predation pressure would be likely to increase. Animals that lost their fear of humans could become more vulnerable to shooting, poisoning, and roadkill (USFWS 2010).

Stressor: Waterfowl blinds
Exposure: Waterfowl blinds in playas.
Response: Individuals are trapped.
Consequence: Mortality
Narrative: Waterfowl blinds are large drums dug partway into the ground and placed at the edges of playas to conceal hunters. When left uncovered, these structures are pitfall traps for blunt-nosed leopard lizards and other reptiles and small mammals, resulting in their mortality. Hunting clubs should be informed of this problem, and active waterfowl blinds should be covered when not in use; abandoned blinds should be removed or filled in. At this time, however, waterfowl blinds are only being retrofitted with covers, or removed on a case-by-case basis (USFWS 2010).

Stressor: Pesticides
Exposure: Direct and indirect: broad-scale pesticide use and application.
Response: Individuals removed from populations, and reduced availability of food.
Consequence: Population decline.
Narrative: Pesticide use may directly and indirectly affect blunt-nosed leopard lizards. The use of pesticides reduces food available for reproducing blunt-nosed leopard lizards in the spring, and later for hatchlings when they should be storing fat to sustain themselves during their first winter. The most expansive pesticide program within the range of the blunt-nosed leopard lizard is the broad-scale use of malathion. Malathion is a pesticide regulated by the California Department of Food and Agriculture (CDFA), and is typically aerially distributed across much of the blunt-nosed leopard lizard range to reduce impacts of the curly top virus on sugar beet production. The most important effect of malathion on blunt-nosed leopard lizard survival and recovery is the associated reduction in insect prey populations, which can last between 2 and 5 days. Fumigating rodents in burrows may also harm blunt-nosed leopard lizards that shelter in those burrows. U.S. Environmental Protection Agency (U.S. EPA) bulletins governing the use of rodenticides have greatly reduced the risk of significant mortality to blunt-nosed leopard lizard populations. The California Environmental Protection Agency, CDFA, county agricultural departments, California Department of Fish and Game (CDFG), and the U.S. EPA collaborated with USFWS in the development of County Bulletins that both are efficacious and acceptable to land owners. However, the use of rodenticides in blunt-nosed leopard lizard habitat continues to

be a potential threat to the species because this effectively reduces the number of rodents available to dig burrows for secondary use by blunt-nosed leopard lizards (USFWS 2010).

Stressor: Climate change
Exposure: Climate change modifying habitats.
Response: Habitat degradation and loss.
Consequence: Unknown
Narrative: Long-term monitoring studies show that blunt-nosed leopard lizard populations drastically decline during consecutive years of drought or above-average precipitation. Also, blunt-nosed leopard lizard aboveground activity is highly dependent on temperature. Therefore, blunt-nosed leopard lizard population stability and behavior is very sensitive to any changes in precipitation or temperature. Climate models predict for California an overall warming, but vary in their predictions for precipitation. Other scientists predict a decrease in precipitation in the southern San Joaquin. Any significant changes in temperature or precipitation could have drastic effects on blunt-nosed leopard lizard populations. Climate change will likely result in changes in the vegetative communities of blunt-nosed leopard lizard habitat, and potentially increase exotic species. However, there are insufficient data available at this time to predict the effects of climate change on the blunt-nosed leopard lizard (USFWS 2010).

Recovery

Reclassification Criteria:
Reclassification to threatened status should be evaluated when the species is protected in specified recovery areas from incompatible uses; management plans have been approved and implemented for recovery areas that include survival of the species as an objective; and population monitoring indicates that the species is stable (USFWS 2010).

Protection of five or more areas, each about 2,427 ha (5,997 ac.) or more of contiguous, occupied habitat: A) Valley floor in Merced or Madera counties; B) Valley floor in Tulare or Kern counties; C) Foothills of the Ciervo-Panoche Natural Area; D) Foothills of western Kern County; and E) Foothills of the Carrizo Plain Natural Area (USFWS 2010).

A management plan approved and implemented for all protected areas identified as important to the continued survival of blunt-nosed leopard lizard that includes survival of the species as an objective (USFWS 2010).

Each protected area has a mean density of two or more blunt-nosed leopard lizards per ha (one per ac.) through one precipitation cycle (USFWS 2010).

Delisting Criteria:
Delisting will be considered when, in addition to the criteria for reclassification/downlisting, all of the following conditions have been met:

Three additional areas with about 2,427 ha (5,997 ac.) or more of contiguous, occupied habitat, including: A) One on the valley floor; B) One along the western Valley edge in Kings or Fresno counties; and C) One in the Upper Cuyama Valley of eastern San Luis Obispo and eastern Santa Barbara counties (USFWS 2010).

A management plan has been approved and implemented for all protected areas identified as important to the continued survival of blunt-nosed leopard lizard that includes survival of the species as an objective (USFWS 2010).

Each protected area has a mean density of two or more blunt-nosed leopard lizards per ha (one per ac.) through one precipitation cycle (USFWS 2010).

Recovery Actions:

- Based on the 2010 5-Year Review, the five most important actions that should be taken within the next five years to facilitate the recovery of the blunt-nosed leopard lizard include:
- Facilitate research on the effects of solar projects on blunt-nosed leopard lizard behavior and compatibility (USFWS 2010).
- Establish corridors between existing natural areas in Kern and Tulare counties (i.e., Buena Vista Valley, Elk Hills, Lokern Natural Area, Buttonwillow Ecological Reserve [ER], Semitropic Ridge Preserve, Kern National Wildlife Refuge [NWR], Allensworth ER, and Pixley NWR) to enhance the metapopulation recovery strategy (USFWS 2010).
- Establish a preserve or conservation easement on the natural lands of Madera Ranch in western Madera County. Protect blunt-nosed leopard lizard habitat in the Panoche Valley and in dispersal corridors in western Fresno County—Panoche Creek and Silver Creek, Anticline Ridge, the western rim of Pleasant Valley, Guijarral Hills, and the north end of the Kettleman Hills (USFWS 2010).
- Include the flexibility to alter the dates and stocking rates of livestock in all Resource Management Plans (RMPs) where blunt-nosed leopard lizards have potential to occur—including the Carrizo Plain National Monument RMP, Bakersfield RMP, Caliente RMP, and Hollister RMP—to adaptively manage annual plant production and prevent the dominance of exotic grasses in blunt-nosed leopard lizard habitat. Grazing prescriptions should be tailored to suit the ecological needs specific to the area (USFWS 2010).
- Coordinate with hunting clubs for blunt-nosed leopard lizard protection. Active waterfowl blinds should be covered when not in use, and abandoned blinds should be removed or filled in to prevent entrapment of blunt-nosed leopard lizard and other wildlife (USFWS 2010).
- Other important actions that are important to facilitate blunt-nosed leopard lizard recovery include the following items:
- Kern County--completion of Habitat Conservation Plans (HCPs) and issuance of incidental take permits: a. Complete the Kern County Valley Floor HCP; b. Complete the Chevron Lokern HCP; c. Complete the Oxy of Elk Hills HCP; and d. Encourage Crimson Resource Management to start an HCP or Section 7 formal consultation to protect lands in Buena Vista Valley, NPR-2, and Buena Vista Hills (USFWS 2010).
- Habitat management: a. Assist the Lokern Coordination Team in development of the 44,000-ac. Lokern Natural Area in western Kern County (USFWS 2010).
- Future research and monitoring: a. Continue long-term monitoring of population trends on the valley floor (e.g., Pixley NWR, Lokern Natural Area, Semitropic Ridge Preserve, and Buttonwillow ER) and in the foothills (e.g., Carrizo Plain Natural Area and Elk Hills); b. Census and monitor blunt-nosed leopard lizard populations in western Madera County, central Merced County, and the Ciervo-Panoche Natural Area; c. Study the effects of grazing on blunt-nosed leopard lizard along precipitation gradients in the Elkhorn and Carrizo Plains to determine appropriate grazing prescriptions specific for each area; d. Facilitate research on

the effects of the Central Valley Project Conservation Program and Central Valley Project Improvement Act programs on blunt-nosed leopard lizard recovery, and study the effects of translocation (e.g., Allensworth ER) and agricultural land retirement (e.g., Tranquility and Atwell Island sites) on blunt-nosed leopard lizard; and e. Assess potential effects of malathion on the prey base of the blunt-nosed leopard lizard, and apply findings to the CDFA Curly Top Virus Control Program (USFWS 2010).

- The 1998 Recovery Plan for the species identifies the following specific needed recovery actions:
- 1. Determine appropriate habitat management and compatible land uses for blunt-nosed leopard lizards (USFWS 1998).
- 2. Conduct range-wide surveys of known and potential habitat for presence and abundance of blunt-nosed leopard lizards (USFWS 1998).
- 3. Protect additional habitat for blunt-nosed leopard lizards in key portions of their range; areas of highest priority to target for protection are: a. Natural lands in western Madera County; b. Natural lands in the Panoche Valley area of Silver Creek Ranch, San Benito County; c. Agricultural and natural land between the northern end of the Kettleman Hills and the Guijarral Hills and the Guijarral Hills and Anticline Ridge (the western rim of Pleasant Valley, Fresno County) to restore and protect a corridor of continuous habitat for blunt-nosed leopard lizards and other species without the ability to move through irrigated farmland; d. Natural lands west of Highway 33 and east of the coastal ranges between the Pleasant Valley, Fresno County, on the north and McKittrick Valley, Kern County, on the south; e. Natural lands of the linear, piedmont remnants of their habitat west of Interstate Highway 5 between Pleasant Valley and Panoche Creek, Fresno County; and f. Natural lands in upper Cuyama Valley (USFWS 1998).
- 4. Gather additional data on population responses to environmental variation at representative sites in the blunt-nosed leopard lizard's extant geographic range (USFWS 1998).
- 5. Design and implement a range-wide population monitoring program (USFWS 1998).
- 6. Protect additional habitat for blunt-nosed leopard lizards in the following areas (all are of equal priority): a. Natural and retired agricultural lands around Pixley NWR, Tulare County, with an objective of expanding and connecting the NWR units with each other and with the Allensworth ER; b. Natural land in and around the Elk Hills Naval Petroleum Reserves in California and Lokern Natural Area, with the objective of expanding and connecting existing lands with conservation programs; and c. Natural and retired agricultural lands in the Semitropic Ridge Natural Area, Kern County, with the objective of expanding and connecting existing reserves and refuges (USFWS 1998).
- Other more general recovery actions, identified in the Upland Species of the San Joaquin Valley Recovery Plan, include:
- Develop and implement a regional cooperative program and participation plan (USFWS 1998).
- Protect and secure existing populations (USFWS 1998).
- Determine distributions and population status (USFWS 1998).
- Conduct important research and monitoring (USFWS 1998).
- Maintain and establish linkages in existing natural lands and between islands of habitat on the valley floor and natural lands around the fringe of the valley (USFWS 1998).
- Apply adaptive management in protected areas (USFWS 1998).

Conservation Measures and Best Management Practices:

- CDFW has developed approved survey methodology to provided a minimum level of protection when projects or maintenance activities are scheduled to occur within potential blunt-nosed leopard lizard habitat. The standardized protocol survey methods require a minimum of 12 days of surveys to assess presence/absence of the species during specific ambient air and ground temperature conditions (CDFW 2004, USFWS 2010).

Additional Threshold Information:

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SPECIES ACCOUNT: *Gopherus agassizii* (Mojave desert tortoise)

Species Taxonomic and Listing Information

Listing Status: Threatened; 8-20-1980 (California/Nevada Region (R8)

Physical Description

The Mojave desert tortoise is a large, herbivorous reptile that occurs north and west of the Colorado River in the Mojave Desert of California, Nevada, Arizona, and southwestern Utah, and in the Sonoran (Colorado) Desert in California. Desert tortoises reach 8 to 15 inches in carapace (upper shell) length and 4 to 6 inches in shell height. Hatchlings emerge from eggs at about 2 inches in length. Adults have a domed carapace and relatively flat, unhinged plastrons (lower shell). Their shells are greenish-tan to dark brown in color with tan scute (horny plate on the shell) centers. Adult desert tortoises weigh 8 to 15 pounds. The forelimbs have heavy, claw-like scales and are flattened for digging; hind limbs are more elephantine.

Taxonomy

The generic assignment of the Mojave desert tortoise has gone through a series of changes since its original description by Cooper (1863) as Xerobates agassizii. It has also been referred to in the literature as Scaptochelys agassizii. The currently accepted scientific name of Gopherus agassizii (Campbell 1988; Crumly 1994) was in use at the time of listing. The Mojave desert tortoise differs from the Sonoran desert tortoise (Gopherus morafkai) in the Sonoran having a relatively narrower shell, shorter gular scutes, shorter projections of the anal scutes and in having a flatter, pear-shaped carapace (Murphy et al. 2011). Note that reliable identification of captive tortoises can be impossible due to hybridization or abnormalities resulting from poor nutrition.

Historical Range

The overall range has not changed very much from historical times, but populations in many areas have substantially declined, though the degree of decline is not well known (USFWS 2010).

Current Range

all tortoises south and east of the Colorado River.

Distinct Population Segments Defined

No.

Critical Habitat Designated

Yes; 8/8/1994.

Legal Description

On February 8, 1994, the U.S. Fish and Wildlife Service (Service) designated critical habitat for the Mojave population of the desert tortoise (Gopherus agassizii), a species federally listed as threatened under the Endangered Species Act of 1973, as amended (Act).

Critical Habitat Designation

Critical habitat for the Mojave desert tortoise is designated in 12 areas, encompassing a total of 8.4 million acres. The Service has designated eight units totaling 4.8 million acres in California, four units totaling 1.2 million acres in Nevada, two units totaling 129,100 acres in Utah, and two units totaling 338,700 acres in Arizona. The final designation encompasses approximately 4,790,500 acres of BLM land, 242,200 acres of military land, 147,200 acres of National Park Service land. 166.200 acres ofState land. 1,600 acres of Tribal land, and 1,098,400 acres of private land.

1. Fremont-Kromer Unit. Kern, Los Angeles, and San Bernardino Counties. From BLM Maps: Victorville 1978 and Cuddeback Lake 1978.

2. Superior-Cronese Unit. San Bernardino County. From BLM Maps: Cuddeback Lake 1978, Soda Mts. 1978, Victorville 1978, and Newberry Springs 1978.

3. Ord-Rodmon Unit. San Bernardino County. From BLM Maps: Newberry Springs 1978 and Victorvllle 1978.

4. Chuckwalla Unit. Imperial and Riverside Counties. From BLM Maps: Chuckwalla #18 1978, Parker-Blythe #16 1978, Salton Sea #20 1978, and Midway Well #21 1979.

5. Pinto Mountain Unit. Riverside and San Bernardino Counties. From BLM Maps: Yucca Valley 1982, Sheep Hole Mountains 1978, Chuckwalla 1978, and Palm Springs #17 1978.

6. Chemehuevi Unit. San Bernardino County. From BLM Maps: Sheep Hole Mts. 1978, Parker 1979, Needles 1978, and Amboy 1991.

7. Ivanpah Unit. San Bernardino County. From BLM Maps: Amboy 1991, lvanpah 1979, and Mesquite Lake 1990.

8. Piute-Eldorado Unit. San Bernardino County. From BLM Maps: Amboy 1991, Needles 1978, and Ivanpah 1979.

9. Piute-Eldorado Unit. Clark County. From BLM Maps: Mesquite Lake 11990, Boulder City 1978. Ivanpah 1979, and Davis Dam 1979.

10. Mormon Mesa Unit. Clark and Lincoln Counties. From BLM Maps: Pahranagat 1978, Clover Mts. 1978, Overton 1978, Indian Springs 1979, Lake Mead 1979, and Las Vegas 1988.

11. Gold Butte-Pakoon Unit. Clark County. From BLM Maps: Overton 1978 and Lake Mead 1979.

12. Beaver Dam Slope Unit. Lincoln County. From BLM Maps: Clover Mountains 1978 and Overton 1978.

13. Beaver Dam Slope Unit. Washington County. From BLM Maps: St. George 1980 andClover Mts. 1978.

14. Upper Virgin River Unit. Washington County. From BLM Map: St. George 1980.

15. BeaverDam Slope Unit. Mohave County. From BLM Maps: Overton 1978 and Littlefield 1987.

16. Gold Butte-Pakoon Unit. Mohave County. From BLM Maps: Overton 1978, Littlefield 1987, Mount Trumbull 1986, and Lake Mead 1979.

Primary Constituent Elements/Physical or Biological Features

Primary constituent elements are desert lands that are used or potentially used by the desert tortoise for nesting, sheltering, foraging. dispersal, or gene flow.

Special Management Considerations or Protections

Current and historic desert tortoise habitat loss, deterioration, and fragmentation is largely attributable to urban development, military operations, and multiple-uses of public land, such as off-highway vehicle (OHV) activities and livestock grazing.

Human “predation” (taking desert - tortoises outof their natural populations either by death (accidental or intentional) or by removal) is also a major factor in the decline of the desert tortoise.

Desert tortoises are often struck and killed by vehicles on roads and highways, and mortalityof desert tortoises due to gunshot and OHV activities is common in many parts of the Mojave Region, particularly near cities and towns.

Possible direct impacts from grazing include trampling of both tortoises and shelter sites; possible indirect impacts include loss of plant cover, reduction in number of suitable shelter sites, change in-vegetation. compaction ofsoils, reduced water infiltration, erosion, inhibition-of nitrogen fixation in desert plants, and the provision of a favorable seed-bed far exotic annual vegetation (U.S. Fish and Wildlife Service 1991, 1993).

Common raven (Corvus corax) populations inthe southwestern deserts have increased significantly since the 1940s, presumably in-response to expanding human use of the desert. While not all ravens’may include tortoises as significant components of their diets, these birds are highly opportunistic in their feeding patterns and concentrate on easily available seasonal food sources, such as juvenile tortoises.

Life History

Feeding Narrative

Juvenile: Precipitation is vitally important to the desert tortoise. Summer and winter rain storms provide an immediate source for consumption, as well as stimulating and sustaining the plant forage essential to the survival of the species (Henen et al.1998 p. 370, Duda et al. 1999 p. 1185). Desert tortoise activity increases after rainstorms as they emerge to drink standing water restablishing osmotic homeostasis (Nagy and Medica 1986 p. 79, Henen et al.1998 p. 371, Duda et al. 1999 p. 1182, USFWS 2011 p. 10). Desert tortoises can drink up to 20% of their body mass in water after a rain storm (Nagy and Medica 1986 p. 86). Yearly percipitation rates also influence reproduction. Egg production by female desert tortoises increases during years with wet conditions (Turner et al. 1986 p. 102, Henen et al. 1998 p. 371). While desert tortoises are typically found in areas that receive 5-20 cm or precipitation per year, the species can survive for more than a year without access to free water and can tolerate large imbalances in their water and energy budget (Nagy and Medica 1986 pp. 83-84, Henen et al.1998 p. 371, Duda et al. 1999 p. 1189, USFWS 2011 p. 10).

Adult: Tortoises forage primarily on native winter and summer annuals (dicots and grasses), perennial grasses, cacti, and other vegetation, including a few perennial shrubs. Insects also may be eaten, and caterpillars and other insect larvae may occasionally provide rich lipid and protein supplements to an otherwise vegetarian diet; these may be especially valuable to juvenile growth (Avery, pers. comm.). Annual grasses important in the diet are largely exotic species, part of the Mediterranean "weedland" that dominates spring growth in much of the western Mohave Desert (Berry 1984). Perennial grasses, largely native, contribute more to shelter, soil retention, and a longer growing season. One of the few shrubs regularly ingested is the herbaceous Sphaeralcea ambigua (Berry 1978). Succulent buds, flowers, and fruit are also ingested.

Reproduction Narrative

Adult: Tortoises are long-lived and grow slowly, requiring 13 to 20 years to reach sexual maturity, and have low reproductive rates during a long period of reproductive potential (Turner et al. 1984; Bury 1987; Germano 1994). Growth rates are greater in wet years with higher annual plant production (e.g., desert tortoises grew an average of 12.3 millimeters [0.5 inch] in an El Niño year compared to 1.8 millimeters [0.07 inches] in a drought year in Rock Valley, Nevada; Medica et al. 1975). The number of eggs as well as the number of clutches that a female desert tortoise can produce in a season is dependent on a variety of factors including environment, habitat, availability of forage and drinking water, and physiological condition (Turner et al. 1986, 1987; Henen 1997; McLuckie and Fridell 2002). Mojave desert tortoises lay up to 3 clutches (set of eggs laid at a single time) of eggs per year (Turner et al. 1984, 1986; Henen 1994; Karl 1998; Mueller et al. 1998; Wallis et al. 1999; McLuckie and Fridell 2002). The success rate of clutches has proven difficult to measure, but predation, while highly variable (Bjurlin and Bissonette 2004), appears to play an important role in clutch failure (Germano 1994).

Geographic or Habitat Restraints or Barriers

Adult: The results of human urbanization, such as residential fencing, roads, and railroad tracks, create barriers to movement and population connectivity, leading to inbreeding and mortality; untraversable topography (e.g., cliff); major river, lake, pond, or deep marsh.

Tolerance Ranges/Thresholds

Adult: Desert tortoises retreat into burrows when air temperature reach 91.0° F ± 3.55° F and ground temperatures reach 94.6° F ± 6.05° F; 95 percent of desert tortoise observations of desert tortoises above ground occurred at air temperature less than 91° F (Walde et al. 2003). The body temperature at which desert tortoises become incapacitated ranges from 101.5° F to 113.2° F (Naegle 1976, Zimmerman et al. 1994).

Habitat Narrative

Juvenile: Desert tortoises typically occur in valleys, flats, washes, bajadas, and alluvial fans with sand to sandy-gravel soils at lower elevations and rocky terrain and slopes at higher elevations (USFWS 1994 p. 15, USFWS 2009 p. 3). Home ranges of the desert tortoise can exceed 80 hectares (Berry 1986 p. 118, Duda et al. 1999 p. 1181, USFWS 2011 p. 10). Core areas within the larger home range is comprised of a network of burrows in which the desert tortoise spends most of its life (Nagy and Medica 1986 p. 78, Duda et al. 1999 p. 1187, Harless et al. 2009 p. 378, USFWS 2011 p. 10). Burrows are used by the species for predator avoidance, thermoregulation, and reproduction (Duda et al. 1999 p. 1181, Harless et al. 2009 p. 378). Burrows may be excavations into the soil, shallow scrapes under vegetation, or naturally occuring caliche caves, rock crevices or overhangs (USFWS 2009 p. 3, USFWS 2011 p. 11). The species requires soils that are friable enough to burrow into but firm enough not to collapse (USFWS 2011 p. vii). Desert tortoises avoid thermal extremes by taking shelter in burrows during the hottest part of the day and by hibernating in burrows during low winter temperatures (Duda et al. 1999 p. 1182). Desert tortoises retreat into burrows when air temperature reach 91.0° F ± 3.55° F and ground temperatures reach 94.6° F ± 6.05° F; 95 percent of desert tortoise observations of desert tortoises above ground occurred at air temperature less than 91° F (Walde et al 2003). The body temperature at which desert tortoises become incapacitated ranges from 101.5° F to 113.2° F (Naegle 1976, Zimmerman et al. 1994). While inactive in burrows, desert tortoises loose extremely little water or energy while avoiding extreme temperatures (Duda et al. 1999 p. 1189). Burrows are also used for the deposition of eggs and for courtship behavior during nesting (Turner et al.1986 p. 95, Berry 1986 pp. 116-117).

Adult: Optimal habitat for the Mojave desert tortoise has been characterized as creosote bush scrub in which precipitation ranges from 2 to 8 inches, where a diversity of perennial plants is relatively high, and production of ephemerals is high (Luckenbach 1982, Turner 1982, Turner and Brown 1982). Soils must be friable enough for digging burrows, but firm enough so that burrows do not collapse. Desert tortoises occur from below sea level to an elevation of 7,300 feet, but the most favorable habitat occurs at elevations of approximately 1,000 to 3,000 feet (Luckenbach 1982). They are most commonly found within the desert scrub vegetation type, primarily in creosote bush scrub. In addition, they occur in succulent scrub, cheesebush scrub, blackbrush scrub, hopsage scrub, shadscale scrub, microphyll woodland, Mojave saltbush-allscale scrub and scrub-steppe vegetation types of the desert and semidesert grassland complex (Service 1994). Within these vegetation types, Mojave desert tortoises potentially can survive and reproduce where their basic habitat requirements are met. These requirements include a sufficient amount and quality of forage species; shelter sites for protection from predators and environmental extremes; suitable substrates for burrowing (see below), nesting, and overwintering; various plants for shelter; and adequate area for movement, dispersal, and gene flow. The results of human urbanization, such as residential fencing, roads, and railroad tracks, create barriers to movement and population connectivity, leading to inbreeding and mortality.Throughout most of the Mojave Region, tortoises occur most commonly on gently sloping terrain with soils ranging from sandy-gravel and with scattered shrubs, and where there is abundant inter-shrub space for growth of herbaceous plants. Throughout their range, however, tortoises can be found in steeper, rockier areas (Gardner and Brodie 2000).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Local migrant moving relatively short distances from winter burrows to summer feeding grounds.

Dispersal

Adult: Establish home range

Dependency on Other Individuals or Species for Dispersal

Adult: Burrows created by other species

Dispersal/Migration Narrative

Adult: The size of desert tortoise home ranges varies with respect to location and year (Berry 1986a) and also serves as an indicator of resource availability and opportunity for reproduction and social interactions (O'Connor et al. 1994). Females have long-term home ranges that may be as little or less than half that of the average male, which can range to 80 or more hectares (200 acres) (Burge 1977; Berry 1986a; Duda et al. 1999; Harless et al. 2009). Core areas used within tortoises' larger home ranges depend on the number of burrows used within those areas (Harless et al. 2009). Over its lifetime, each desert tortoise may use more than 3.9 square kilometers (1.5 square miles) of habitat and may make periodic forays of more than 11 kilometers (7 miles) at a time (Berry 1986a). During periods of drought, desert tortoises decrease surface activity and remain mostly inactive or dormant underground (Duda et al. 1999), which reduces water loss and minimizes energy expenditures (Nagy and Medica 1986). Duda et al. (1999) showed that home range size, number of different burrows used, average distances traveled per day, and levels of surface activity were significantly reduced during drought years.

Population Information and Trends

Population Trends:

Declining

Species Trends:

Declining

Resiliency:

Moderate

Representation:

Moderate

Redundancy:

Low

Population Growth Rate:

Declining

Number of Populations:

Unknown

Population Size:

Unknown

Resistance to Disease:

Moderate

Adaptability:

Low

Population Narrative:

Populations of Majove desert tortoise are typically uneven in density and often discontinuously distributed. This is particularly true of the upland "island" populations (Dodd 1982). Even in relatively undisturbed expanses of good lowland Mojave Desert habitat high density clusters are separated by low densities or even total absence. The minimal population unit, or deme, could be as small as 10-20 adults. Intervening habitat supporting less than 10 adult tortoises/sq mi could effectively isolate, at least behaviorally, such patches. Such patches, estimated by the collective home ranges, and allowing for partial overlap, might cover 500-1,000 hectares. Larger demographic units could be defined in terms of clusters of these demes isolated by topographic barriers, namely uplands higher than 4,000 to 5,200 feet (Yucca Mt., Nevada) in the Mojave Desert and paradoxically, valleys below 2,000 feet elevation in the Sonoran Desert. [This paragraph by D. Morafka.] Adult Mojave desert tortoise populations surveyed from 2001 to 2013 in the Northeastern Mojave Recovery Unit increased by almost 20% per year since 2004, with the rate of increase apparently resulting from increased survival of adults and sub-adult tortoises moving into the adult size class. Populations surveyed in the other four recovery units are declining: Upper Virgin River (-5.1%), Western Mojave (-9.8%), and Colorado Desert (-2.4%, however, two of the Tortoise Conservation Areas appear to be increasing). Overall, we are seeing fewer juvenile tortoises in all recovery units except a slight increase in Eastern Mojave. Of particular concern is a large decline in the proportion of juveniles found in the Western Mojave, where there has been a serious drop in the number of adults. This trend indicates that juveniles show an even more stark decrease than the adults, and that we do not see recovery of the number of adults in the near future, given this decline in number of juveniles. (L. Allison, pers. comm. 2014).

Threats and Stressors

Stressor: Habitat loss, fragmentation, and degradation
Exposure:
Response:
Consequence:
Narrative: Since the 1800s, portions of the desert southwest occupied by desert tortoises have been subject to a variety of impacts that cause habitat loss, fragmentation, and degradation, thereby threatening the long-term survival of the species (USFWS 1994a). Some of the most apparent threats are those that result in mortality and permanent habitat loss across large areas, such as urbanization, and those that fragment and degrade habitats, such as proliferation of roads and highways, off-highway vehicle activity, poor grazing management, and habitat invasion by nonnative invasive species (Berry et al. 1996; Avery 1997; Jennings 1997; Boarman 2002; Boarman and Sazaki 2006). Indirect impacts to desert tortoise populations and habitat are also known to occur in areas that interface with intense human activity (Berry and Burge 1984; Berry and Nicholson 1984b).

Stressor: Non-native invasive species
Exposure:
Response:
Consequence:
Narrative: A threat that has come to the forefront is the invasion of desert habitats by non-native plant species and the resultant increased frequency of wildfire (USFWS 1994a; Brooks

1998). Changes in plant communities caused by non-native plants and recurrent fire can negatively affect the desert tortoise by altering habitat structure and species available as food plants (Brooks and Esque 2002). Off-highway vehicle activity, roads, livestock grazing, agricultural uses, and other activities contribute to the spread of non-native species (or the displacement of native species) and the direct loss and degradation of habitats (Brooks 1995; Avery 1998). For example, unmanaged livestock grazing, especially where plants are not adapted to large herbivorous mammals or where the non-native species are less palatable than the natives, can preferentially remove native vegetation, leaving non-native plants to grow under reduced competition (Wittenberg and Cock 2005:228).

Stressor: Energy development
Exposure:
Response:
Consequence:
Narrative: Dozens of project sites have been proposed for the development of solar and wind energy development on public lands within the range of the desert tortoise in California and Nevada. The Bureau of Land Management has committed to excluding these projects from designated critical habitat for the desert tortoise and Desert Wildlife Management Areas. However, potential long-term effects of large-scale energy development fragmenting or isolating desert tortoise conservation areas and cutting off gene flow between these areas have not been evaluated.

Stressor: Negative effects of human settlements (e.g., landfills, toxic chemicals, increased predators, etc.)
Exposure:
Response:
Consequence:
Narrative: Landfills and other waste disposal facilities potentially affect desert tortoises and their habitat through fragmentation and permanent loss of habitat, spread of garbage, introduction of toxic chemicals, increased road kill of tortoises on access roads, and increased predator populations (Boarman et al. 1995; Kristan and Boarman 2003). Military operations (e.g., construction and operation of bases, field maneuvers) have taken place in the Mojave Desert since 1859 and can affect tortoises and their habitats similarly to other large human settlements (i.e., illegal collection of tortoises, trash dumping, increased raven (Corvus corax) populations, domestic predators, off-highway vehicle use, increased exposure to disease, and increased mortality) (USFWS 1994a; Krzysik 1998; Boarman 2002).

Stressor: Disease
Exposure:
Response:
Consequence:
Narrative: To date the available evidence indicates that upper respiratory tract disease, as caused by the bacteria Mycoplasma agassizii and M. testudineum (Jacobson et al. 1991), is probably the most important infectious disease affecting desert tortoises. Less is known about other diseases that have been identified in the desert tortoise (e.g., herpesvirus, cutaneous dyskeratosis, shell necrosis, bacterial and fungal infections, and urolithiasis or bladder stones) (Jacobson et al. 1994; To date the available evidence indicates that upper respiratory tract disease, as caused by the bacteria Mycoplasma agassizii and M. testudineum (Jacobson et al.

1991), is probably the most important infectious disease affecting desert tortoises. Less is known about other diseases that have been identified in the desert tortoise (e.g., herpesvirus, cutaneous dyskeratosis, shell necrosis, bacterial and fungal infections, and urolithiasis or bladder stones) (Jacobson et al. 1994; Homer et al. 1998; Berry et al. 2002b; Origgi et al. 2002). There is evidence that any one disease may predispose an animal to other diseases (Christopher et al. 2003). However, it is not known whether this is a cause or effect. Additional research is needed to clarify the role of disease in desert tortoise population dynamics relative to other threats.

Stressor: Global climate change and drought
Exposure: See narrative.
Response: See narrative.
Consequence: See narrative.
Narrative: Global climate change and drought are potentially important long-term considerations with respect to recovery of the desert tortoise. There is now sufficient evidence that recent climatic changes have affected a broad range of organisms with diverse geographical distributions (Walther et al. 2002). While little is known regarding specific direct effects of climate change on the desert tortoise or its habitat, predictions can be made about how global and regional precipitation regimes may be altered and about the consequences of these changes (Weltzin et al. 2003; Seager et al. 2007).

Recovery

Reclassification Criteria:
Not applicable.

Delisting Criteria:
Rates of population change (?) for desert tortoises are increasing (i.e., ? > 1) over at least 25 years (a single tortoise generation), as measured: (a) by extensive, range-wide monitoring across tortoise conservation areas within each recovery unit, and (b) by direct monitoring and estimation of vital rates (recruitment, survival) from demographic study areas within each recovery unit.

Distribution of desert tortoises throughout each tortoise conservation area is increasing over at least 25 years (i.e., ? [occupancy] > 0).

The quantity of desert tortoise habitat within each desert tortoise conservation area is maintained with no net loss until tortoise population viability is ensured. When parameters relating habitat quality to tortoise populations are defined and a mechanism to track these parameters established, the condition of degraded desert tortoise habitat should also be demonstrably improving.

Recovery Actions:
- Develop, support, and build partnerships to facilitate recovery through prioritization, coordination, and implementation of recovery plan.
- Protect existing populations and habitat.
- Augment depleted populations through a strategic program.
- Monitor progress toward recovery.

- Conduct applied research and modeling in support of recovery efforts within a strategic framework.
- Implement an adaptive management program.

Conservation Measures and Best Management Practices:

- Develop, support, and build partnerships to facilitate recovery through prioritization, coordination, and implementation of recovery plan.
- Protect existing populations and habitat.
- Augment depleted populations through a strategic program.
- Monitor progress toward recovery.
- Conduct applied research and modeling in support of recovery efforts within a strategic framework.
- Implement an adaptive management program.

References

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SPECIES ACCOUNT: *Gopherus polyphemus* (Gopher tortoise)

Species Taxonomic and Listing Information

Listing Status: Threatened; Southeast Region (R4); Candidate; Southeast Region (R4) (USFWS, 2015)

Physical Description

Gopher tortoise, Testudinidae.The gopher tortoise is a relatively large (carapace length often 15-28 cm, but up to 38 cm) terrestrial turtle with a domed carapace, short elephantine hindlimbs, shovellike forelimbs, a gular projection from the anterior plastron, and a short tail. The anterior surface of the flattened forelimb is covered with 7-8 rows of large scales. Often the surface of the carapace is quite smooth in adults, reflecting the abrasion it receives as an individual enters or exits its burrow. The carapace is keelless and oblong, with the greatest width just anterior to the well-developed bridge (connecting the carapace to the plastron), and the greatest height in the sacral region. The carapace drops off abruptly to the rear of the highest region (Ernst and Barbour 1972). The carapace of an adult varies from dark- brown to grayish-black. In Florida, individuals from coastal areas are generally darker than those from central populations. The gular scutes of the robust, hingeless plastron project below the chin. Males often have longer gular projections than do females. However, because both sexes use their projections during agonistic encounters, the gular projections are often broken and may not be an accurate diagnostic feature of the sex of an individual (Mushinsky et al. 1994). Most gopher tortoises have well defined "growth rings" on the scutes of the yellowish plastron. Use of the growth rings to age individuals must be done with caution, as there is much variation in the number of "false" growth rings throughout the range of this taxon. Female gopher tortoises become sexually mature at a carapace length of about 23-24 cm. Males are somewhat smaller at maturity and do not obtain the large body size of females. The best indicator of the sex of an adult gopher tortoise is the depth of the plastral concavity (Mushinsky et al. 1994). Mature males have a shallow depression in the posterior, central portion of the plastron to facilitate mounting a female for copulation. Large females may have a shallow plastral concavity (2-4 mm) compared to the deeper concavity found on mature males (5-8 mm). Males often have larger integumentary glands under the chin than do females (Ernst and Barbour 1989), but the size of these integumentary glands varies seasonally. Based upon numerous anatomical measurements, McRae et al. (1981a) developed a discriminant function that accurately identified the sex of adult individuals. Using a stepwise multiple regression on numerous morphological measurements, Burke et al. (1994) developed a non-invasive sex identification technique for determining the sex of hatchling and juvenile gopher tortoises. Hatchlings emerge from their eggs at a carapace length of generally about 3-5 cm. Coloration of the vertebral and costal scutes of the carapace of hatchlings is yellowish to yellowish-orange, and each scute is bordered by brownish coloration (Allen and Neill 1953). The skin on the head and limbs is likewise brightly colored yellow to yellowish-orange. The bright coloration of hatchlings darkens during the first year or two of life. The gular scutes of young tortoises do not project forward as in the adult tortoises, and the claws of young tortoises are long and sharp (Allen and Neill 1953). Hatchlings dig their own burrows, often just a few meters away from the nest from which they emerged. Hatchlings and juveniles, up to an age of 5-7 years, have relatively soft shells and are highly vulnerable to predation (Wilson 1991). Eggs are white, nearly spherical, and brittle-shelled. For photographs of eggs see Allen and Neil (1951) and Pope (1939). Iverson (1980) reported an average maximum egg diameter of 42-43 mm and an average wet mass of 40.9 g (also see Arata 1958, Landers et al. 1980). LENGTH:28 (NatureServe, 2015)

Taxonomy

Auffenberg (1976), Bramble (1982), Crumly (1987, 1994), and Lamb and Lydeard (1994) provided information on phylogenetic relationships among tortoises of the genus Gopherus, which comprises four living species and nine fossil taxa. A recent study of phylogeny based on mtDNA variation identified the four living North American tortoises as a monophyletic group consisting of two well-defined clades, the agassizii clade and the polyphemus clade (Lamb and Lydeard 1994). MtDNA and osteological data indicate that G. polyphemus is more closely related to G. flavomarginatus of Mexico than it is to the other two species of Gopherus. Gopherus polyphemus is only slightly distinct from G. flavomarginatus based on allozymes (Morafka et al. 1994). Using mtDNA, Osentoski (1993) assessed rangewide genetic variation and found three major assemblages: (1) a western assemblage consisting of seven haplotypes (Louisiana eastward to Taylor County, Florida, and along the Chattahoochee River drainage north to Talbot County, Georgia); (2) an eastern assemblage containing the two most common haplotypes (South Carolina through peninsular Florida) and (3) a mid-Florida assemblage consisting of seven haplotypes (along the Gulf coast from southern Levy County north to Pinellas County, then east to north of the Hillsborough River, and northeast into Orange/Oseola counties). (NatureServe, 2015)

Historical Range

Southeastern United States from southern South Carolina (Clark et al. 2001) through southern Georgia to southern Florida (excluding most of inland southern Florida), west through southern Alabama and southeastern Mississippi to eastern Louisiana (Diemer 1989). Occurs on islands off the Gulf coast of Florida as far south as Cape Sable (Logan 1981, Kushlan and Mazzotti 1984, Mushinsky and McCoy 1994). Most common in southern Georgia and northern and central Florida (Diemer 1989). (NatureServe, 2015)

Current Range

At the northern end of the range in South Carolina, four disjunct populations remain in Jasper County and a few tortoises occur in southern Hampton County (Wright 1982); recently found in Aiken County (Clark et al. 2001). In Georgia, large populations occur in the western Fall Line Sand Hills and the central Tifton Uplands (Landers and Garner 1981); severely fragmented populations occur in the Coastal Plain. The largest remaining population in Mississippi is in Desoto National Forest (Lohoefener and Lohmeier 1984). A few populations remain at the western edge of the range in eastern Louisiana. For a detailed range map, see Iverson (1992). (NatureServe, 2015)

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The gopher tortoise is the primary grazer in its xeric habitats (Landers 1980) and aids in seed dispersal for native grasses (Auffenberg 1966) (USFWS, 1990). Females normally reach sexual maturity at 19-21 years of age and males reach sexual maturity at a younger age than females (USFWS, 1990).

Reproduction Narrative

Adult: Longevity is estimated at 40-60 years (Landers 1980) and may extend to 80—100 years (Landers et al. 1982). Growth annuli on scutes become worn at 20—40 years, making age determination imprecise. Age at sexual maturity in the Georgia study (Landers et al. 1982) ranged from 19-21 years for females. These animals had a plastral length of 25—26.5 cm (9.8—10.4 inches). Males normally reach reproductive maturity at a smaller size and younger age than females. Growth rates vary with environmental and genetic factors among gopher tortoise populations. Breeding periods may begin as early as February and extend into September, depending on location. The period of maximum reproductive activity reported by Landers et al. (1980) is May 18 through June 27. Iverson (1980) reported the nesting peak in Florida also to be May and June. Clutch sizes in Mississippi average 4.8 eggs (Lohoefener and Lohmeier 1984); however, this report was based on a rather small sample (N=14). Landers et ~ (1980) reported a range in clutch size of 4-12 eggs with a mean and SD of 7.0 + 1.7. He also found that clutch size increased with the size of the female. The lower value reported by Lohoefener and Lohmeier (1984) may have been due to limited sampling, the result of human depredation (leaving primarily smaller nesting females), or a combination of both. The nest is usually 15—25 cm (6—10 inches) beneath the surface (Landers et al. 1980). Incubation periods range from 80-90 days in northern Florida (Iverson 1980) to 110 days in South Carolina, the northern limit of the gopher tortoise’s range (Wright 1982). Most gopher tortoise eggs never hatch because of predation (USFWS, 1990).

Tolerance Ranges/Thresholds

Adult: Moderate (inferred based on USFWS, 1990)

Site Fidelity

Adult: Moderate (inferred based on USFWS, 1990)

Habitat Narrative

Adult: Gopher tortoises occupy a wide range of upland habitat types; however, general physical and biotic features provided by Landers (1980) with slight modifications, characterize most suitable habitat. These are: 1. the presence of well-drained, sandy soils, which allow easy burrowing (because of lower ambient temperatures, the western population may require a meter or more of sandy soil depths); 2. an abundance of herbaceous ground cover; and 3. a generally open canopy and sparse shrub cover, which allow sunlight to reach the forest floor. Juvenile habitat is generally considered to be similar to that of adults. The traditional habitats of the western population of gopher tortoises are natural xeric communities, mostly of the longleaf-pine-scrub oak type, located on sand ridges. The original ecology of these xeric, fire—dependent communities has been significantly altered. Gopher tortoises may also be found in ruderal habitats such as fence rows, pastures, and field edges and power lines (USFWS, 1990). Moderate ecological integrity of the population, tolerance ranges and site fideilty are inferred based on the species ability to survive in degraded environments and tolerate less than ideal habitats for atelast a moderate amount of time.

Dispersal/Migration

Motility/Mobility

Adult: low (USFWS, 1990)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (USFWS, 1990)

Dispersal/Migration Narrative

Adult: McRae et al. (1981) studied movement related to feeding separately from movements related to other behavior and determined 95 percent of all feeding activity took place within 30 m (33 yards) of the burrow being used. Auffenberg and Iverson (1979) reported increasing foraging radii from the burrow in areas with reduced ground cover. This suggests that food availability can increase or decrease foraging distances. McRae et al. (1981) trailed 13 adults and determined their movements to be in a nearly circular or elliptical pattern around the burrow. Depletion of preferred foods near burrows by late summer is thought to contribute to larger movements later in the year. In the Georgia study, the home ranges of =aleswere much larger than females; males had a home x=ngeof~ 0.06—1.44 ha (0.14—3.56 A) with a mean of 0.47 ha (1.16 A), while females had a home range of 0.04-0.14 ha (0.10—0.35 A) with a. mean of 0.08 ha (0.20 A) (McRae et al. 1981). The sexual differences are attributed to breeding forays by the males. Landers and Speake (1980) found the average colony typically used an area less than 4 ha (9.88 A) (USFWS, 1990).

Population Information and Trends

Resiliency:

Moderate (inferred from USFWS, 1990; NatureServe, 2015)

Representation:

Moderate (inferred from USFWS, 1990; NatureServe, 2015)

Redundancy:

Moderate (inferred from USFWS, 1990)

Population Size:

10,000 to >1,000,000 individuals (NatureServe, 2015)

Population Narrative:

Moderate resiliency, representation and redundancy are inferred based on the total number of known individuals and the relatively wide geography that the species inhabits.

Threats and Stressors

Stressor: Habitat alteration (USFWS, 1990)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: The current threats to the western population of the gopher tortoise in terms of habitat loss or degradation consist of certain forest management practices, conversion of dry sites to agriculture, road placement and other developments on these higher ridges, and urbanization (Lohoefener and Lohmeier 1984) (USFWS, 1990).

Stressor: Predation (USFWS, 1990)

Exposure:
Response:
Consequence: Loss of individuals
Narrative: Gopher tortoise predators, other than -human beings, are many. The most important egg and hatchling predator appears to be the raccoon (Procyon lotor) (Landers and Speake 1980); however, a variety of mammals are reported predators of G. polyphemus, including gray foxes (Urocvon cinereoarcrenteus), striped skunks (Mephitis mephitis) , opossums (Didelphis vir~iniana), armadillos (Dasvnus noveincinctus) (Landers et al. 1980), and dogs (Canis domesticus) (Causey and Cude 1978). Imported fire ants (Solenopsis saevissima and/or ~. victa) are reported as hatchling predators (Landers et al. 1980, Lohoefener and Lohmeier 1984). Snakes and raptors have also been reported as preying on G. polyphemus. Reported clutch and hatchling losses often approach 90 percent (Landers et al. 1980) (USFWS, 1990).

Stressor: Other mortality (USFWS, 1990)
Exposure:
Response:
Consequence: Loss of indiivduals
Narrative: Road mortality is reported by Landers and Buckner (1981) and Lohoefener and Lohmeier (1984) as a significant mortality factor. Lohoefener and Lohmeier (1984) believe nests and juveniles are often destroyed by intensive site preparation (heavy equipment). Tanner and Terry (1981) report a major reduction in burrow density in Florida which was believed attributable to roller chopping or web plowing. Diemer and Moler (1982) demonstrated that tortoises are able to dig out following chopping treatment on deep sandy soils, but concluded that additional data were needed regarding tortoise response to various site preparation techniques in different soil types. Lohoefener and Lohmeier (1981) believed that a serious problem for the Mississippi goph9rtortoise was isolation of sexually mature animals becaus&of habitat fragmentation aggravated by forest management practices. Only 14 percent of the tortoises encountered in density survey transects by Lohoefener and Lohmeier (1981) in Mississippi were considered so situated that interactions with other sizeable (sexually mature) tortoises might occur. As further support for this hypothesis, the discontinuous nature and small size of Mississippi sand ridges, which are often separated by streams or wet boggy areas, may serve as impediments to courtship travels of adult males (Lohoefener and Lohmeier 1984) (USFWS, 1990).

Stressor: Population Viability (USFWS, 1990)
Exposure:
Response:
Consequence: Localized extinction
Narrative: Local populations of the western gopher tortoise can in theory become extirpated through chance events and these extirpations (and thus more rangewide extirpations) are inversely related to population size. Shaffer (1981) cites four sources of uncertainty to which a population may be subject: (1) demographic stochasticity, which arises from chance events in the survival and reproductive success of a finite number of individuals; (2) environmental stochasticity due to temporal variation of habitat parameters and the populations of competitors, predators, parasites, and diseases; (3) natural catastrophes, such as floods, fires, and droughts, which may occur at random intervals through time; and (4) genetic stochasticity resulting from changes in genetic frequencies due to founder effect, random fixation, or inbreeding. Based on the concern expressed by Lohoefener and Lohmeier (1984) regarding

reproductive isolation, genetic drift and inbreeding may already be occurring. Recovery, therefore, must consider population viability in establishing both the objectives and the procedures for meeting those objectives (USFWS, 1990).

Recovery

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SPECIES ACCOUNT: *Graptemys flavimaculata* (Yellow-blotched map turtle)

Species Taxonomic and Listing Information

Listing Status: Threatened; 1/14/1991; Southeast Region (R4) (USFWS, 2016)

Physical Description

It is a medium-sized aquatic turtle with females attaining a carapace (upper shell) length of a least 2O centimeters (cm) (8 inches) and males occasionally exceeding 12 cm (4 and 3/4 inches). The carapace is olive to light brown. Each costal scute has an irregular bright yellow or orange blotch. Juveniles and adult males have a black spine on the first four vertebral scutes. These spines become smaller and may be lost in adult females (USFWS, ECOS Page).

Taxonomy

Lamb et al. (1994) conducted a mtDNA-based phylogenetic analysis of turtles in the genus Graptemys and discovered three monophyletic lineages: G. pulchra group (including G. pulchra, G. gibbonsi, G. ernsti, and G. barbouri); G. pseudogeographica group (including G. pseudogeographica, G. nigrinoda, G. flavimaculata, G. oculifera, G. versa, G. caglei, and G. ouachitensis); and G. geographica. Overall genetic divergence was relatively low, and G. pseudogeographica, G. nigrinoda, G. flavimaculata, G. oculifera, and G. versa all shared the same mtDNA genotype. There was no evidence of infraspecific variation in any species. Walker and Avise (1998) reviewed these data and suggested that the Graptemys complex has been taxonomically oversplit at the species level. McDowell (1964) concluded that the genus Graptemys should be included in the genus Malaclemys, but this arrangement generally has been rejected (e.g., see Dobie 1981 for information on osteological differences between the two genera) (NatureServe, 2015).

Current Range

Pascagoula River system, including the Leaf, Chickasawhay, and Escatawpa rivers, southern Mississippi. Apparently most abundant in Pascagoula River between Wade and Vancleave, Mississippi (USFWS 1990). The largest population is in the Pascagoula River in Jackson County, mainly in the Ward Bayou Wildlife Management Area (Horne et al. 2003) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Ernst and Barbour (1989) stated that the diet consisted largely of insects and snails, and that captives would eat fish (USFWS, 1993).

Reproduction Narrative

Adult: Nests from mid- to late May through early to mid-August; clutch size 3-9 (mean 4.7); at least some adult females are not reproductive each year; most adult females apparently do not produce more than one clutch per reproductive year (Horne et al. 2003). Males are sexually mature in 3-4 years (or reportedly in second growing season), females later (perhaps at 6-9 years) (Behler and King 1979, USFWS 1990) (NatureServe, 2015).

Spatial Arrangements of the Population

Adult: Clumped (inferred from USFWS, 1993)

Environmental Specificity

Adult: Narrow/Specialist (inferred from USFWS, 1993)

Tolerance Ranges/Thresholds

Adult: Low (inferred from USFWS, 1993)

Site Fidelity

Adult: High (inferred from USFWS, 1993)

Habitat Narrative

Adult: The yellow-blotched map turtle is a species of rivers and large creeks. It apparently avoids smaller streams where the surface of the water is shaded by bank vegetation for much of the day. Its preferred habitat has been described as river stretches with moderate currents, abundant basking sites, and sand bars (McCoy and Vogt 1987). The Pascagoula River near Vancleave has numerous accessory channels connecting oxbow lakes to the main river, and the yellow-blotched map turtle occurs in all of these habitats (R.L. Jones, pers. obs. 1991). It is more abundant, however, in the main channel (USFWS, 1993). Clumped spatial arrangement, Narrow environmental specificity, moderate ecological integrity, low tolerance range and high site fidelity are inferred based on habitat specificity, etc. (USFWS, 1993).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from USFWS, 1993)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from USFWS, 1993)

Dispersal

Adult: Low (inferred from USFWS, 1993)

Immigration/Emigration

Adult: Unlikely (inferred from USFWS, 1993)

Dispersal/Migration Narrative

Adult: Turtles in a riverine habitat have the ability to move long distances. However, most turtles (with the exception of sea turtles) are non-migratory. Low dispersal of this species and unlikely immigration are inferred based on the species limited number of populations and patchy distribution. (USFWs, 1993; NatureServe, 2015))

Population Information and Trends

Population Trends:
Decreasing (NatureServe, 2015)

Resiliency:
Low (inferred from NatureServe, 2015)

Representation:
Low (inferred from NatureServe, 2015)

Redundancy:
Low (NatureServe, 2015)

Population Growth Rate:
Declining (NatureServe, 2015)

Number of Populations:
1 - 20 (NatureServe, 2015)

Population Size:
2500 - 100,000 (NatureServe, 2015)

Population Narrative:
NatureServe (2015) notes that both the long-term and short-term population trends are declining and that population densities have declined in recent years. In addition, the number of populations is between 1 and 20 and the number of individuals between 2500 and 100,000. Low resiliency and representation are inferred from the low number of populations (NatureServe, 2015).

Threats and Stressors

Stressor: Sedimentation and Stream Modification
Exposure:
Response:
Consequence:
Narrative: Navigation and flood control projects usually call for removal of logs and snags used by Graptemys flavimaculata for basking. They may also result in the alteration or elimination of sand bars, which are important for nesting. Increased sedimentation and turbidity resulting from both flood control projects and gravel mining can also negatively impact the invertebrate species that are fed upon by the yellow-blotched map turtle. Several channel modification projects in the Pascagoula watershed have been planned, authorized, or completed. A snagging project along almost 4.1 kilometers (2.5 miles) of the Leaf River at Hattiesburg has eliminated basking structure for map turtles and impacted invertebrate prey populations through increased sedimentation and the elimination of the snags and logs that provide habitat for the invertebrates. Seven additional projects on tributaries of the Leaf and Chickasawhay Rivers have either been completed, are being planned, or are under study. In addition, four reservoirs have

been built in the Pascagoula watershed and two more are authorized. A gravel mining operation in the Bowie River at its confluence with the Leaf River has caused increased sedimentation downstream in the Leaf River (USFWs, 1993).

Stressor: Commercial Collecting, Wanton Shooting, and Trapping
Exposure:
Response:
Consequence:
Narrative: Yellow-blotched map turtles were collected in the past for the commercial pet trade where they sold for as much as $65 per specimen (Stewart 1989). Illegal collecting for this market probably continues at a reduced level. Some individuals habitually use basking turtles for target practice. Slat baskets and wire traps used illegally to capture catfish have also caught and drowned Graptemys flavimaculata (G. George, pers. comm. 1991).

Stressor: Water Quality Degradation
Exposure:
Response:
Consequence:
Narrative: Water quality degradation from chemical pollution could result in the bioaccumulation of toxic compounds in yellow-blotched map turtles. Although the effects of water quality degradation on Graptemys flavimaculata are not known, moribund turtles, including some Graptemys, afflicted with a subcutaneous ulcerative disease, have been observed in highly polluted segments of the Flint River of Georgia (G. George, pers. comm. 1991). Dodd (1988) speculated that a disease of unknown origin affecting Sternotherus depressus could have involved either an environmental contaminant or a viral infection resulting from an impaired immune system. Stewart (1989) found few turtles less than 4 years old in the lower Pascagoula River near Vancleave. This may reflect limited nesting habitat, high levels of egg and hatchling predation, or the effects of some effluents on the hatchlings or reproductive physiology of the turtle. Although the effects of industrial and municipal effluents (on the turtles of the Pascagoula watershed) are currently unknown, the effects on the invertebrates that most likely constitute the yellow-blotched map turtle’s prey base are well known (Grantham 1962, 1964, 1967). Much of the upper Pascagoula, the Chickasawhay, and the Leaf Rivers have abundant basking sites and wide sandy nesting beaches. The absence or scarcity of Graptemys flavimaculata may indicate that effluents have severely impacted its food resources in these areas.

Recovery

Delisting Criteria:
Conduct assessment of yellow-blotched map turtle populations throughout the Pascacioula River system. An assessment of Grantemys flavimaculata (USFWS, 1993).

Investigate life history of the yellow-blotched map turtle (USFWs, 1993).

Investigate water quality and determine habitat suitability for the yellow-blotched map turtle in the Pascagoula River system (USFWs, 1993).

Formulate actions to protect the lower 129 kilometers of the Leaf and Chickasawhay Rivers and the entire Pascagoula River for the yellow-blotched map turtle (USFWs, 1993).

Develop educational materials about the yellow-blotched map turtle (USFWS, 1993).

Develop plan for monitoring populations for at least 5 years after delisting (USFWS, 1993).

Recovery Actions:
- Determine current status of yellow-blotched map turtle populations in the Leaf, Chickasawhay, and Pascagoula Rivers (USFWS, 1993). Determine status of yellow-blotched map turtle populations in the upper Leaf, upper Chickasawhay, and lower Escatawpa Rivers (USFWs, 1993).
- Determine sex ratios of adults, sizes and ages at maturity, age structure, and growth rates (USFWS, 1993). Investigate reproductive biology by determining clutch size, clutch frequency, nest site selection, time of nesting, incubation period, and clutch survival rate (USFWs, 1993). Investigate daily and seasonal movements (USFWS, 1993). Determine diet by sex and maturity class (USFWs, 1993).
- Examine water quality at selected sample points on the Leaf, Chickasawhay, and Pascagoula Rivers (USFWS, 1993). Characterize habitat conditions in the Chickasawhay, Leaf, and Pascagoula Rivers (USFWS, 1993). Investigate distribution and abundance of major prey species (USFWS, 1993).
- Protect habitat through appropriate conservation measures (USFWS, 1993). Develop a monitoring plan to evaluate yellow-blotched map turtle populations and habitat quality in the conservation areas (USFWS, 1993).

Conservation Measures and Best Management Practices:
- RECOMMENDATIONS FOR FUTURE ACTIONS: 1. Designate specific yellow-blotched map turtle populations in the Leaf, Chickasawhay, and Pascagoula Rivers for regular monitoring of population densities and the habitat that supports them. Focus on populations at sites across the species' range (i.e., Hattiesburg, Leakesville, and Vancleave). 2. Develop a standardized protocol for data collection to determine turtle population density/viability, demography, growth, long-term movements, and longevity. 3. Reassess how best to define "stable" or "increasing" populations and determine if density numbers as currently defined in recovery criteria of the existing recovery plan are appropriate. 4. Conduct an analysis of potential effects to the yellow-blotched map turtle from proposed impoundments of Big Cedar Creek and Little Cedar Creeks, tributaries to the Pascagoula River in George and Jackson Counties, Mississippi. 5. Educate the public about the protected status of the yellow-blotched map turtle in order to reduce the direct take of turtles by shooting and encourage support of limiting public use of nesting sandbars. 6. Study effects of high nest predation on selected populations. 7. Pursue land acquisition of selected river reaches in order to achieve further protection of critical yellow-blotched map turtle populations. 8. Conduct follow-up research to determine if clutch frequency differences between north and south Pascagoula River populations are affecting long-term population viability. 9. Compare water quality data from habitat occupied by stable yellow-blotched map turtle populations with data from habitat occupied by declining populations. 10. Provide training to Law Enforcement personnel on identifying turtles of conservation concern and the threats they face from disturbance and collecting while encouraging enforcement of existing laws and regulations. 11. Develop (when necessary), adopt, and implement Best Management Practices for different land use/land cover categories, including those of timber activities, cropland and pastureland agricultural practices, urbanization, and/or other development

activities in order to prevent runoff and sedimentation of the Pascagoula River drainage. 12. Evaluate the size and status of the Escatawpa yellow-blotched map turtle population and conduct a telemetry study in this region to assess this population's spatial use of coastal environments. 13. Conduct a comparative ecological study of upper Pascagoula River drainage populations since focus has been on work on the lower Pascagoula River population. The availability data on upper Pascagoula River populations indicate there are differences in size and possibly reproductive output that could influence future management decisions. 14. Work with partners to limit threats to the yellow-blotched map turtle such as restricting the size of boats that access occupied river reaches and enforcing speed limits to reduce the negative impacts of excessive boat wakes. 15. Revise the yellow-blotched map turtle recovery plan to more accurately reflect the current data on life history, ecology, and distribution, and revise the recovery criteria (USFWS, 2018).

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SPECIES ACCOUNT: *Graptemys oculifera* (Ringed map turtle)

Species Taxonomic and Listing Information

Listing Status: Threatened; 12/23/1986; Southeast Region (R4) (USFWS, 2016)

Physical Description

The ringed sawback turtle is a small turtle (adults 7.5 – 22 cm) having a yellow ring bordered inside and outside with dark olive-brown on each shield of the upper shell or carapace and a yellow undershell or plastron. The head has a large yellow spot behind the eye, two yellow stripes from the orbit backwards and characteristic yellow stripe covering the whole lower jaw (Cagle 1953). Males are considerably smaller than females (USFWS, 1993).

Taxonomy

Lamb et al. (1994) conducted a mtDNA-based phylogenetic analysis of turtles in the genus Graptemys and discovered three monophyletic lineages: G. pulchra group (including G. pulchra, G. gibbonsi, G. ernsti, and G. barbouri); G. pseudogeographica group (including G. pseudogeographica, G. nigrinoda, G. flavimaculata, G. oculifera, G. versa, G. caglei, and G. ouachitensis); and G. geographica. Overall genetic divergence was relatively low, and G. pseudogeographica, G. nigrinoda, G. flavimaculata, G. oculifera, and G. versa all shared the same mtDNA genotype. There was no evidence of infraspecific variation in any species. Walker and Avise (1998) reviewed these data and suggested that the Graptemys complex has been taxonomically oversplit at the species level. See McCoy and Vogt (1988) for taxonomic history of G. oculifera. McDowell (1964) concluded that the genus Graptemys should be included in the genus Malaclemys, but this arrangement generally has been rejected (e.g., see Dobie 1981 for information on osteological differences between the two genera) (NatureServe, 2015)

Historical Range

See current range/distribution.

Current Range

The ringed map turtle is restricted to the Pearl River and its major tributaries in Mississippi and Louisiana. It is not found in the tidally influenced section of the lower West Pearl River. This species' distribution has been monitored periodically since the late 1970's (McCoy and Vogt 1980; Jones and Hartfield 1995; Dickerson and Reine 1996; Lindeman 1998; Shively 1999; Jones 2009; LDWF 2009). The spatial distribution of the ringed map turtle throughout the Pearl River drainage has not changed based on these studies (USFWS, 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Insects, mollusks, and crustaceans are primary foods. Feeds mostly on aquatic insects picked off submerged logs (Shively, no date) (NatureServe, 2015). Fish and carrion may be an occasional and opportunistic food source (USFWS, 1988).

Reproduction Narrative

Adult: Lays clutch of about 3-4 eggs (4-8 according to Matthews and Moseley 1990) in June and probably another later. Males are sexually mature in about 3-5 years (Kofron 1991, Amphibia-Reptilia 12:161-168). Jones and Hartfield (1995) determined that males matured at 3.5 years, females at 10-16 years. In addition (NatureServe, 2015). Mating likely occurs in late spring and early summer and egg incubation under natural conditions required an average of 63-65 days (USFWS, 1988).

Spatial Arrangements of the Population

Adult: Clumped (inferred from NatureServe, 2015)

Tolerance Ranges/Thresholds

Adult: Low (inferred from NatureServe, 2015)

Habitat Narrative

Adult: Most abundant in streams with moderate to fast current, numerous basking logs, nearby sand and gravel bars, and channel wide enough to allow sun to reach basking logs from 1000-1600 hrs (McCoy and Vogt 1980, Dickerson and Reine 1996). Not in tributaries or tidal areas. Requires high water quality to support main food sources. Eggs are laid in nests dug in sandy beaches or gravel bars (NatureServe, 2015). Spatial arrangement of the population, ecological integrity of the population and tolerance ranges are inferred based on specific habitat requirements.

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from NatureServe, 2015)

Immigration/Emigration

Adult: Unlikely (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Map turtles live in riverine-riparian systems and associated floodplain lakes, ponds, and sloughs. Often they nest on sandy banks or sand bars but sometimes up to about 100 m from water. Long-distance overland movements appear to be rare, but available information indicates that map turtles may move considerable distances along riverine corridors. Hence, separation distance for suitable habitat refers to riverine corridors whereas separation distance for unsuitable habitat refers to upland habitat. For Graptemys flavimaculata in Mississippi, mean male home range area was 1.12 ha, mean home range length was 1.9 km (range 0.2-5.9 km); these values for females were 5.75 ha and 1.6 km (range 0.2-2.8 km) (difference is not significant) (Jones 1996). For Graptemys geographica, daily and annual movements varied greatly among individuals in a river in central Pennsylvania (up to several thousand meters in a few days, or virtually no movement over several years; Pluto and Bellis 1988). Range length was 0.2-6.1 km (mean 2.1 km) for 46 males and 0-5.3 km (mean 1.2 km) for 14 females. Juveniles moved 4.7-5.3 km upstream or downstream over 1-2 seasons. In Vermont, range length for 6 adult females (with sonic tracking tags) was 1.5-8.0 km along the Lamoille River; some individuals moved downstream to Lake Champlain (2.7 km) and along the lakeshore as much as 2.2 km before returning to the hibernaculum (Graham et al. 2000). Graptemys pseudogeographica sometimes may move more than 1 mile (1.6 km) upstream in less than a month (Vogt 1981). These data suggest that a large separation distance of at least 20 stream km is appropriate for distinguishing different occurrences along a stretch of suitable habitat (NatureServe, 2015). High mobility is inferred based on similar species mobility. Non-migratory is inferred based on its highly specific habitat needs as is unlikely immigration (inferred from NatureServe, 2015).

Population Information and Trends

Population Trends:
Decreasing (NatureServe, 2015)

Resiliency:
Low (inferred from NatureServe, 2015)

Representation:
Low (inferred from NatureServe, 2015)

Redundancy:
Low (inferred from NatureServe, 2015)

Population Growth Rate:
Stable (NatureServe, 2015)

Number of Populations:
1-5 (NatureServe, 2015)

Population Size:
10,000-100,000 (NatureServe, 2015)

Population Narrative:
NatureServe (2015) notes that there are 1-5 populations with 10,000-100,000 individuals. NatureServe also notes that the short-term trend is relatively stable while the long-term trend is a decline of 30-50%. Resiliency, representation and redudancy are inferred based on specific habitat needs and the low number of populations.

Threats and Stressors

Stressor: Impoundments (USFWS, 2010).
Exposure:
Response:

Consequence: Loss of basking and nesting areas (USFWS, 2010)
Narrative: The ringed map turtle requires structures (logs, snags, etc.) on which it can safely bask protected from predation and suitable nesting habitat (large, high, sandbars adjacent to the river). These habitat features are threatened by habitat modification conducted for flood control (impoundments) and navigation, as well as sand and gravel mining (USFWS, 2010).

Stressor: River channel erosion (USFWS, 2010).
Exposure:
Response:
Consequence: Loss of basking sites (USFWS, 2010)
Narrative: River channel erosion is continuing to change the structural dynamics of the river system, especially south of the reservoir at Jackson, Mississippi. Sand and gravel mining and the removal of logs in streams are contributing to river channel erosion in Louisiana (Shively 1999). Erosion results in a wider and shallower channel due to stream bank destabilization. River channel erosion may have negative effects on the basking sites of the ringed map turtle (USFWS, 2010).

Stressor: Human collection (USFWS, 2010)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Shooting of basking turtles for recreation and collecting turtles for commercial purposes posed a threat to the ringed map turtle at the time of listing. Direct take by humans is a continuing threat. Shooting of ringed map turtles has been documented since the time of listing the species (Shively 1999). There is evidence that collecting for commercial purposes also continues (USFWS, 2010).

Stressor: Predation (USFWS, 2010)
Exposure:
Response:
Consequence: Nests destroyed
Narrative: Approximately 86 percent of the ringed map turtle nests in the study were attacked by vertebrates and approximately 24 percent of the remaining eggs were destroyed by invertebrates (Jones 2006). Armadillos (Dasypus novemcinctus) and raccoons (Procyon lotor) were the most frequent nest predators; fish crows (Corvus ossifragus) were also significant nest predators (Jones 2006). Invertebrate predators included Solenopsis molesta, a native species of fire ant, and larvae of the dipteran Tripanurga importuna, a sarcophagid fly (Jones 2006) (USFWS, 2010).

Stressor: Pollutants (USFWs, 2010)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: The Mississippi and Louisiana Departments of Environmental Quality have developed lists of impaired waters in their respective states to satisfy the requirements with respect to Section 303(d) of the CWA (Louisiana Department of Environmental Quality 2004; Mississippi Department of Environmental Quality 2006). Reaches of the Pearl River in both states, and reaches of the Bogue Chitto River in Louisiana, are included on these lists. Also identified on the

lists are the pollutants causing or potentially causing impairment of designated uses. Pollutants include excessive nutrients, organic enrichment/low dissolved oxygen, pesticides, sedimentation/siltation, mercury and other toxics, and pathogens. One of these pollutants, increased siltation, has been implicated in the decline of diversity in the fish fauna of the Bogue Chitto River in Louisiana where the ringed map turtle also occurs (Stewart et al. 2005) (USFWS, 2010).

Stressor: Boating/Recreation (USFWS, 2010)
Exposure:
Response:
Consequence: limiting nesting habitat/low fecundity
Narrative: Boating and other recreational uses of the Pearl and Bogue Chitto Rivers during the summer months are threats to basking turtles and turtle nests. Ringed map turtles usually abandon their perches when people boat or float by their sites and may not re-emerge to bask for up to an hour (Shively 1999). A study has been conducted on the impacts of boating on basking by the yellow-blotched map turtle in the Pascagoula River. In order to reduce the negative impacts to basking behavior that they documented, the authors of the study suggested that a limit be enacted on the size of boats allowed to access the river (Selman et al. 2010). Graptemys species bask with a greater frequency than many other turtles (Lindemann 1998). Alterations in basking frequencies may affect the general health of ringed map turtles, and because basking may be integral to the maturation of eggs, lower basking frequencies may reduce the ability of females to mature their clutches of eggs. In addition, large numbers of people party and camp on the same open, high sandbars favored by nesting ringed map turtles (Jones 2006). This use of sandbars by humans can limit turtle nesting habitat when turtles avoid these otherwise quality nesting sites (Jones 2006) or nests may be destroyed inadvertently by human activities on the sandbars (USFWS, 2010).

Recovery

Delisting Criteria:
Protection of a total of 150 miles of the turtle's habitat in two reaches of the Pearl River, There must be a minimum of 30 miles in either reach with the total protected area totaling 150 river miles (USFWS, 1988).

Evidence of a stable or increasing population over at least a ten year period on these two Pearl River reaches (USFWS, 1988).

An established, continuing plan of periodic monitoring of population trends and habitat to ensure a stable population in these river reaches (USFWS, 1988).

Recovery Actions:
- Characterize physical parameters of habitat (USFWS, 1988).
- Determine reproductive requirements (USFWS, 1988).
- Determine food sources (USFWS, 1988).
- Determine population structure (USFWS, 1988).
- Determine activity periods and behavior (USFWS, 1988).

- From the information gathered, determine and protect at least two river reaches critical to maintaining a stable population (USFWS, 1988).

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SPECIES ACCOUNT: *Kinosternon sonoriense longifemorale* (Sonoyta mud turtle)

Species Taxonomic and Listing Information

Listing Status: Endangered; Southwest Region (R2)

Physical Description

The Sonoyta mud turtle (Kinosternon sonoriense longifemorale, Iverson 1981) is a dark, medium-sized (carapace length to 14.5 centimeters (cm) (5.7 inches (in.))), aquatic turtle with a mottled pattern on the head, neck, and limbs. The upper shell (carapace) is olive brown to dark brown with dark seams; the lower shell (plastron) is hinged, front and rear, and yellow to brown. Long barbels (whisker-like organs) are typically present on the chin, and all four feet are webbed.

Taxonomy

The Sonoyta mud turtle is an isolated endemic subspecies of the Sonoran mud turtle (Kinosternon sonoriense) recognized by the Society for the Study of Amphibians and Reptiles as a valid taxon (Crother 2008, p. 71). This is based upon Iversons (1981, p. 18) description of the subspecies established on a set of 19 shell measurements. It appeared to be distinctive from the nominate race based on a long femoral scute, short anal scute, wide first vertebral scute, and narrow gular scutes (Iverson 1981, pp. 43-44). Results from a population genetics study indicate that the Quitobaquito-Rio Sonoyta populations are distinct from all other Arizona-New Mexico populations of Sonoran mud turtles, which is consistent with the taxonomy developed by Iverson (1981, p. 27; Rosen 2003, p. 13). Based upon a careful review of the available taxonomic information and its recognition as a valid taxon by Study of Amphibians and Reptiles (Crother 2008, p. 71), we consider the Sonoyta mud turtle to be a valid taxon.

Historical Range

The Sonoyta mud turtle historically occurred throughout the Rio Sonoyta watershed where surface water was present. The Rio Sonoyta drainage originates in the Sierra del Pozo Verde in Mexico, and crosses into the United States where it turns west on the Tohono Oodham Nation, north of the international border. Vamori and San Simon washes on the Tohono Oodham Nation drain into the Rio Sonoyta before it crosses back into Mexico 48 kilometers (km) (30 miles (mi)) east of Sonoyta, Sonora, and continues approximately 23 km (14 mi) west, paralleling the United States and Mexico border. The river channel then turns south along the east side of the Pinacate volcanic shield, passing through the eastern fringe of a sand field (the Gran Desierto) before reaching the Sea of Cortez east of Puerto Peñasco, Sonora, Mexico. Rio Sonoyta is a disjunct stream of the Colorado River system that was likely isolated in the Pinacate region during a volcanic activity period in the Pleistocene (Ives 1936, p. 349). Before 19th and 20th century degradation by groundwater pumping, livestock grazing, and subsequent downcutting, perennial waters flowed through portions of the river channel, and fed springs and cienegas in the area (wet, marshy areas) (Miller and Fuiman 1987, p. 602; Shoenherr 1988, p. 110; Hendrickson and Varela-Romero 1989, p. 481). The Quitobaquito-Rio Sonoyta region of southwestern Arizona and northwestern Sonora, Mexico, is characterized by extremely arid climate and isolation from other river systems (i.e., Colorado and Gila Rivers and Rio Concepcion). Isolation of the Rio Sonoyta drainage probably occurred sometime in the last

100,000 to 1,000,000 years when eruptions from the Pinacate Volcanic Field diverted flow of the Rio Sonoyta southward to the Gulf of California resulting in several endemic animal taxa from this aquatic system including the Sonoyta mud turtle (Ives 1936, p. 349-350; Turner 1983, p. 691).

Current Range

The Sonoyta mud turtle is extant in the United States at Quitobaquito Spring in OPCNM, Arizona, and in Mexico along the Rio Sonoyta and Quitovac Spring in Sonora (Rosen 2003, pp. 2-5). Quitobaquito Spring is a unique desert oasis in the Rio Sonoyta watershed located on the international border and 23 km (14 mi) west of Lukeville, Arizona. A series of natural springs rises in fractured granites and gneiss along the southwestern facing slopes of the Quitobaquito Hills. The two largest springs are captured and conducted into a manmade (gunnite) stream channel, which flows south approximately 244 meters (m) (800 feet (ft)) to a manmade pond that is up to 1 m (3 ft) deep and 0.2 ha (0.5 ac) in area. Other springs in the immediate area result in small natural seeps with no significant pooled water. The subspecies inhabits the Rio Sonoyta in Sonora, Mexico, with the majority of the sites within or near the town of Sonoyta where pools are present for most of the year. The sites include an intermittent reach approximately 2 to 4 km (1 to 2 mi) upstream of the town of Sonoyta, an ephemeral dam pool near Presa Xochimilco, a sewage lagoon adjoining the river near the town of Sonoyta, and an intermittent reach that begins some 15 km (9 mi) downstream of the town of Sonoyta near Santo Domingo, continuing for several kilometers through the 2 to 3.4 km (1 to 2 mi) perennial Papalote Reach in the northwestern corner of the Reserva de la Biosfera el Pinacate y Gran Desierto de Altar (Pinacate) south of Quitobaquito (Rosen 2003, pp. 2-5). The Papolote Reach, formerly known as the Agua Dulce reach, is the only remaining perennial reach of the Rio Sonoyta. Lastly, the Sonoyta mud turtle inhabits an approximate 2 ha (5 ac) spring complex at Quitovac approximately 40 km (25 mi) southeast of the town of Sonoyta. The population at Quitovac might represent an introduced population, as there are no aquatic migratory pathways between Rio Sonoyta and Quitovac, or it could be an isolated relict (Paredes-Aguilar and Rosen 2003, p. 10).

Distinct Population Segments Defined

Not applicable

Critical Habitat Designated

No;

Life History

Feeding Narrative

<u>Adult:</u> The subspecies feeds primarily on aquatic invertebrates and plants, although fish and other vertebrates are also eaten (Hulse 1974, p. 197).

Reproduction Narrative

<u>Adult:</u> Male Sonoyta mud turtles become mature at 3 to 4 years in age, females at 5 to 6 years, and they can live as long as 25 years. Females deposit an average of 1.5 clutches per year with an average of four eggs per clutch from July to September and are buried in the soil on land (Rosen and Lowe 1996a, p. 21).

Spatial Arrangements of the Population

Adult: clumped according to suitable habitat

Environmental Specificity

Adult: generalist

Tolerance Ranges/Thresholds

Adult: unknown

Dependency on Other Individuals or Species for Habitat

Adult: not applicable

Habitat Narrative

Adult: Sonoyta mud turtles are found both in natural and artificial spring-fed ponds and stream channels. Adults are typically captured in the deeper sections of the pond near dense stands of tules and other vegetation. Juveniles and sub-adults are found along the stream channel under overhangs and dense clumps of grass (Rosen and Lowe 1996a, p. 11). In addition to the aquatic environments, Sonoyta mud turtle habitat also includes basking sites for thermal regulation, vegetated areas for cover, and vegetation free shoreline for nesting substrates. In addition, shorelines must be accessible from aquatic environments to provide easy access to terrestrial habitat features essential for the life-history processes of the Sonoyta mud turtle.

Dispersal/Migration

Motility/Mobility

Adult: moderately low

Migratory vs Non-migratory vs Seasonal Movements

Adult: non-migratory

Dispersal

Adult: unknown

Immigration/Emigration

Adult: unknown

Dependency on Other Individuals or Species for Dispersal

Adult: unknown

Dispersal/Migration Narrative

Adult: Not much information is available regarding the dispersal of this species

Population Information and Trends

Population Trends:

declining longterm trend, but an increasing short term trend

Species Trends:

declining longterm trend, but an increasing short term trend

Resiliency:
low

Representation:
low

Redundancy:
low

Population Growth Rate:
unnknown

Number of Populations:
8

Population Size:
1200

Minimum Viable Population Size:
unnknown

Resistance to Disease:
unnknown

Adaptability:
low

Population Narrative:
The Sonoyta mud turtle was once abundant at Quitobaquito Springs, but the population declined from approximately several hundred in the 1950s to less than 100 in the late 1980s. Biologists at OPCNM and their partners have conducted annual mark-recapture surveys at Quitobaquito since 2001, except from 2008 to 2010 when water levels were too low for a regular census. Census methods and previous results are described in National Park Service reports (NPS) (2008a, entire). Sampling results since 2001 suggest the population is doing quite well despite an unexplained dip in 2005 and low water levels in 2007-2009 (NPS 2013, p. 1). The average population estimate, excluding young of the year (up to 40 millimeters (mm) (1.6 in) carapace length), is 105.1 turtles based on 18 years of data collected since 1984 (NPS 2013, p. 1). Population estimates were not generated between 2007 and 2009 (Holm 2011, p. 1). Since 2001, estimates have ranged from a low of 39 turtles in 2005 to a high of 189 in 2013 (NPS 2013, p. 1). The population estimate of 189 +/- 78 turtles for 2013 is the largest estimate since mark-recapture surveys began in 1984, and excluded turtles released from captivity. Size classes peaked at 81 to 90 mm (3 to 3.5 in) in 2011, compared to 101 to 110 mm (4 to 4.3 in) during 2001 to 2007, suggesting a wave of recruitment. The 2011 captures were also used as a second catch to generate an estimate for 2010, with the 29 captures in 2010 serving as the first catch. This results in an estimate of 123 turtles for 2010. In 2013, the most recent sampling effort, Sonoyta mud turtles were sampled at Quitobaquito Springs over two consecutive nights in

October. These captures included 21 females, 32 males, 7 turtles of undetermined sex, and 16 young of the year. Six of the 24 turtles released from captivity in 2011 were recaptured in the 2013 sampling effort. Between 2001 and 2007, the number of hatchlings per trap night ranged from a low of 0.08 in 2003 to a high of 1.04 in 2007 and an average of 0.35. In the past two years, young-of-the-year captured during surveys increased to 3 hatchlings per trap night in 2012 and 8 hatchlings per trap night in 2013. Sonoyta mud turtles have been documented at seven sites in Mexico (Paredes-Aguilar and Rosen 2003, p. 5; Rosen 2003, pp. 2-5); however, sampling in Mexico has not been extensive enough to make accurate estimates of total population size. The population discovered in March 2002 at Quitovac, Mexico, was estimated at about 200 individuals (Rosen 2003, p. 5). Rosen (2003, pp. 5-6) also estimated the combined population size of all Sonoyta mud turtle populations to be 1,200 individuals (range 600-2,700).

Threats and Stressors

Stressor: Groundwater Depletion and Surface Water Diversion
Exposure:
Response:
Consequence:
Narrative: Rio Sonoyta and Quitobaquito Spring have long been stopover points for travelers heading west across the Sonoran Desert. As the only water source in the region, both surface and subsurface water have been used heavily for agricultural and other purposes. As a perennial desert stream, any additional withdrawals from the water table, particularly during drought years, could have negative impacts on the stream and the Sonoyta mud turtle. Quitobaquito pond is a dredged and impounded pond fed by springs and seeps in nearby granite outcrops. Flow from springs may have been connected to the Rio Sonoyta via surface flows in recent times, but is now separated by approximately 1.5 km (.9 mi) of Sonoran Desert and Mexico Highway 2. The effects of the original dredging and impoundment on the Sonoyta mud turtle are unknown. Prior to 1957, humans and livestock occupied the area and there was considerably less vegetation and more water in the springs. Discharge from the spring has diminished by nearly 50 percent over the past 30 years (NPS, unpubl. data). Since essentially no water withdrawal or livestock grazing occurs upslope or upstream of Quitobaquito, drought is suspected as the primary cause for this depletion. Lack of water in Quitobaquito pond is an ongoing threat to the species, and the pond continues to be highly managed by the NPS to maintain water levels as described below under conservation measures. In Mexico, the Sonoyta mud turtles aquatic habitat along the Rio Sonoyta continues to shrink and degrade due to groundwater pumping and surface water diversion. Increases in the amount of groundwater withdrawal, changes in wastewater treatment, and the potential for complete desiccation of the only remaining perennial stretch of Rio Sonoyta are threats to the Sonoyta mud turtle in Mexico. Irrigated agriculture is widespread in the Rio Sonoyta Valley, and continued development in the towns of Sonoyta and Lukeville is placing increased demands on limited water supplies (Brown 1991, pp. 48-49). Paredes-Aguilar and Rosen (2003, p. 8) observed that groundwater pumping for agricultural purposes may have decreased. This decrease was likely temporary, because the town of Sonoyta continues to grow and is expected to create an increasing demand on the local water supply. At an Arizona-Mexico Commission Water Committee meeting in Tucson in June 2007, an official from the Comisión Estatal de Agua del Estado de Sonora presented results from a recent study of the Rio Sonoyta aquifer. Preliminary results from the study indicate current groundwater usage in the Rio Sonoyta watershed is greater than the estimated recharge rate, and the Comisión Estatal de Agua del Estado de Sonora recommended no further well drilling

(Quitobaquito-Rio Sonoyta Working Group (QRSWG) in prep.). As a result, complete desiccation of the Papalote Reach of Rio Sonoyta is likely to occur in the future as a result of upstream aquifer depletion by agricultural pumping and drought exacerbated by climate change (QRSWG in prep.). Loss of the Papalote Reach would result in the loss of the Sonoyta mud turtle population found there. In 2010, the water level was greatly reduced at the Papalote Reach of the Rio Sonoyta likely due to increased groundwater pumping associated with improvements to Mexican Highway 2 (Aguirre-Pompa 2011, pers. comm.).

Stressor: Development of and Changes to Urban Infrastructure
Exposure:
Response:
Consequence:
Narrative: Current thought suggests that the turtles at the town of Sonoyta may be surviving primarily because of the consistent influx of sewage run-off from a wastewater treatment plant. Although sewage effluent may grow in overall volume, if treated using more modern methods, the actual volume of treated water returned to the Rio Sonoyta may decrease and ultimately lead to the demise of the turtles using it. Currently in Sonora, Mexico, surface water remains generally present in the Rio Sonoyta at Sonoyta. Here a dam retains seasonal run-off, forming an ephemeral reservoir, Presa Xochimilco, and produces a small spring in the bedrock. Within the town of Sonoyta, water can be found above and below the Presa Xochimilco. Approximately 0.5 km (0.3 mi) upstream, wastewater discharge from a military complex located above Presa Xochimilco was used to create large perennial pools within the Rio Sonoyta streambed at the upper end of Presa Xochimilco. In 2008, the effluent was piped to the wastewater treatment facility in the town of Sonoyta, bypassing Presa Xochimilco. As a result, the Presa Xochimilco pools rely only on stormwater runoff and may no longer be perennial. Despite the potential detrimental effects of chemical pollutants and nutrient loading, these pools provided habitat for Sonoyta mud turtles during frequent periods when the stream was otherwise dry. This was the largest known population of the Sonoyta mud turtle in Mexico (Paredes-Aguilar and Rosen 2003, p. 9). No surveys have been completed for this population since the water source was diverted. Loss of these perennial pools has likely adversely impacted this population of Sonoyta mud turtles. On the west side of the town of Sonoyta, Sonoyta mud turtles currently occupy a sewage lagoon greater than 5 ha (12 ac) that drains into the Rio Sonoyta. In 2008, the U.S. Environmental Protection Agency awarded a grant to the wastewater utility of Sonoyta for the construction of a new wastewater treatment facility east of the town of Sonoyta to improve water quality and human health conditions in the town. The current wastewater treatment system will be decommissioned once the new wastewater treatment facility is completed. This will result in elimination of wastewater flow into the sewage lagoon currently occupied by Sonoyta Mud turtles, and cause the lagoon to dry so that it is unsuitable habitat for the subspecies. The project will also result in the elimination of outflow from the current sewage lagoon into the Rio Sonoyta and could diminish recharge of the shallow aquifer that contributes to the perennial Papalote Reach of the Rio Sonoyta downstream of the town of Sonoyta. However, the Secretaría de Medio Ambiente y Recursos Naturales (SEMARNAT) issued a resolution with binding conditions for the project proponent to provide habitat for this population of Sonoyta mud turtles at the new facility, as described below under conservation measures.

Stressor: Contaminants
Exposure:
Response:

Consequence:
Narrative: Between 1989 and 1993, environmental contaminants biologists employed by the U.S Fish and Wildlife Service (Service) investigated Sonoyta mud turtles found dead by Rosen and Lowe (1996a, p. 29), and also analyzed pond sediments from Quitobaquito Springs. They found that these turtles from Quitobaquito Springs had very low body fat reserves which indicated possible dietary deficiency and starvation. In 2007, the U.S. Geological Survey National Wildlife Health Centers initial necropsy resulted in the same findings (Holm 2007, p. 1). The Service biologists also found relatively high levels of boron, chromium, selenium, strontium, and zinc in Sonoyta mud turtle tissues. Chromium, selenium, and zinc are Environmental Protection Agency designated priority pollutants regulated by the Clean Water Act. High levels of these elements combined with low availability of protein-rich foods may be limiting turtle survival (King et al. 1996, p. 5). Low lipid reserves may also result in reduced egg production. Other contaminants, including pesticides and herbicides used on agricultural lands along the Rio Sonoyta may enter turtle habitats via runoff. For example, low levels of dichlorodiphenyldichloroethylene (DDE), a metabolite of the insecticide dichlorodiphenyltrichloroethylene (DDT), and Dacthal, an active ingredient in herbicides, have been found in Sonoyta mud turtles from Quitobaquito since 1981 (King et al. 1996, p. 3; Rosen and Lowe 1996a, pp. 30-31). The effects of such pesticides on this species have not been studied. Sonoyta mud turtles that are still present in the sewage lagoon on the west side of the town of Sonoyta are subject to contaminants from sewage as well as potential contaminants in runoff from agricultural fields and livestock holdings (King et al. 1996, pp. 4-5).

Stressor: Alteration of Native Plant Composition
Exposure:
Response:
Consequence:
Narrative: Several invasive plant species have displaced native vegetation and present a fire hazard in Sonoyta mud turtle habitat. Salt cedar (Tamarix ramosissima) has become established along the Rio Sonoyta (Paredes-Aguilar and Rosen 2003, pp. 7-8). It also poses a threat at Quitobaquito but currently is being aggressively and successfully controlled by OPCNM (Tibbitts 2010, pers. comm.). It is a high water use plant, and may utilize valuable water resources during dry periods. Although the dense thickets of salt cedar at Rio Sonoyta may use more water than native vegetation that it has displaced, its roots stabilize the stream banks and provide hard shelter protecting turtles against predation and floods. Also, bufflegrass (Pennisetum ciliare) and Sahara mustard (Brassica tournefortii) have become established along the Rio Sonoyta. In addition to altering the native plant composition, the presence of nonnative plant species increases the potential for wildfire (both frequency and intensity). Staff at OPCNM are currently concerned about the build-up of dead wood in the bosque (an area of trees along streams or river banks) surrounding Quitobaquito that is currently a potential for severe fire (Holm 2012, pers. comm.). Large intense fires could result in increase siltation within the stream system and further degrade the watershed. The OPCNM is currently developing a fire management plan to address this issue.

Stressor: Border Activities
Exposure:
Response:
Consequence:

Narrative: Although Quitobaquito Spring lies mostly within designated wilderness, Mexico Highway 2 also lies approximately 100 m (328 ft) to the south and is the primary land transportation link between mainland Mexico and the Baja California peninsula. Threats to Quitobaquito pond and springs include high levels of cross-border violator and U.S. Border Patrol activities in the immediate area. To date this has not been documented, although cross-border violators could damage the pond or springs and surrounding area or contaminate the pond or springs. U.S. Border Patrol or other vehicles have driven several times recently on the berm that impounds Quitobaquito pond. Evidence of driving on the berm was noted in an OPCNM database on May 13, 2008; November 20, 2008; March 4, 2009. June 11, 2009; September 4, 2009; and October 7, 2009; however, staff have also informally observed tracks about 10-15 times in the last two years. The tracks often show tread types characteristic of U.S. Border Patrol vehicles, although other unauthorized vehicles have likely driven on the berm as well (Tibbitts 2009, pers. comm.). The OPCNM has recently constructed wooden fence at the western and eastern ends of the berm to discourage vehicle traffic. Vehicle activity on the berm could cause its partial collapse or deterioration. If the integrity of the berm is compromised and the berm collapses, much or all of the pond could be lost. Even if the berm does not collapse, driving on it could cause deterioration, resulting in materials spilling into the pond, decreasing its volume, reducing habitat for Sonoyta mud turtle. Additionally, vehicles could slide into the pond, either due to collapse of the berm or driving too close to the edge followed by accidental slippage off the berm and into the pond. Contaminants in the form of oil or other vehicle fluids could cause damage to Sonoyta mud turtle habitat. As documented in October 2009, vehicles have been driven over the stream crossing that connects the springs to the pond. The stream flows through an artificial concrete channel designed by the Arizona-Sonora Desert Museum (ASDM) in 1989 to create habitat for Sonoyta mud turtles, while supplying a dependable flow of water to the pond. Though no significant damage was sustained from this recent incident in which a U.S. Border Patrol agent drove over the channel several times in an all terrain vehicle, such events could alter the flow of water from the spring to the pond. If the concrete channel was broken or damaged, water could be diverted from the channel, resulting in dewatering of the spring channel and possible lowering or drying of the pond. The future of Quitobaquito pond and springs depends heavily on OPCNMs ability to manage the site, which is currently affected by the threat posed by high levels of cross-border violator activities along the border at OPCNM (i.e., OPCNM biologists and staff cannot freely visit the site to conduct management, maintenance, and monitoring, as they must be accompanied by law enforcement on all visits).

Stressor: Inadequate regulations
Exposure:
Response:
Consequence:
Narrative: Arizonas State Wildlife Action Plan, formerly known as the Comprehensive Wildlife Conservation Strategy, considers the Sonoyta mud turtle to be 1 of 57 species in Arizona in immediate need of conservation actions (Arizona Game and Fish Department (AGFD) 2006a, pp. 13, 32, and 490). Arizona State law allows collection of Sonora mud turtles with an annual bag limit of four, live or dead, under the species level taxon. However, the NPS requires special permitting for any collections of the Sonoyta mud turtle subspecies on OPCNM where it solely occurs in the United States. The subspecies may be afforded some regulatory protection because it co-occurs with the federally endangered desert (Quitobaquito) pupfish (Cyprinodon [macularis] eremus). The range of the Sonoyta mud turtle completely overlaps that of desert (Quitobaquito) pupfish. Designated critical habitat for the desert pupfish (Cyprinodon macularius) includes

Quitobaquito Springand a 100-foot riparian buffer zone around the spring (Service 1986, p. 10848). We interpret this to mean Quitobaquito pond and a 30 m (100 ft) buffer around the pond. Federal actions affecting the desert pupfish or its critical habitat would require consultation under section 7 of the Endangered Species Act and potentially provide benefits to the Sonoyta mud turtle. Such activities have included the General Management Plan for OPCNM (Service File# 22410-F-1989-0078) and issuance of a special use permit by OPCNM to CBP (Service File# 22410-F-2009-0089). The extent of these benefits is limited to the aquatic habitat and critical habitat overlap; effects to turtles using terrestrial habitat are not addressed. In Mexico, the Sonoyta mud turtle does not have protected status, nor is the habitat protected. We conclude that the inadequacy of existing regulatory mechanisms in the United States is not a significant threat to the subspecies. However, the existing regulatory mechanisms in Mexico do not ameliorate the threats to the subspecies in Mexico.

Stressor: Climate change
Exposure:
Response:
Consequence:
Narrative: A reduction in annual precipitation at OPCNM and a reduction in water levels in Quitobaquito Springs have been contributing factors to the drop in the population estimates from 2002 to 2005, based upon earlier work by Rosen and Lowe (1996a, p. 24), which directly correlated precipitation with recruitment (Rosen et al. 2006, p. 4). This relationship may be related to impacts of drought on terrestrial vegetation, spring output, and evaporation rate as these impacts can decrease turtle food supply and egg survival during drought (Rosen et al. 2006, p. 4). In addition, this population of Sonoyta mud turtles has likely experienced some nutritional stress based upon a lack of stored fat reserves found in dead individuals (Rosen and Lowe 1996a, pp. 31-32; Rosen et al. 2006, p. 6; Holm 2007, p. 1). Five adult individuals were found dead at Quitobaquito in late 2007 when water levels were extremely low. A necropsy was performed by the U.S. Geological Survey National Wildlife Health Center on one of the dead male Sonoyta mud turtles. Initial results found two principle abnormalities in this male Sonoyta mud turtle, such as fluids in the body cavity and severe depletion of fat reserves (Holm 2007, p. 1). Both abnormalities are non-specific changes that could have multiple causes. No evidence of infectious disease was found in the Sonoyta mud turtle. The finding of low fat reserves is consistent with previous autopsies of dead Sonoyta mud turtles at Quitobaquito (Rosen and Lowe 1996a, pp. 31-32). Rosen and Lowe (1996a, pp. 31-41) suggested that stressors associated with poor nutrition are important contributors to observations of unexplained mortality of the subspecies, and that competition for limited food resources with desert pupfish likely accounts for nutrient deficiency in Sonoran mud turtles at Quitobaquito. In Mexico, aquatic habitat in the Rio Sonoyta is extremely dynamic due to climatic extremes (Ives 1936, pp. 352-354; Hendrickson and Varela-Romero 1989, p. 482), which may also contribute to Sonoyta mud turtle population fluctuations. Because turtle populations have a low intrinsic population growth rate, they are incapable of expanding rapidly to take advantage of temporary habitats created by periods of high precipitation, but populations can decline rapidly during drought years. Also, populations of Sonoyta mud turtles are relatively small. Small populations may be vulnerable to environmental and demographic random events, such as drought, which increase the probability of extinction (Lande 1993, p. 923). Periods of drought in the Sonoyta mud turtles range are not uncommon; however, the frequency and duration of dry periods may become more frequent. Global climate change and associated effects on regional climatic regimes, is not well understood, but the predictions for the Southwest indicate less overall precipitation and longer periods of drought.

Seager et al. (2007, p. 1181) predict, based on broad consensus among 19 climate models, that the Southwest will become drier in the 21st century and that the transition to this drier state is already underway. The increased aridity associated with the current ongoing drought will become the norm for the Southwest within a timeframe of years to decades, if the models are correct. This aquatic subspecies, along with its habitat, will likely be affected in some manner by climate change, but the magnitude and extent of possible change cannot be verified or quantified at this time. We conclude that the other natural or manmade factors are a significant threat to the subspecies, primarily from stressors that limit water availability. We believe effects of drought are substantial enough to threaten the subspecies throughout its entire range in the foreseeable future.

Recovery

Reclassification Criteria:
Not applicable

Delisting Criteria:
Not applicable

Recovery Actions:
- Secure and maintain all Sonoyta mud turtle habitat occurring within OPCNM.
- Improve habitat occurring along the Rio Sonoyta.
- Reduce and remove threats as much as possible within Quitobaquito Spring and Sonora, including the protection of the aquifers that supply Quitobaquito Spring and the Papalote reach of the Rio Sonoyta.
- Collaborate with and assist Mexican and Environmental Protection Agency efforts to reconcile conservation of the Sonoyta mud turtle with modernization of the public health infrastructure and riparian parkland in and adjoining Sonoyta. Monitor the status of these efforts underway with town of Sonoyta, Pinacate, SEMARNAT, CEDES, Environmental Protection Agency, and OPCNM.
- Establish and maintain refuge and assurance populations.
- Monitor all populations of Sonoyta mud turtles and implement adaptive management practices as needed to maintain or increase existing population numbers.
- Conduct research that investigates the ecology of and threats to Sonoyta mud turtles.
- Increase local awareness of the unique resources of the Rio Sonoyta and increase community involvement in the conservation of these resources.
- Continue to work towards development and implementation of a Candidate Conservation Agreement.

Conservation Measures and Best Management Practices:
- Conservation Agreement: The Service awarded a section 6 grant to the AGFD to develop a conservation agreement for the Sonoyta mud turtle. Through this section 6 grant, AGFD provided funding to the University of Arizona, and Centro de Estudios de Estado y Sociedad (CEDES) (formerly Instituto del Medio Ambiente y el Desarrollo Sustentable del Estado de Sonora or IMADES), Hermosillo, Sonora, to define the status and distribution of the Sonoyta mud turtle in Sonora, Mexico. Results of this work are reported in Paredes-Aguilar and Rosen (2003) and Rosen et al. (2006). The QRSWG was formed in 2001 with the agencies and interested parties in the United

States and Mexico to assist in development of a conservation strategy and agreement for the subspecies. The QRSWG is working together to improve the status of the Sonoyta mud turtle and has developed potential conservation measures for this subspecies (QRSWG in prep.). The ASDM currently supports a refugia population of Sonoyta mud turtles, and though most will be repatriated to Quitobaquito, some will likely be retained at the ASDM. The Phoenix Zoo has also expressed interest in propagating Sonoyta mud turtles and perhaps establishing a captive population on the zoo grounds.

- NPS Maintenance of Quitobaquito Pond: The imperiled status of the Sonoyta mud turtle was unknown to NPS personnel for many years. The pond at Quitobaquito Spring was drained twice to eliminate nonnative fish and enhance habitat for the endangered desert pupfish. During these drying episodes many Sonoyta mud turtles were collected and apparently distributed to individuals (Rosen 1986, p. 17). The NPS has since recognized the unique nature of the Sonoyta mud turtle population and managed for its conservation. The NPS identified habitat features such as basking sites, banks free of vegetation, access to terrestrial habitats, and pools in the inlet channel, that are becoming less available to the subspecies. The NPS is working to maintain these habitat features and improve habitat heterogeneity. Maintaining water levels at Quitobaquito pond continues to be a challenge. In 2006, the water level in the pond at Quitobaquito Spring reached an all time low in June prior to summer rains. In an effort to increase the discharge rate from Quitobaquito Spring, OPCNM staff reconstructed the leach field below the springhead through trenching and replacing the existing gravel and perforated pipe in April 2007 (Pate 2007, p. 1). From September to October 2007, the pond reached its lowest recorded water level at 59 cm (23 in) below the overflow pipe (Tibbitts 2007, p. 1). This resulted in an estimated 70 percent reduction in surface area and an average depth of about 11 cm (4 in). The OPCNM staff removed the dead vegetation around the pond, and trimmed the aquatic vegetation and improved the pools along the stream channel to improve access to basking structures at Quitobaquito Springs (Tibbitts 2007, pers. comm.). In March 2008, water levels began to drop again, causing OPCNM staff to conclude that the pond may be leaking water through the retaining berm. A small turtle moat was created that captured the water coming from the spring channel. In April and May 2008, the NPS removed several decades of tree growth on the retaining berm and installed a diaphragm wall down the center of Quitobaquito ponds retaining berm in hopes of stopping any water leaking through the berm (NPS 2008a, p. 4). This diaphragm wall was constructed with a plastic liner and dry cement fill placed in a 0.3-m (1-ft) wide by 1.8 m (5.9 ft) deep trench down the center of the retention berm. After the completion of the diaphragm wall, the water remained at an all time low of minus 72 cm (29 in) (or 29in below the outflow pipe) (NPS 2008a, p. 5). More than 1,830,246 liters (l) (483,500 gallons (gal)) of water were hauled to Quitobaquito pond during July and August of 2008. When the monsoon rains came in late August and early September, the water level was raised in the pond by 8.8 cm (3.5 in) in late August and early September (NPS 2008a, p. 5). By the end of 2008, water levels increased through a combination of spring input, water hauling, and precipitation events to a minus 49.5 cm (19.5 in) below the outflow pipe (NPS 2008a, p. 5). During the winter of 2008 to 2009, OPCNM staff removed extensive growths of bulrush, which had encroached toward the pond center since water levels had dropped. Following these efforts and to test whether a leak persisted, additional water was trucked to the pond during March 2009. This effort resulted in the highest water level in the pond since mid-September 2007. By April 2009, falling water levels confirmed a leak was present (the lowest level reached in 2009 was minus 69.9 cm (27.5 in). In the summer of 2009, approximately 1,371 m2 (4,500 ft2) of the southeastern corner of the pond was isolated by constructing a temporary coffer dam. All possible Sonoyta mud turtles were removed for temporary safekeeping offsite. The southeastern corner was then emptied of water, mud, and detritus. The retaining berm was widened inward approximately 4 ft, using compacted clean fill material. A bentonite wall was built into the center of this enlargement of the berm. Finally, the pond bottom was covered with about 15 cm (6 in) of compacted bentonite and fill mixture. In early December 2009, the total rise in water level since the southeastern corner renovation was approximately 25 cm (10 in) (the pond level was minus 36 cm (14 in) below the outflow pipe), with no rain, relatively low spring input, and above average temperatures much of that time, suggesting the renovation plugged a leak in the berm. Rain events in January 2010 increased the pond level to about minus 15 cm (6 in) below the outflow pipe; however, in February 2010, the level of Quitobaquito pond fell to minus 30 cm (12 in) (Tibbitts, 2010, pers. comm.). The pond level held steady at minus 30 cm (12 in), which indicated one remaining leak was controlling the pond at that level. The large leaning cottonwood tree was the leading candidate for the remaining leak and therefore, in October 2010, OPCNM sealed around this tree. The effort was successful and the pond leveled off at minus around 12 cm (5 in). This seal is temporary and partial, and was expected to be capable of holding for up to 5 years (through October 2015). Regardless of these efforts, water levels in the pond dropped 46 cm (18 in) between December 2011 and July 2012. This is the largest single loss of water in recorded history of Quitobaquito pond. The cause of the loss was likely a combination of pressure-induced activation of one or more leaks in the liner, failure of the pond layer seal around the cottonwood tree, and large-scale evapotranspiration loss via increasing stands of bulrush. In May 2012, OPCNM staff initiated bulrush mowing and continued weekly mechanical removal of bulrush through July when monsoon rains were in full swing. The daily drop in pond level prior to mowing was 0.6 cm/day (0.24 in/day) with spring input into the pond about 3.7 l/min (14 gal/min). After bulrush mowing was implemented, the daily drop in pond level remained between 0.3 to 0.4 cm (0.1 to 0.15 in), even with spring input falling to 3.2 l/min (12 gal/min) and hotter temperatures than before mowing began. Lower water levels revealed new leaks in the liner around the cottonwood tree caused by woodrats (Neotoma sp.) taking up residence in the tree. In light of these continuing challenges, the QRSWG discussed long-term plans for Quitobaquito pond at its annual meeting in June 2012 and again in May 2013. The group is in full support of reconstructing the dam, removing the leaning cottonwood before it falls and destroys the berm, and resetting the pond liner. Due to a decrease in flow from the spring heads, the group also supports creating a smaller pond. Unfortunately OPCNM is not in full support of removing the cottonwood. In the meantime, OPCNM staff repaired some rodent-chewed holes in the pond liner and raised the lowest edge of the pond liner up at least an inch prior to the 2013 monsoon season. OPCNM also attempted to address the largest leak from the pond by tamping 500 pounds of granular bentonite and high-clay soil into a newly-opening crevice where the tree roots enter the earthen retaining berm. Rains from the subsequent 2013 monsoon raised the water level to -1.8 inches, the highest water level of the pond in the past 15 years. OPCNM staff measured water level in the pond on April 3, 2014 at -3.15 inches, which is the highest level recorded in April since April 19, 2002. This suggests that these interim measures are working, but they are still considered temporary. The QRSWG will continue to work with OPCNM staff towards a longterm solution to the leaking pond.

- Turtle Salvage and Repatriation: On October 30, 2007, 13 juveniles, subadults, and adults were salvaged from Quitobaquito Pond and taken to the ASDM in Tucson, Arizona, as a response to the unexpected drop in the water level. Unfortunately, raccoons (Procyon lotor) gained access to the ASDMs Sonoyta mud turtle pens and killed 12 of the 13 salvaged turtles. The remaining individual was placed in a more secure location. On April 22, 2008, 31 individuals were captured out of the pond and transported to The Phoenix Zoo for temporary holding while ASDM repaired its turtle pens (NPS 2008b, p. 3). One individual died in captivity at The Phoenix Zoo. The remaining 30 individuals were transported to the ASDMs newly secured Sonoyta mud turtle pens in February 2009 with the goal of establishing a captive population. In 2009, large volumes of water were lost from Quitobaquito Pond over a short period of time, providing evidence of one or more leaks in the pond.

On August 20, 2009, 37 additional individuals were captured from Quitobaquito Pond and transported to the ASDMs secure Sonoyta mud turtle pens (NPS 2009, p. 18). Five more turtles have died in captivity at ASDM. In total, 81 turtles were removed from Quitobaquito Pond due to decreased pond water levels. Of these salvaged turtles, 18 individuals were lost from predation or died in captivity so that 63 turtles remained in the salvage population at ASDM. On July 13, 2011, 12 turtles from ASDM were repatriated to Quitobaquito Pond. An additional 12 turtles were repatriated on September 13, 2011. Another 12 turtles were due to be released to Quitobaquito Pond in 2012; however, the low water levels in June 2012 prompted a decision to delay the release until the pond could be stabilized. No releases occurred in 2013. Three of the females at ASDM drowned in August 2012 when they were paired with males. This leaves a total of 33 individuals (7 males, 10 females, and 16 juveniles) remaining in the refuge population at ASDM (NPS 2012, p. 1). The long-term plan is for 12 turtles to remain at ASDM in an assurance population in a turtlarium that was constructed in June 2013 with $7,500 in funding provided by AGFD. ASDM intends to move turtles to the new turtlarium in the winter of 2014 (S. Poulin, 2014, pers. comm.). There are also two mud turtles currently in the COBACH pond in the town of Sonoyta. Other captive holding facilities suggested by the QRSWG include International Sonoran Desert Alliance, Ajo Wastewater Services in Ajo, Arizon; Tohono O'odham Nation; Mayan Pace in Puerto Pensaco, Sonora; Quitovac, Sonora; and a mine southeast of Quitovac, Sonora.

- Population Viability Analysis: In 2008, OPCNM funded J. Daren Riedle and Richard Kazmaier of West Texas A&M University, to construct an individual-based population viability analysis model based on the available population monitoring data from 1982-1995 and 2001-2006 monitoring efforts at OPCNM to determine the number of Sonoyta mud turtles that should be held in an assurance colony. The population viability analysis was calculated using four 3-stage models based on female survivorship (Riedle et al. 2012, p. 185). The three stages were divided among 3 age classes (0-1 yr, 2-6 yrs, and 7-12 yrs). All simulations were set to run 1000 replications for 50 time steps (50 yr). Model 1 simulated conditions based on 2001 to 2006 data to determine current population status within Quitobaquito. The population was set at 65 and divided between 3 age classes. Models 2 4 were recovery-based models testing minimum number of animals needed to recover the OPCNM population while reducing extinction risk and population-halving events. Model 2 was based on the initial 13 females being held within offsite assurance colonies. In Model 3, they simulated the effects of doubling the number of adult females. Model 4 simulated the effects of adding 10 individuals from younger age classes to animals already held within the assurance colony. Based on current population estimates, Model 1 predicts that the OPCNM population of Sonoyta mud turtles is increasing significantly (Riedle et al. 2012, p. 186). Models 2 and 3, which calculate the likelihood of recovery by using only adult turtles, predict that the total estimated population size remains low. Of more concern is the probability of a population-halving event occurring when Models 2 and 3 were compiled. With the addition of just five prereproductive turtles in both prereproductive age classes in Model 4, estimated population sizes doubled and the probability of the population halving was reduced to zero. Based on iterations within Model 4, the smallest viable population to return a zero extinction risk was 24 individuals. Reidle et al. (2012, p. 186) conclude that maintaining reproduction and juvenile survivorship is important to the persistence of this population. Their PVA models also support the importance of prereproductive females to this population, particularly when dealing with assurance colonies and reintroductions (Riedle et al. 2012, p. 187).
- Water Protection in Mexico: In 2008 the SEMARNAT issued a resolution with binding conditions for the proposed Environmental Protection Agency funded wastewater treatment facility project to the water and wastewater utility for the municipality of Sonoyta, Mexico, Organismo Operador Municipal de Agua Potable,. Alcantarillado y Saneamiento de Sonoyta (Sonoyta OOMAPAS). These conditions include a requirement for Sonoyta OOMAPAS to negotiate an agreement with the

Pinacate Biosphere Reserve to: 1) ensure all treated water from the new facility is returned to the Rio Sonoyta, 2) build a pond for Sonoyta mud turtles near the new facility, and 3) hire a biologist to oversee management of these measures. Sonoyta OOMAPAS began construction of the new facility in Spring 2011 and it was planned for completion in 2012. However, completion of the new wastewater treatment facility has been delayed. One of the ponds at the new treatment facility failed in early 2012, resulting in effluent running directly into the Rio Sonoyta. No liner was installed in the pond, nor was soil compacted during construction. The Pinacate Biosphere Reserve and EPA continue to work with Sonoyta OOMAPAS to provide technical assistance with implementation of conditions of the Resolutivo as appropriate. In September 2013, La Comisión Nacional del Agua (CONAGUA) and the Sonoyta OOMAPAS agreed that the wastewater treatment facility would be completed as originally designed (H. Aguirre-Pompa 2013, pers. comm.). The EPA is still awaiting written confirmation from CONAGUA, but is cautiously optimistic that berm repair and construction of the facility will be finished in calendar year 2014 (H. Aguirre-Pompa 2013, pers. comm.). Sonoyta mud turtles will eventually be moved from the decommissioned lagoon to the new lagoons once they are filled and operating, which could be several years once the treatment facility is completed (H. Aguirre-Pompa 2012, pers. comm.).

References

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2014

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2015

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2016

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2017

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2018

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2019

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2020

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2021

U.S. FISH AND WILDLIFE SERVICE SPECIES ASSESSMENT AND LISTING PRIORITY ASSIGNMENT FORM 05/30/2022

SPECIES ACCOUNT: *Lepidochelys kempii* (Kemp's ridley sea turtle)

Species Taxonomic and Listing Information

Listing Status: Endangered; 12/02/1970; Southwest Region (R2) (USFWS, 2016)

Physical Description

A small marine turtle. This is a sea turtle with an almost circular carapace, olive green (adults) or gray (young) above, yellow below; 5 costals on each side of carapace, the first one touching the nuchal; usually 4 enlarged scutes on bridge, with a single pore at the posterior edge of each scute; usually there is an interanal scute at the posterior tip of the plastron; beak is somewhat parrotlike; young have 3 tuberculate dorsal ridges, four plastral ridges; limbs are flattened flippers; adult carapace length usually 58-70 cm (to 75 cm), mass 36-45 kg (to 50 kg); 3.8-4.4 cm at hatching (Conant and Collins 1991) (NatureServe, 2015). Kemp's ridley sea turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Taxonomy

The Kemp's ridley is closely related to the olive ridley (Lepidochelys olivacea) (Kichler Holder and Holder 2007), but it is a genetically distinct species (Bowen et al. 1991, 1998) (NMFS and USFWS, 2015). The Kemp's ridley was first described by Samuel Garman (Garman 1880), as Thalassochelys kempii (or Colpochelys kempii) (NMFS, USFWS, and SEMARNAT, 2011).

Historical Range

Nesting aggregations at Rancho Nuevo in Tamaulipas, Mexico, were discovered in 1947 (NMFS, USFWS, and SEMARNAT, 2011).

Current Range

Adults essentially are restricted to the Gulf of Mexico. Immatures inhabit the Gulf and also the U.S. Atlantic coast north to Long Island Sound (Morreale et al. 1992), New England, and Nova Scotia. Occasional individuals reach Bermuda, the Azores, and European waters (see USFWS 1992, 1998). There is a single major nesting beach, at Rancho Nuevo, Tamaulipas, Mexico; 60 percent of nesting occurs along a 40-kilometer stretch of beach there (NMFS and USFWS 2007). In 2006, eggs were deposited in several hundred nests near Tampico, Mexico, and in about 100 nests in Texas (NMFS and USFWS 2007). Sporadic nesting has occurred as far north as North Carolina and south to Colombia (Palmatier 1993) (NatureServe, 2015). The Kemp's ridley occurs from the Gulf of Mexico and along the Atlantic coast of the U.S. (TEWG 2000). Kemp's ridley sea turtles have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomas and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2010) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Distinct Population Segments Defined

No

Critical Habitat Designated
No;

Life History

Feeding Narrative

Adult: Adults and immatures are invertivores. Adults evidently are primarily benthic feeders that specialize on crabs; juveniles feed on sargassum, mollusks often associated with sargassum, and fishes and shrimps probably discarded by anglers (Shaver 1991). Spider crabs and rock crabs were important prey at Long Island, New York, where ridleys also consumed lady crabs, blue mussels, bay scallops, mud snails, marine plants, and debris (Burke et al. 1994; Copeia 1993:1176-1180). Recorded stomach contents also include shrimp, sea urchins, sea stars, and fishes. In northern estuaries, diving activity peaked at dusk and dawn (see Morreale and Standora, no date) (NatureServe, 2015). Generally, growth rates in the Gulf of Mexico are greater (~7.0 cm/yr; Fontaine et al. 1989; Landry et al. 2005; Schmid and Woodhead 2000) than in the Atlantic Ocean (< ~ 6.0 cm/yr; Morreale and Standora 1998; Schmid and Woodhead 2000) (NMFS and USFWS, 2015).

Reproduction Narrative

Egg: As is true of all sea turtles, this species has temperature-dependent sex determination. Egg survivorship (to hatching) was 0.59 in one study (see Iverson 1991) (NatureServe, 2015). Temperatures of 32.5ºC or higher produced 100% female hatchlings, and although a minimum temperature could not be determined, temperatures less than 29º C produced predominately male hatchlings (LeBlanc et al. 2012) (NMFS and USFWS, 2015).

Adult: Nesting occurs from April to July. Individual females nest at intervals of 1 - 4 years (most often 2 years). Available information indicates that females begin nesting at an estimated age of 10 - 17 years (see NMFS and USFWS 2007). Nesting occurs on well-defined elevated dune areas, especially on beaches backed up by large swamps or bodies of open water having seasonal, narrow ocean connections (NatureServe, 2015). It has been estimated that females lay an average of 2.5 clutches within a season (TEWG 1998, 2000). The average number of eggs per clutch range from 95 to112 with 42 - 62 days of incubation prior to hatching (Burchfield 2009; Guzmán-Hernández et al. 2007). Kemp's ridleys tend to nest in large aggregations or arribadas (Bernardo and Plotkin 2007) (NMFS and USFWS, 2015). For small, immature Kemp's ridleys in the neritic environment an annual Survival Rate (S) of 0.61 was estimated. The best-fit parameter estimates for annual survival were 0.31 for pelagic immatures and 0.91 for large benthic immatures and adults (Heppell et al. 2005) (NMFS, USFWS, and SEMARNAT, 2011). Females mature at twelve years of age. The average remigration is two years. Nesting occurs from April to July in large arribadas, primarily at Rancho Nuevo, Mexico. Females lay an average of 2.5 clutches per season. The annual average clutch size is ninetyseven to one hundred eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats. Juvenile Kemp's ridley sea turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep, although they can also be found in deeper offshore waters. As adults, Kemp's ridleys forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS 2011) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Environmental Specificity

Adult: Very narrow to narrow (NatureServe, 2015)

Site Fidelity

Adult: High (USFWS, 2016)

Habitat Narrative

Egg: Embryonic development occurs in the supralittoral zone of the nesting beach (NMFS, USFWS, and SEMARNAT, 2011).

Adult: Habitat of adults primarily includes shallow coastal and estuarine waters, often over sandy or muddy bottoms where crabs are numerous. Most adults stay in the Gulf of Mexico, and they are rare along the Atlantic coast of the northeastern United States. Apparently most activity is benthic. Post-hatchlings spend 1 - 4 years as surface pelagic drifters in weedlines of offshore currents in the Gulf of Mexico and Atlantic Ocean, then shift to benthic coastal habitats of various types, especially where crabs and other invertebrates are numerous (CSTC 1990, NMFS and USFWS 2007). The environmental specificity is very narrow to narrow (NatureServe, 2015). A female will lay eggs during the day and may return to the same nesting beach the next year (USFWS, 2016).

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migrates between nesting and feeding areas (NatureServe, 2015)

Dispersal

Adult: High (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Most individuals move north or south from the major nesting beach at Rancho Nuevo and then settle in resident feeding areas for several months or more in various coastal locations in the Gulf of Mexico (see NMFS and USFWS 2007). An unknown percentage of the population migrates up to thousands of kilometers between nesting beaches and Atlantic coastal feeding areas as far north as Long Island Sound, New York (Morreale et al. 1992; Morreale and Standora, no date), and beyond (NatureServe, 2015). Kemp's ridley hatchlings enter the Gulf of Mexico from beaches near Rancho Nuevo, Mexico, and are presumably carried by major oceanic currents (e.g., anticyclonic Mexican Current) into various areas of the Gulf of Mexico and North Atlantic (NMFS and USFWS, 2015).

Population Information and Trends

Population Trends:

Decline of > 90% (NatureServe, 2015)

Species Trends:

Increasing (NMFS, USFWS, and SEMARNAT, 2011)

Resiliency:

high (inferred from NatureServe, 2015; see current range/distribution)

Representation:

High (inferred from USFWS, 2015)

Redundancy:

Low (inferred from NatureServe, 2015)

Number of Populations:

1 nesting (NatureServe, 2015)

Population Size:

10,000 - 100,000 individuals (NatureServe, 2015)

Population Narrative:

The number of nesting females declined from possibly more than 42,000 in a single arribada in the 1940s to only around 234 (740 nests) by the mid-1980s to 7,000-8,000 in 2006 (NMFS and USFWS 2007). However, the 1940s population may have been an order of magnitude smaller (see NMFS and USFWS 2007). This species has experienced a long term population decline of > 90%. The total number of nests for all beaches in Mexico in 2006 was estimated at 12,143, with another 100 in the United States (mainly Texas) (NMFS and USFWS 2007). This equates to more than 4,000 females. Given a nesting interval of about 2 years or a little less, the total number of adult females in 2006 was approximately 7,000 - 8,000. In 2007, more than 4,000 females nested during a 3-day period at Rancho Nuevo. Despite occurrence of this species throughout the Gulf of Mexico and in much of the northern Atlantic, there remains only a single important nesting area (NatureServe, 2015). Kichler (1996) showed that the genetic variability as measured by heterozygosis at microsatellite loci is high (H = 0.60) (NMFS and USFWS, 2015). The Kemp's ridley nesting population is exponentially increasing, which may indicate a similar increase in the population as a whole (NMFS, USFWS, and SEMARNAT, 2011). The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. A successful head-start program has resulted in the reestablishment of nesting at Texan beaches. While fisheries bycatch remains a threat, the use of turtle excluder devices mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. It is clear that the species is steadily increasing; however, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017). Abundance Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS 2015). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, fifty in 2005, 197 in 2009, and 119 in 2014 (NMFS 2015). Productivity / Population Growth Rate From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15% annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2015). Genetic Diversity Genetic variability in Kemp’s ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS 2011). Additional analysis of the mitochondrial DNA taken from samples of Kemp’s ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006) (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Threats and Stressors

Stressor: Habitat destruction and degradation (NMFS and USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Nesting areas in Mexico that are close to larger cities, such as Altamira and Ciudad Madero (near Tampico) and La Pesca (north of Rancho Nuevo), are more commercialized and there is a greater potential for human impact from coastal development on the nesting habitat. Because the Kemp’s ridley has one primary nesting beach, this species is particularly susceptible to habitat destruction by natural (e.g., hurricanes) and human caused events. Human caused threats include the potential for oil spills, especially in the Gulf of Mexico since it is an area of high-density offshore oil exploration and extraction. Observations of oil and other pollutants have been found within major foraging grounds for Kemp’s ridleys (Witherington et al. 2012a). Habitat destruction is also occurring as a result of activities that directly impact bottom habitats, primarily bottom trawling, dredge fishing, dredging of channels, and dredging associated with beach nourishment activities (NMFS and USFWS, 2015).

Stressor: Climate change (NMFS and USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Based on substantial new evidence, observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. These changes include shifts in ranges and changes in algal, plankton, and fish abundance (IPCC 2007), which could affect Kemp’s ridley prey distribution and abundance. Turtles may also alter their migratory behaviors in response to increasing water temperatures. Global warming is expected to increase the frequency and intensity of tropical storms and hurricanes, which can result in degradation of nesting habitat (e.g., Pike 2013) (NMFS and USFWS, 2015).

Stressor: Fisheries bycatch (NMFS and USFWS, 2015)

Exposure:
Response:
Consequence:
Narrative: Bycatch occurs throughout the Gulf of Mexico and northwest Atlantic Ocean (reviewed by Wallace et al. 2013). Kemp's ridleys have the highest rate of interaction with fisheries operating in the Gulf of Mexico and Atlantic Ocean than any other species of turtle (Finkbeiner et al. 2011). Despite an apparent decrease in Kemp's ridley injury and mortality in the shrimp fishery operating in the southeastern United States as evidenced by the use of properly installed TEDs, Kemp's ridleys continue to be captured and killed at high rates (Finkbeiner et al. 2011; NMFS 2014). Bycatch of Kemp's ridleys in bottom otter trawls also occurs in the mid-Atlantic, generally off Virginia and southward (Epperly et al. 1995, 1996; Haas 2010; Warden 2011). Gill net fisheries operating along the mid and southeast U.S. Atlantic coastlines are known to incidentally capture Kemp's ridleys (Byrd et al. 2011; Finkbeiner et al. 2011; McClellan et al. 2009, 2011; Murray 2009, 2013; Snoddy and Williard 2010; Snoddy et al. 2009; TEWG 2000; Trent et al. 1997). Kemp's ridleys also are caught in pound nets. In 2012, almost 200 turtles, the majority were immature Kemp's ridleys, were caught alive by recreational fishermen at coastal fishing piers in Mississippi (Coleman et al. 2013). An estimated 100 adult Kemp's ridley sea turtles were found stranded along the Tamaulipas coast during the month of March 2007, and the cause was suspected to be the shark fishery (P. Burchfield, Gladys Porter Zoo, personal communication, 2007) (NMFS and USFWS, 2015).

Stressor: Mortality and injury associated with anthropogenic activities (NMFS and USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Incidental take of Kemp's ridleys has also been documented in channel dredging operations (NMFS et al. 2011). Exposure to heavy metals and other contaminants in the marine environment is also of concern. In addition to other sources of contaminants, coastal runoff has the potential to pollute shallow coastal habitats used by Kemp's ridleys. Kemp's ridleys are known to bioaccumulate a variety of toxins including organochlorine compounds and heavy metals (Gardner et al. 2006; Innis et al. 2008; Keller et al 2004, 2005; Kenyon et al. 2001; Lake et al. 1994; Pugh and Becker 2001; Rybitski et al. 1995; Wang et al. 2003). Additional human caused factors affecting Kemp's ridleys include the impacts of boat traffic on turtles and coastal habitats, ingestion and entanglement in marine debris, and intake of turtles into cooling systems of coastal power plants. Boat strikes have been shown to be a mortality source in the Gulf of Mexico and Atlantic Ocean (Foley et al. 2009; Singel et al. 2003; STSSN/NMFS: http://www.sefsc.noaa.gov/species/turtles/strandings.htm). Terrestrial hazards such as beach vehicles have caused a number of fatalities by running over nesting turtles, nests and hatchlings (NMFS et al. 2011). Marine debris in the Gulf of Mexico is becoming an increasing threat to the Kemp's ridley (Frazier et al. 2007; Mallos and Schutes 2013; NMFS et al. 2011; Schuyler et al. 2013). The ingestion of and entanglement in marine debris can increase absorption of toxic materials and reduce food intake and digestive capacity (Balazs 1985; Bjorndal et al. 1994; Sako and Horikoshi 2002), and entanglement has been shown to cause mortality of sea turtles (Bugoni et al. 2001; Snoddy and Williard 2010; Snoddy et al. 2009; Stabenau and Vietti 2003). Along the U.S. Atlantic coast and in the Gulf of Mexico, power plants are known to entrain Kemp's ridleys in the intake channels of their cooling systems (Finn 2013; Florida Power and Light and Quantum Resources Inc. 2005; NMFS and FWS 2014; TEWG 2000) (NMFS and USFWS, 2015).

Recovery

Reclassification Criteria:
1. A population of at least 10,000 nesting females in a season (as measured by clutch frequency per female per season) distributed at the primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained. Methodology and capacity to implement and ensure accurate nesting female counts have been developed (NMFS and USFWS, 2015).

2. Recruitment of at least 300,000 hatchlings to the marine environment per season at the three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) in Mexico is attained to ensure a minimum level of known production through in situ incubation, incubation in corrals, or a combination of both (NMFS and USFWS, 2015).

3. Long-term habitat protection of two of the primary nesting beaches is maintained in Mexico (Rancho Nuevo, Tepehuajes) as federal, state, municipal, or private natural protected areas under a similar legally protective designation or mechanism. Long-term habitat protection of the nesting beach at Playa Dos, through establishment as a natural protected area or similar legally protective designation or mechanism is initiated (NMFS and USFWS, 2015).

4. Social and/or economic initiatives that are compatible with the Kemp's ridley conservation programs have been initiated and/or developed in conjunction with the Kemp's ridley conservation program at Rancho Nuevo and at least two other communities adjacent to Kemp's ridley sea turtle camps. The National Commission of Protected Natural Areas (CONANP) will determine whether these initiatives are sufficient based on community need and potential benefits to conservation (USFWS, 2014).

5. Predation of nests is reduced through protective measures implemented to achieve 300,000 hatchlings per season at Rancho Nuevo, Tepehuajes and Playa Dos in Mexico through in situ incubation, incubation in corrals or a combination of both (USFWS, 2014).

6. Turtle excluder device (TED) regulations, or other equally protective measures are maintained and enforced in all U.S. and Mexican trawl fisheries (e.g., shrimp, summer flounder, whelk) that are known to have an adverse impact on Kemp's ridleys in the Gulf of Mexico and Northwest Atlantic (NMFS and USFWS, 2015).

7. A sub-group of the Team and other technical experts has been convened and made progress in identifying and reviewing the most current data on major foraging areas (especially for juveniles), inter-nesting habitats, mating areas, and adult migration routes in Mexico and U.S. waters to provide information to ensure recovery (NMFS and USFWS, 2015).

See the 2011 Final Bi-National (U.S. and Mexico) Revised Recovery Plan for Kemp's ridley sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were identified as priorities to recover Kemp's ridely sea turtles: 11. Protect and manage nesting and marine habitats. 12. Protect and manage populations on the nesting beaches and in the marine environment. 13. Maintain a stranding network. 14. Manage captive stocks. 15. Sustain education and partnership programs. 16. Maintain, promote awareness of and expand U.S. and Mexican laws. 17. Implement international agreements. 18. Enforce laws (NMFS Chlorpyrifos, Diazinon, and Malathion BiOp, 2017).

Delisting Criteria:
1. An average population of at least 40,000 nesting females per season (as measured by clutch frequency per female per season) over a 6-year period distributed among nesting beaches in Mexico and the U.S. is attained. Methodology and capacity to ensure accurate nesting female counts have been developed and implemented (NMFS, USFWS, and SEMARNAT, 2011).

2. Ensure average annual recruitment of hatchlings over a 6-year period from in situ nests and beach corrals is sufficient to maintain a population of at least 40,000 nesting females per nesting season distributed among nesting beaches in Mexico and the U.S into the future. This criterion may rely on massive synchronous nesting events (i.e., arribadas) that will swamp predators as well as rely on supplemental protection in corrals and facilities (NMFS, USFWS, and SEMARNAT, 2011).

3. Long-term habitat protection of the nesting beaches of Tamaulipas (Rancho Nuevo, Tepehuajes, Playa Dos), Veracruz (Lechuguillas and Tecolutla), and Texas (federally managed sections of North Padre (PAIS), South Padre, and Boca Chica Beach) is maintained via federal, state, municipal, or private natural protected areas or under a similar legally protective designation or mechanism (NMFS, USFWS, and SEMARNAT, 2011).

4. Community socioeconomic programs initiated in conjunction with Kemp's ridley conservation programs at Rancho Nuevo, Tepehuajes, and La Pesca are maintained and expanded to other areas such as La Pesca-Costa Lora, San Vicente, Buena Vista, Barra del Tordo and Barra Moron—Playa Dos Rancho Nuevo where significant Kemp's ridley nesting occurs in Mexico. The CONANP will determine whether these initiatives are sufficient based on community need and potential benefits to conservation (NMFS, USFWS, and SEMARNAT, 2011).

5. Predation of nests is reduced through protective measures implemented to achieve criterion number 2 (NMFS, USFWS, and SEMARNAT, 2011).

6. Specific and comprehensive Federal, State, and local legislation or regulations are developed, promulgated, implemented, and enforced to ensure post-delisting protection of Kemp's ridleys and their terrestrial and marine habitats, as appropriate. These would address significant impacts to Kemp's ridleys in trawl, gillnet, hook and line, trap/pot activities, including the Mexican shark fishery. Mexico and U.S. continue collaborative efforts to ensure post-delisting protection of Kemp's ridleys and their terrestrial and marine habitats under the auspices of the Inter-American Convention for the Protection and Conservation of Sea Turtles (NMFS, USFWS, and SEMARNAT, 2011).

7. A network of in-water sites in the Gulf of Mexico and U.S. Atlantic to monitor populations (e.g., demographics and abundance) is established, and surveys are implemented (as developed by the sub-group convened under downlisting criteria) (NMFS, USFWS, and SEMARNAT, 2011).

8. Monitoring programs have been initiated in commercial and recreational fisheries of concern in both Mexico and the U.S to monitor Kemp's ridley bycatch. Necessary measures to minimize mortality in all commercial and recreational fisheries have been implemented sufficiently to ensure recruitment to maintain population level in criterion number 1 after delisting (NMFS, USFWS, and SEMARNAT, 2011).

9. All other human significant sources of Kemp's ridley mortality have been addressed sufficiently through implementation measures to minimize mortality to ensure recruitment to maintain population level in criterion number 1 after delisting (NMFS, USFWS, and SEMARNAT, 2011).

10. Sea Turtle Stranding and Salvage Network research and data collection will be continued to monitor the effectiveness of protection and restoration activities for Kemp's ridley in the U.S. and Mexico (NMFS, USFWS, and SEMARNAT, 2011).

Recovery Actions:

- Protect and manage nesting and marine habitats (NMFS, USFWS, and SEMARNAT, 2011).
- Protect and manage populations on the nesting beaches and in the marine environment (NMFS, USFWS, and SEMARNAT, 2011).
- Maintain a stranding network (NMFS, USFWS, and SEMARNAT, 2011).
- Manage captive stocks (NMFS, USFWS, and SEMARNAT, 2011).
- Educate the public (NMFS, USFWS, and SEMARNAT, 2011).
- Develop community partnerships (NMFS, USFWS, and SEMARNAT, 2011).
- Maintain and develop local, state, and national government partnerships (NMFS, USFWS, and SEMARNAT, 2011).
- Maintain, promote awareness of, and expand U.S. and Mexico laws (NMFS, USFWS, and SEMARNAT, 2011).
- Implement international agreements (NMFS, USFWS, and SEMARNAT, 2011).
- Enforce laws in the marine and terrestrial environment and in the marketplace (NMFS, USFWS, and SEMARNAT, 2011).

Conservation Measures and Best Management Practices:

- Continue funding by FWS, NMFS, CONANP at a level of support needed to run the successful turtle camps in the State of Tamaulipas, Mexico, in order to continue the high level of hatchling production and nesting female protection (NMFS and USFWS, 2015).
- Increase TED compliance in U.S. and Mexico shrimp fisheries (NMFS and USFWS, 2015).
- Require TEDs in U.S. skimmer trawl fisheries and other trawl fisheries (or where TEDs are not effective, other measures to reduce bycatch) in coastal waters where fishing overlaps with the distribution of Kemp's ridleys (NMFS and USFWS, 2015).
- Assess bycatch in gillnets in the Northern Gulf of Mexico and States of Tamaulipas and Veracruz, Mexico, to determine whether modifications to gear or fishing practices are needed (NMFS and USFWS, 2015).
- Collect data on vital rates starting in the 2015 season, and for the next 5 years, including clutch frequency, remigration intervals, growth and mortality rates, recruitment into the breeding population, age distribution at first nesting, and oceanic temperature influences on fecundity. These data are needed to better assess nesting trends in the future and to better inform recovery actions (NMFS and USFWS, 2015).
- Collect and continue to evaluate data on climate change and how it effects Kemp's ridley sea turtles and their habitat. Develop management plans to minimize any effects from climate change (NMFS and USFWS, 2015).

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SPECIES ACCOUNT: *Lepidochelys olivacea* (Olive Ridley sea turtle)

Species Taxonomic and Listing Information

Listing Status: Threatened; 7/28/1978; Southeast Region (R4) (USFWS, 2016)

Physical Description

Adults are olive or grayish green above, but sometimes appear reddish due to algae growing on the carapace. The underparts are greenish white, especially in younger specimens, becoming creamy yellow with age. Hatchlings are all black when wet (dark gray otherwise) with a pale yolk scar. Hatchlings and juveniles have serrated posterior marginals; these become smooth with age and the adult has a rounded carapace. Juveniles also have three longitudinal dorsal keels; the central keel gives younger animals a serrated profile and persists almost until maturity. Two keels on the plastron also disappear with age (NMFS & USFWS, 1998).

Taxonomy

This species was originally described as Testudo mydas minor Suckow, 1798, later renamed Chelonia olivacea Eschscholtz, 1829, and eventually Lepidochelys olivacea Fitzinger, 1843. The genus name is derived from the Greek words lepidos, meaning scale, and chelys, meaning turtle, possibly in reference to the supernumerary costal scute counts characteristic of this species (cf. Smith and Smith 1979). The etymology of the English vernacular name "ridley" is unclear (Dundee 1992). Lepidochelys is the only sea turtle genus with more than one extant species: L. olivacea and the closely related Kemp's ridley L. kempii (Bowen et al. 1991). Although the name L. o. remivaga has been proposed for the eastern Pacific populations, there are no currently accepted named subspecies (Pritchard 1969a; Smith and Smith 1979). Detailed taxonomic reviews of this genus and species are provided by Smith and Smith (1979) and Pritchard and Trebbau (1984) (NMFS & USFWS, 1998).

Historical Range

See current range/distribution.

Current Range

The olive ridley sea turtle is widely regarded as the most abundant sea turtle in the world (Carr 1972; Zwinenberg 1976). Until recent historical times and the advent of modern commercial exploitation of sea turtles, the olive ridley was superabundant in the eastern Pacific, undoubtedly outnumbering all other sea turtle species combined in the area. For example, Carr (1972) states that more than 1,000,000 olive ridleys were commercially harvested in Mexico during 1968 alone, and Cliffton et al. (1982) estimated that a minimum of 10,000,000 olive ridleys swam in the seas off Pacific Mexico before the recent era of exploitation (NMFS & USFWS, 1998).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Data on the food and foraging habits of olive ridleys are remarkably sparse with much of the information only anecdotal. An early suggestion that olive ridleys are primarily vegetarian (Deraniyagala 1939; Bustard 1972) has not been substantiated (Márquez et al. 1976). The general picture suggests a catholic diet with crustaceans playing a major role. Identified prey include a variety of mostly benthic, but also some pelagic, prey items. Benthic prey include bottom fish, crabs, oysters, sea urchins, snails, sessile tunicates, shrimp, and algae; pelagic prey include jellyfish medusae, salps, and pelagic red crabs (Pleuroncodes planipes) (Deraniyagala 1939; Carr 1961; Caldwell 1969; Fritts 1981; Cornelius and Robinson 1986; Mortimer 1982; Márquez 1990). Landis (1965) reported a sighting by the crew of a semisubmersible craft from Scripps Institution of Oceanography (University of California) of a "green turtle" feeding on crabs at a depth of 300 m in the Sea of Cortez. This turtle identification was later corrected as an olive ridley (Eckert et al. 1986). Olive ridleys have also been observed feeding on flotsam-associated epibiota, mostly acorn and gooseneck barnacles, molluscs, algae and crabs (IATTC, unpubl. data). The most complete study of olive ridley diet in the eastern Pacific (Montenegro et al. 1986, cited in Márquez 1990) indicates the wide variety of prey taken by this species: adult males (n = 24) fed mainly on fishes (57%), salps (38%), crustaceans (2%), and molluscs (2%), while adult females (n = 115) fed on salps (58%), fishes (13%), molluscs (11%), algae (6%), crustaceans (6%), bryozoans (0.6%), sea squirts (0.1%), sipunculid worms (0.05%), and fish eggs (0.04%). Olive ridleys off western Baja California may feed almost entirely on pelagic red crabs (Márquez 1990), which are superabundant in that area (Pitman 1990). There are several accounts of olive ridleys being caught on longline fishing gear (e.g., Pritchard 1977; Fritts 1981; Balazs 1982b; Cornelius and Robinson 1986). Bait used in these cases include fish (Fritts 1981), squid (R. Pitman, NMFS, pers. obs.), shrimp and turtle meat (Cornelius and Robinson 1986). These observations suggest that olive ridleys scavenge at times, which should be considered when evaluating food and feeding habits based on stomach contents alone. The only information on the natural diet of olive ridleys in offshore waters comes from Bailey and Bailey (1974) who butchered a specimen they collected several hundred miles west of Costa Rica. The turtle was full of shell fragments and they assumed it had been feeding on crabs that had taken up residence around their life raft. Olive ridleys in the open ocean of the eastern Pacific are often seen near floating objects, possibly to feed on associated fish and invertebrates (Pitman 1992; IATTC unpubl. data) (NMFS & USFWS, 1998).

Reproduction Narrative

Adult: Most mating is generally assumed to occur in the vicinity of nesting beaches (Márquez et al. 1976), but copulating pairs have also been reported over 1,000 km from the nearest nesting beach (Hubbs 1977; Pitman 1990). From research conducted at Playa Nancite, Costa Rica, it appears that the number of copulating (or courting) pairs observed near the nesting beach cannot account for the fertilization of tens of thousands of gravid females, and some if not the majority of mating must occur away from the nesting grounds (O. Owens, Texas A & M University [TAMU], pers. comm.). Arenas and Hall (1992) observed that turtles start to aggregate near the nesting beach two months before the nesting season. Olive ridleys nest throughout the year in the eastern Pacific with peak months, including major arribadas, occurring from September through December. Preferred nesting habitat is a relatively flat, middle beach zone, free of debris (Cornelius 1976). Beach fidelity is not absolute. Hughes and Richard (1974) reported individual ridleys nesting at both Playa Naranjo and Playa Nancite, Costa Rica, approximately 1.5 km apart, during the same season. Nesting is mostly nocturnal but some diurnal emergences are known, especially during large arribadas (Pritchard 1969a; Caldwell and Casebeer 1964; Cliffton et al. 1982). Age at sexual maturity is not known, but there are data on the minimum breeding size. For example, the average length of 251 turtles nesting at Playa Nancite, Costa Rica, was 63.3 cm, with the smallest being 54.0 cm (Hughes and Richard 1974). Ten of 22 nesting females recaptured at Punta Raton, Honduras, had internesting intervals of 15 to 17 days (Minarik 1985). Similarly, Pritchard (1969b) and Schulz (1975) reported modal internesting intervals of 17 days and 16 days, respectively, for olive ridleys nesting in Suriname. These are typical internesting intervals for solitary nesters. Most olive ridleys, however, undertake to nest synchronously in arribadas which typically occur on 28-day, lunarassociated cycles. For example, Márquez et al. (1982) report that olive ridleys nesting in Mexico show "clear internesting cycles every 28 days." Gravid females ascend the beach with an alternate gait, excavate a nest chamber with their rear flippers, deposit the clutch, and vigorously tamp down the nest site with their plastron after the eggs are covered. Most females lay two clutches of eggs per season, remaining nearshore for the approximately one month internesting period (Plotkin et al. 1994). Mean clutch size for Mexican populations is 105.3 eggs (n = 1,120 nests) (Márquez 1990). Mean clutch sizes for two nesting beaches in Costa Rica is 99.6 eggs (SD = 17.0, n = 115 nests) and 107.4 eggs (SD = 17.4, n = 66) (Cornelius et al. 1991). Eggs range from 32.1 to 44.7 mm in diameter and 30 to 38 g. Incubation usually takes from 50 to 60 days, but can vary depending on temperature, humidity, sand grain size and organic content. Hughes and Richard (1974) found that individuals from nests in shady, vegetated areas took up to 70 days or more to hatch. Plotkin et al. (in review) satellite-tagged nesting females during an arribada at Playa Nancite, Costa Rica, and monitored internesting movements and cohort cohesiveness. They found that the turtles dispersed away from each other during the internesting period, returning to nest in successive arribadas. After their final nest, the turtles from each of the three cohorts studied dispersed independently of each other. It is noteworthy that scientific opinions differ as to the extent to which arribadas, which are unique to Lepidochelys, contribute to overall population status. Some researchers feel that the tremendous reproductive output of arribadas is essential to the success of the species by subsidizing smaller colonies elsewhere. For example, Lagueaux 1991 mentions beaches in Nicaragua where 100% of the eggs have been harvested for many years. It seems logical that those beaches recruit breeding turtles from other populations. On the other hand, the excessive egg loss (up to 99.8% in some instances) and the subsequent decline in reproductive output suggests that traditional arribada beaches may fall far short of their reproductive potential and may not be primarily responsible for maintaining olive ridley populations in the ETP. The greatest single cause of olive ridley egg loss comes from the nesting activity of conspecifics on arribada beaches where nesting turtles destroy eggs by inadvertently digging up previously laid nests or causing them to become contaminated by bacteria and other pathogens from rotting nests nearby. At Playa Nancite, Costa Rica, an estimated 0.2% of 11.5 million eggs laid during a single arribada produced hatchlings (Hughes and Richard 1974). Predators also contribute to egg loss and include coyotes, opossums, raccoons, coatimundies, feral dogs and pigs, and humans. At Playa Nancite during 1981-1984 an average of 14.2% nests per year was excavated by mammalian predators (range 3.4-25%), with coatimundies being the most numerous predator (Cornelius et al. 1991). Abiotic sources of egg loss include inundation by high tides and erosion. The predators of hatchlings are legion: on the beach they include crabs, snakes, iguanas, frigatebirds, vultures, coyotes, and raccoons; in the water they include predatory fish (Hughes and Richard 1974). (NMFS & USFWS, 1998). In general, individual olive ridleys may nest one, two, or three times per season but on average two clutches are produced annually, with approximately 100-110 eggs per clutch (Pritchard and Plotkin, 1995) (NMFS & USFWS, 2007).Female olive ridleys attain sexual maturity at an age similar to its cogener, the Kemp's ridley (Lepidochelys kempii). Based on samples collected in the north-central Pacific Ocean, Zug et al. (2006) recently confirmed this and estimated the median age of sexual maturity for the olive ridley is 13 years with a range of 10 to 18 years (NMFS & USFWS, 2007).

Habitat Narrative

Adult: This species is found in a wide variety of ocean habitats and nests on various sand beaches (NMFS & USFWS, 1998).Olive ridleys occupy large marine ecosystems. Most abundant in the Pacific Ocean (NMFS & USFWS, 2007).The olive ridley has a circumtropical distribution in the Pacific (Pritchard, 1969). They are not known to move between or among ocean basins. Within a region, olive ridleys may move between the oceanic zone (the vast open ocean environment from the surface to the sea floor where water depths are greater than 200 meters) and the neritic zone (the inshore marine environment form the surface to the sea floor where water depths do not exceed 200 meters) (Plotkin et al. 1995, Shanker et al. 2003a) or just occupy neritic waters (Prithcard 1976, Reichart 1993). However, it is important to note that some data are derived from tag returns of turtles recaptured in coastal fisheries and may present a biased impression of the true distribution of these populations. Recent telemetric data indicate offshore movements well beyond the continental shelf (Georges et al. 2007) (NMFS & USFWS, 2007).

Dispersal/Migration

Motility/Mobility

Juvenile: High (NMFS & USFWS, 2007)

Adult: High (NMFS & USFWS, 2007)

Migratory vs Non-migratory vs Seasonal Movements

Juvenile: Migratory (NMFS & USFWS, 2007; NMFS & USFWS, 1998)

Adult: Migratory (NMFS & USFWS, 2007; NMFS & USFWS, 1998)

Dispersal

Juvenile: High (NMFS & USFWS, 2007)

Adult: High (NMFS & USFWS, 2007)

Dispersal/Migration Narrative

Juvenile: Hatchlings leave the beach to begin what is presumed to be a pelagic phase, the so-called "lost year". No information is available on the movements or the kind of habitat these turtles use during their first year (or possibly years) of life. Information on the habitat of juvenile ridleys is almost nonexistent. During a three hour period on 14 September 1989, R. Pitman observed 75 turtles (only olive ridleys identified), 90 to 120 nautical miles due southwest of Acapulco, Mexico. Numerous individuals in the 20-30 cm size range were present. These turtles were noticeably more common in areas where flotsam and debris were also visible at the surface (R. Pitman, NMFS, unpubl. data). During tuna fishing cruises in the eastern Pacific, the only place turtles less than 60 cm were seen was in the feeding/nursery area in the Panama Bight, off Ecuador and Colombia (IATTC, unpubl. data). It is possible that young turtles move offshore and occupy areas of surface current convergences to find food and shelter among aggregated floating objects until they are large enough to recruit to the nearshore benthic feeding grounds of the adults. A similar scenario has been suggested for hatchling loggerheads that associate with Sargassum weed in the western Atlantic (Carr 1987) (NMFS & USFWS, 1998).

Adult: Information on the movements of adult olive ridleys comes from recaptures of females previously tagged on nesting beaches and satellite telemetry studies. Cornelius and Robinson (1986) reported on 189 recaptured individuals from over 45,000 ridleys tagged in Costa Rica, and summarized results of smaller scale tagging efforts in Mexico and Nicaragua. Turtles nesting in Costa Rica were recovered as far south as Peru, as far north as Oaxaca, Mexico, and offshore to a distance of 2,000 km. The majority (37.6%) were recaptured in Costa Rican waters, 28.6% were recaptured in countries south of Costa Rica and 32.3% were recaptured north of Costa Rica. Cornelius and Robinson (op. cit.) reviewed data on surface current flow in the eastern Pacific but were not able to draw any conclusions about whether the movements of Costa Rican ridleys were the result of active migrations or passive drifting with these currents. Regardless of the mode of transport, there is evidence to suggest that many ridleys undergo a regular migration within the eastern Pacific between breeding grounds in the north and feeding grounds to the south. Of the 54 ridleys recaptured south of Costa Rica in the Cornelius and Robinson (1986) study, 80% were from Ecuador, and turtles tagged in Mexico and Nicaragua have also been recaptured in Ecuador. From 1970-1979, turtle fishermen were taking up to 90,000 ridleys per year (Green and Ortiz-Crespo 1982) in Ecuador, a country where apparently very few ridleys actually nest (none according to Green and Ortiz-Crespo 1982). These and other data (e.g., Hurtado 1981; Meylan 1982) suggest that the huge numbers of ridleys that occur (or formerly occurred) off Ecuador and Colombia are comprised of seasonal migrants from nesting populations to the north. Plotkin et al. (1994) provide further insight into olive ridley movements. Satellite monitoring of post-nesting movements (from Nancite Beach, Costa Rica) showed migration routes traversing thousands of kilometers over deep (>1,000 m) oceanic water, distributed over a very broad range from Mexico to Peru and over 3000 km west of Costa Rica. Their data further indicated that rather than migrating to one specific foraging area after nesting, olive ridleys are nomadic and exploit multiple feeding areas. Sightings of large aggregations of ridleys at sea (e.g., Oliver 1946) have led to unconfirmed speculation that turtles travel in large flotillas between nesting beaches and feeding areas (Márquez 1990).(NMFS & USFWS, 1998).

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

High (inferred from NMFS & USFWS, 1998; NMFS & USFWS, 2007)

Representation:

High (inferred from NMFS & USFWS, 1998; NMFS & USFWS, 2007)

Redundancy:

High (inferred from NMFS & USFWS, 1998; NMFS & USFWS, 2007)

Number of Populations:

81-3000

Population Size:

total number >1,000,000 (NatureServe, 2015)

Population Narrative:

NatureServe (2015) notes that both long and short term population trends are declining. In addition they estimate the number of populations between 81 and 300 and the total number of individuals in excess of 1,000,000.NMFS & USFWS, 1998; NMFS & USFWS, 2007 both note that this species is widely distributed with a large number of populations and individuals which would infer high resiliency, representation and redundancy of the population.

Threats and Stressors

Stressor: Nesting Environment (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence:
Narrative: While no olive ridleys nest in U.S. jurisdiction, it is important that the United States participate in restoration efforts of U.S. sea turtle stocks at their nesting beaches. Thus, we have chosen to add a general description of nesting beach threats, so that U.S. resource managers can make informed decisions on policies to support turtles in other political jurisdictions (NMFS & USFWS, 1998).

Stressor: Directed Take (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Reduction of breeding adults
Narrative: The harvest of sea turtles and/or their eggs for food or any other domestic or commercial use constitutes a widespread threat to these species. Removing breeding adults from a population can accelerate the extinction of local stocks, and the persistent collection of eggs guarantees that future population recruitment will be reduced. This category includes only the harvest of sea turtles (typically nesting females) and their eggs on land. Harvest at sea is discussed in a later section. (see Recovery - Section 1.1.1.1) (NMFS & USFWS, 1998).

Stressor: Increased Human Presence (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of nesting habitat
Narrative: Human populations are growing rapidly in many areas of the insular Pacific and this expansion is exerting increasing pressure on limited island resources. Threats to sea turtles include increased recreational and commercial use of nesting beaches, the loss of nesting habitat to human activities (e.g., pig pens on beaches), beach camping and fires, an increase in litter and other refuse, and the general harassment of turtles. Related threats, such as coastal construction, associated with increasing human populations are discussed separately. (see Recovery - Sections 1.1, 1.2) (NMFS & USFWS, 1998).

Stressor: Coastal Construction (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of nesting habitat
Narrative: The most valuable land on most Pacific islands is often located along the coastline, particularly when it is associated with a sandy beach. Construction is occurring at a rapid rate and is resulting in a loss of sea turtle nesting areas. This section discusses construction-related threats to the region's sea turtle nesting beaches, including the construction of buildings (hotels, houses, restaurants), recreational facilities (tennis courts, swimming pools), or roads on the beach; the construction of sea walls, jetties, or other armoring activities that can result in the erosion of adjacent sandy beaches; clearing stabilizing beach vegetation (which accelerates erosion); and the use of heavy construction equipment on the beach, which can cause sand compaction or beach erosion. (see Recovery - Sections 1.1.2, 1.2) (NMFS & USFWS, 1998).

Stressor: Nest Predation (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of eggs
Narrative: The loss of eggs to non-human predators is a severe problem in some areas. These predators include domestic animals, such as cats, dogs and pigs, as well as wild species such as rats, mongoose, birds, monitor lizards, snakes, and crabs, ants and other invertebrates. (see Recovery - Section 1.1.3) (NMFS & USFWS, 1998).

Stressor: Beach Erosion (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of nesting habitat
Narrative: Weather events, such as storms, and seasonal changes in current patterns can reduce or eliminate sandy beaches, degrade turtle nesting habitat, and cause barriers to adult and hatchling turtle movements on affected beaches. (see Recovery - Section 1.1.5.2, 1.2.1) (NMFS & USFWS, 1998).

Stressor: Artificial Lighting (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of eggs and hatchlings
Narrative: Hatchling sea turtles orient to the sea using a sophisticated suite of cues primarily associated with ambient light levels. Hatchlings become disoriented and misdirected in the presence of artificial lights behind (landward of) their hatching site. These lights cause the hatchlings to orient inland, whereupon they fall prey to predators, are crushed by passing cars, or die of exhaustion or exposure in the morning sun. Nesting adults are also sensitive to light and can become disoriented after nesting, heading inland and then dying in the heat of the next morning, far from the sea. Security and street lights, restaurant, hotel and other commercial lights, recreational lights (e.g., sports arenas), and village lights, especially mercury vapor, misdirect hatchlings by the thousands throughout the Pacific every year. (see Recovery - Section 1.1.2, 1.1.4) (NMFS & USFWS, 1998).

Stressor: Beach Mining (Nesting Environment) (NMFS & USFWS, 1998).

Exposure:
Response:
Consequence: Loss of eggs and hatchlings/Loss of nesting habitat
Narrative: Sand and coral rubble are removed from beaches for construction or landscaping purposes. The extraction of sand from beaches destabilizes the coastline (e.g., reduces protection from storms), removes beach vegetation through extraction or flooding and, in severe cases, eliminates the beach completely. When mining occurs on or behind a nesting beach, the result can be the degradation or complete loss of the rookery. In addition, females can become confused when they emerge from the sea only to find themselves heading down slope into a depression formed by mining activities; too often the outcome is that the female returns to the sea without laying her eggs. Even when eggs are successfully deposited, reduced hatch success results if nests are flooded or excavated during mining. (see Recovery - Section 1.2.2) (NMFS & USFWS, 1998).

Stressor: Vehicular Driving on Beaches (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of eggs and hatchlings
Narrative: Driving on the beach causes sand compaction and rutting, and can accelerate erosion. Driving on beaches used by turtles for egg-laying can crush incubating eggs, crush hatchlings in the nest, and trap hatchlings after they emerge from the nest cavity and begin their trek to the sea. In the latter case, hatchlings are exposed to exhaustion and predators when they fall into and cannot climb out of tire ruts that are typically oriented parallel to the sea. (see Recovery - Section 1.2.6) (NMFS & USFWS, 1998).

Stressor: Exotic Vegetation (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of eggs and hatchlings/Alteration of sex ratios
Narrative: Introduced species can displace native dune and beach vegetation through shading and/or chemical inhibition. Dense new vegetation shades nests, potentially altering natural hatchling sex ratios. Thick root masses can also entangle eggs and hatchlings. (see Recovery - Section 1.2.3) (NMFS & USFWS, 1998).

Stressor: Beach Cleaning (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of eggs and hatchlings
Narrative: Removal of accumulated seaweeds and other debris from a nesting beach should be accomplished by hand-raking only. The use of heavy equipment can crush turtle eggs and hatchlings and can remove sand vital to incubating eggs. (see Recovery - Sections 1.2.5) (NMFS & USFWS, 1998).

Stressor: Beach Replenishment (Nesting Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of nesting habitat/Loss of eggs

Narrative: The nourishment or replacement of beaches diminished by seawalls, storms, or coastal development can reduce sea turtle hatching success by deeply burying incubating eggs, depositing substrate (generally from offshore deposits) that is not conducive to the incubation of sea turtle eggs, and/or obstructing females coming ashore to nest by machinery, pipelines, etc. (see Recovery - Section 1.2.4) (NMFS & USFWS, 1998).

Stressor: Directed Take (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of individuals/Population changes
Narrative: The harvest of juvenile and adult sea turtles for food or any other domestic or commercial use constitutes a widespread threat to these species. In particular, the exploitation of large juveniles and adults can accelerate the extinction of both local and regional stocks. This category includes only the harvest of sea turtles at sea. Harvest on the nesting beach was discussed in a previous section. (see Recovery - Section 2.1). There is no directed take of olive ridleys in U.S. waters. (NMFS & USFWS, 1998).

Stressor: Natural Disasters (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of Forage/Change migration pattern and timing
Narrative: Natural phenomena, such as cyclones, can contribute to the mortality of turtles at sea, particularly in shallow waters. Disease epidemics and other debilitating conditions that affect prey items (sea grass, coral, sponges, reef invertebrates) can also harm sea turtle populations. Storms can alter current patterns and blow migrating turtles off course into cold water. Unseasonal warm water incursions from subtropical regions into the northeastern Pacific, known as "El Niño" events, may cause olive ridleys to migrate north where they "cold stun" once they encounter colder water. El Niño events can also cause reduced food production for some turtle species which can reduce growth and fecundity. (see Recovery - Sections 2.1.6, 2.1.7, 2.2.1, 2.2.2) (NMFS & USFWS, 1998).

Stressor: Disease and Parasites (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: There are few data to assess the extent to which disease or parasitism affects the survivability of sea turtles in the wild. Contact with cold water currents in the northeastern Pacific may cause cold-stunning and make turtles more susceptible to disease. Stranded individuals have been found along the U.S. coast in an emaciated condition (Joe Cordaro, NMFS, pers. comm.) (NMFS & USFWS, 1998).

Stressor: Algae, Seagrass, and Reef Degradation (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of Forage
Narrative: Most sea turtle species depend upon sea grass and/or coral reef habitats for food and refuge. The destruction or degradation of these habitats is a widespread and serious threat to the recovery of depleted sea turtle stocks. The general degradation of these habitats can be

affected by eutrophication, sedimentation, chemical poisoning, collecting/gleaning, trampling (fishermen, skin and SCUBA divers), anchoring, etc. (see Recovery - Section 2.2) (NMFS & USFWS, 1998).

Stressor: Environmental Contaminants (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Loss of Forage
Narrative: Chemical contamination of the marine environment due to sewage, agricultural runoff, pesticides, solvents and industrial discharges is widespread along the coastal waters of the western U.S., particularly near the populated coastal areas of southern California. Declining productivity of benthic communities can negatively impact the olive ridley turtles that depend on these communities for nutrition. (see Recovery - Section 2.2) (NMFS & USFWS, 1998).

Stressor: Debris (Entanglement and Ingestion) (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: The entanglement in and ingestion of persistent marine debris threatens the survival of olive ridley turtles in the eastern Pacific. Turtles become entangled in abandoned fishing gear, lines ropes and nets, and cannot submerge to feed or surface to breathe; they may lose a limb or attract predators with their struggling. Turtles will also ingest debris such as plastic bags, plastic sheets, plastic six-pack rings, tar balls, styrofoam, and other refuse. Necropsies of stranded turtles have revealed mortalities due to ingested garbage resulting in poisoning or obstruction of the esophagus. (see Recovery - Section 2.1.3) (NMFS & USFWS, 1998).

Stressor: Fisheries (Incidental Take) (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: Turtles are accidentally taken in several commercial and recreational fisheries. These include bottom trawls commonly used by shrimp vessels in the Gulf of California, gillnets, traps, pound nets haul seines and beach seines commonly used in inshore and coastal waters of Baja California. In addition, trawls, purse seines, hook and line, driftnets, bottom and surface longlines may kill an as yet unknown number of turtles in different areas of the eastern Pacific. IATTC (unpublished data) reported turtles - mostly unidentified but probably olive ridleys or greens - feeding directly off bait (usually shark or dorado) used by tuna fishermen. Olive ridleys comprised 18% of the annual take of all species of sea turtles by the Hawaiian based longline fishery observed from 1990-1994 (NMFS 1995). The predicted annual take of olive ridleys by this fishery is 152 turtles. Although most are released alive, the level of postrelease mortality remains unknown. (see Recovery - Section 2.1.4) (NMFS & USFWS, 1998).

Stressor: Predation (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: Large coastal and pelagic sharks and killer whales are common in the northeastern Pacific and pose a potential threat to adults and juvenile turtles. On two occasions in 1992,

groups of killer whales were observed feeding on an olive ridley off the coast of Mexico (Esquivel et al. 1993) (NMFS & USFWS, 1998).

Stressor: Boat Collisions (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: Sea turtles can be injured or killed when struck by a boat, especially if struck by an engaged propeller. Recreational equipment, such as jet skis, also pose a danger due to collisions and harassment. (see Recovery - Section 2.1.4, 2.1.5, 2.1.7) (NMFS & USFWS, 1998).

Stressor: Marina and Dock Development (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals/Loss of Forage
Narrative: The development of marinas and private or commercial docks in inshore waters can negatively impact turtles through destruction or degradation of foraging habitat. This type of development also leads to increased boat traffic resulting in collision-related injury and mortality of turtles. Fueling facilities at marinas can result in discharge of oil and gas into sensitive estuarine habitats. There is increasing demand to install marinas and docks and develop inland coastal areas where turtles are known or are likely to exist in Baja California and southern California. (see Recovery - Sections 1.2.1, 2.2) (NMFS & USFWS, 1998).

Stressor: Dredging (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals/Loss of Forage
Narrative: Active dredging machinery (especially hopper dredges) may injure or kill sea turtles, and channelization may alter natural current patterns and sediment transportation. Coral reef and sea grass ecosystems may be excavated and lost, and suspended materials may smother adjacent coral and seagrass communities. (see Recovery - Section 2.2) (NMFS & USFWS, 1998).

Stressor: Dynamite 'Fishing' (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals/Loss of Forage
Narrative: The use of explosives to stun or kill fish destroys coral, degrading or eliminating foraging habitat and refugia for all sea turtle species (except the leatherback) as well as killing turtles directly. (see Recovery - Section 2.2) (NMFS & USFWS, 1998).

Stressor: Oil Exploration and Development (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals/Loss of Forage
Narrative: Oil exploration and development pose direct and indirect threats to sea turtles. A rise in transport traffic increases the amount of oil in the water from bilge pumping and disastrous oil spills. Oil spills resulting from blow-outs, ruptured pipelines, or tanker accidents, can result in

death to sea turtles. Indirect consequences include destruction of foraging habitat by drilling, anchoring, and pollution. (see Recovery - Section 2.2) (NMFS & USFWS, 1998).

Stressor: Power Plant Entrapment (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: The entrainment and entrapment of juvenile and sub-adult turtles in the saltwater cooling intake systems of coastal power plants have been documented in southern California at San Diego Gas & Electric (SDG&E) plant at Carslbad, as well as the Southern California Edison Nuclear Generating Station at San Onofre (Kent Miles, SDG&E, pers. comm., Joe Cordaro, pers. comm.). Some of these turtles are released unharmed. (NMFS & USFWS, 1998).

Stressor: Construction Blasting (Marine Environment) (NMFS & USFWS, 1998).
Exposure:
Response:
Consequence: Death of individuals
Narrative: Blasting can injure or kill sea turtles in the immediate area. The use of dynamite to construct or maintain harbors, break up rock formations or improve nearshore access can decimate sea turtle habitat. Anchoring and related activities employed in support of the blasting can also degrade reefs and other benthic communities that support sea turtles. Some types of dynamiting have minimal impact to marine life, such as placing explosive in pre-drilled holes (drilling and shooting) prior to detonation. This is the standard practice to secure armor rock. (see Recovery - Section 2.2) (NMFS & USFWS, 1998).

Recovery

Delisting Criteria:
Nesting Environment: Protect and manage turtles on nesting beaches (NMFS & USFWS, 1998).

Nesting Environment: Protect and manage nesting habitat (NMFS & USFWS, 1998).

Marine Environment: Protect and manage olive ridley populations in the marine habitat (NMFS & USFWS, 1998).

Marine Environment: Determine distribution, abundance, and status in the marine environment (NMFS & USFWS, 1998).

Marine Environment: Protect and manage marine habitat, including foraging habitats (NMFS & USFWS, 1998).

Ensure proper care in captivity (NMFS & USFWS, 1998).

International Cooperation (NMFS & USFWS, 1998).

Recovery Actions:
- Eliminate directed take of turtles and their eggs. Reduce directed take of turtles through public education and information. Increase enforcement of laws protecting turtles by law

enforcement and the courts. Ensure that coastal construction activities avoid disruption of nesting and hatching activities. Reduce nest predation by domestic and feral animals. Reduce effects of artificial lighting on hatchlings and nesting females. Quantify effects of artificial lighting on hatchlings and nesting females. Implement, enforce, evaluate lighting regulations or other lighting control measures where appropriate. Collect biological information on nesting turtle populations. Monitor nesting activity to identify important nesting beaches, determine number of nesting females, and determine population trends. Evaluate nest success and implement appropriate nest-protection measures on important nesting beaches. Define stock boundaries for Pacific sea turtles. Identify genetic stock type for major nesting beach areas. Determine nesting beach origins for juvenile and subadult populations. Determine the genetic relationship among Pacific olive ridley populations. (NMFS & USFWS, 1998).

- Prevent the degradation of nesting habitats caused by sea walls, revetments, sand bags, other erosion-control measures, jetties and breakwaters. Eliminate sand and coral rubble removal and mining practices on nesting beaches. Develop beach-landscaping guidelines which recommend planting of only native vegetation, not clearing stabilizing beach vegetation and evaluating the effects as appropriate. Ensure that beach replenishment projects are compatible with maintaining good quality nesting habitat. Implement non-mechanical beach cleaning alternatives. Prevent vehicular driving on nesting beaches. (NMFS & USFWS, 1998).
- Eliminate directed take of turtles. Reduce directed take of turtles through public education and information. Increase the law-enforcement efforts to reduce illegal exploitation Determine distribution, abundance, and status in the marine environment. Determine the distribution and abundance of post-hatchlings, juveniles and adults. Determine adult migration routes and internesting movements. Determine growth rates and survivorship of hatchlings, juveniles, and adults, and age at sexual maturity. Identify current or potential threats to adults and juveniles on foraging grounds. Reduce the effects of entanglement and ingestion of marine debris. Evaluate the extent to which sea turtles ingest persistent debris. Evaluate the effects of ingestion of persistent debris on health and viability of sea turtles. Formulate and implement measures to reduce or eliminate persistent debris in the marine environment. Monitor and reduce incidental mortality in the commercial and recreational fisheries. Eliminate the harassment of turtles at sea. Study the impact of diseases on turtles. Maintain carcass stranding network. Centralize administration and coordination of tagging programs (NMFS & USFWS, 1998).
- Determine the distribution and abundance of post-hatchlings, juveniles and adults. Determine adult migration routes and internesting movements. Determine growth rates and survivorship of hatchlings, juveniles, and adults, and age at sexual maturity. Identify current or potential threats to adults and juveniles on foraging grounds (NMFS & USFWS, 1998).
- Identify important marine habitats. Ensure the long-term protection of marine habitat. Identify other threats to marine habitat and take appropriate actions (NMFS & USFWS, 1998).
- Develop standards for the care and maintenance of sea turtles, including diet, water quality, tank size, and treatment of injury and disease. Establish a catalog of all captive sea turtles to enhance use for research and education. Designate rehabilitation facilities (NMFS & USFWS, 1998).
- Support existing international agreements and conventions to ensure that turtles in all lifestages are protected in foreign waters. Encourage ratification of the CITES for all non-

member Pacific countries, compliance with CITES requirements, and removal of sea turtle trade reservations held by member nations. Develop new international agreements to ensure that turtles in all life-stages are protected in foreign waters. Develop or continue to support informational displays in airports which provide connecting legs for travelers to the areas which support olive ridleys (NMFS & USFWS, 1998).

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SPECIES ACCOUNT: *Masticophis lateralis euryxanthus* (Alameda whipsnake (=striped racer))

Species Taxonomic and Listing Information

Commonly-used Acronym: None

Listing Status: Threatened; December 5, 1997 (62 FR 64306).

Physical Description

The Alameda whipsnake (Masticophis [=Coluber] lateralis euryxanthus) is a slender, fast-moving, diurnal snake with a broad head, large eyes, and slender neck (USFWS 2011). Adults reach a length of 91 to 122 centimeters (3 to 4 feet [ft.]) (USFWS 2005). Their back is colored sooty black or dark brown, and has a distinct yellow-orange stripe down each side. The front part of their underside is orange-rufous colored. The midsection is cream colored. The rear section and tail are pinkish. This subspecies is distinguished by eight morphological identifiers: 1. A broad dorsolateral light stripe, one and two half-scales wide, or occasionally two full scales wide, on the anterior two-thirds of the body. 2. A virtual lack of black spotting on the ventral surface of the head and neck. 3. A light stripe between nostril and eye usually not interrupted by dark vertical lines along the margins of the loreal. 4. The lack, usually, of a dark line across the rostral, representing a connection between the supralabial stripes. 5. Direct communication anteriorly between lateral light stripe and the light venter. 6. The absence of dorsal color on the ventrals for a distance back from the snout equal to four and one-half to six times the distance from the posterior edge of the parietals. 7. A sooty black dorsal color. 8. The presence of life of a heavy suffusion of orange-rufous on the anterior light portions of the body (Riemer 1954; USFWS 2002).

Taxonomy

Two subspecies of the California whipsnake (Masticophis lateralis) are recognized: Alameda whipsnake (M. l. euryxanthus) and chaparral whipsnake (M. l. lateralis). There are no definitive geographic boundaries that separate the Alameda whipsnake phenotype from the chaparral whipsnake phenotype. Rather, there appears to be a transition zone in southern and eastern Alameda, northern Santa Clara, and southwestern San Joaquin counties. The zone of intergradation occurs where the two species co-occur and breed, producing individuals with characteristics that reflect, to varying degrees, both parents. Some characteristics of the species are more variable than others. Maps are being developed that depict the geographic distribution of each of the eight phenotypic characters, describe the observed variation in each of the eight characters, and present evidence of characters changing over time in individual snakes. There have been no taxonomic classification or nomenclature changes to the species since its listing. Recent mtDNA phylogenetic results provide evidence that the evolutionary history of the Alameda whipsnake is not distinct from other California whipsnakes throughout the central California clade (USFWS 2003; USFWS 2011). None of the eight morphological differences used by Riemer (Riemer 1954) to describe the Alameda whipsnake are diagnostic; that is, each of the eight morphological characters used to describe Alameda whipsnake as a subspecies have been observed in chaparral whipsnake specimens far removed from the San Francisco East Bay. Interpreting some of the eight characters is ambiguous; for instance, distinguishing characteristic number three in Riemer (1954) is described as, “A light stripe between nostril and eye usually not interrupted by dark vertical lines along the margins of the loreal"; characteristic number four is described as, "The lack, usually, of a dark line across the rostral, representing a connection between the supralabial stripes"; and characteristic number seven is described as, "A sooty black dorsal color." Melanistic individuals are, however, not uncommon throughout the range of the species. Throughout much of Alameda and Contra Costa counties, Alameda whipsnake specimens exhibit five or more of the eight characters, particularly in the East Bay Hills (USFWS 2011).

Historical Range

The Alameda whipsnake inhabits the inner Coast Ranges in western and central Contra Costa and Alameda counties. The historical range was continuous, but has been fragmented into five disjunct populations: Tilden–Briones, Oakland–Las Trampas, Hayward–Pleasanton Ridge, Sunol–Cedar Mountain, and Mount Diablo–Black Hills (62 FR 64306).

Current Range

The range of the Alameda whipsnake and phenotypic-intergrade specimens includes mosaics of chaparral, coastal scrub, and adjacent vegetation types throughout Contra Costa County, most of Alameda County, and small portions of northern Santa Clara and western San Joaquin counties. This range can be subdivided into five populations that correspond to relatively contiguous mosaics of suitable habitat types that are fragmented by urban development, transportation corridors, and a lack of coastal scrub and chaparral vegetation in the Tri-Valley. Alameda whipsnakes have been found to be locally abundant, and are the dominant snake species when habitat quality is high (USFWS 2011).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 10/3/2000.

Legal Description

On October 2, 2006, the U.S. Fish and Wildlife Service designated critical habitat for the Alameda whipsnake (Masticophis lateralis euryxanthus) pursuant to the Endangered Species Act of 1973, as amended (Act). Six critical habitat units were designated in Alameda, Contra Costa, Santa Clara, and San Joaquin Counties, California. An earlier Final Rule designating critical habitat, published on October 3, 2000 (65 FR 58933 - 58962), was vacated in 2003 by a U.S. District Court.

Critical Habitat Designation

Seven critical habitat units (1, 2, 3, 4, 5, 5B, and 6) are designated as as critical habitat for the Alameda whipsnake, encompassing approximately 154,834 acres (ac) (62,659 hectares (ha)).

Unit 1: Tilden-Briones; Alameda and Contra Costa Counties (34,119 ac (13,808 ha)). Unit 1 is bordered approximately by State Highway 4 and the cities of Pinole, Hercules, and Martinez to the north; by State Highway 24 and the City of Orinda Village to the south; Interstate 80 and the cities of Berkeley, El Cerrito, and Richmond, to the west; and Interstate 680 and the City of Pleasant Hill to the east. The South end of Unit 1 abuts Unit 6. Land ownership within the unit includes approximately 8,108 ac (3,281 ha) of EBRPD lands, 15 acres (6 ha) of State land, and the remaining 25,997 ac (10,520 ha) under private ownership. The unit contains a complex mosaic of grassland with woody scrub vegetation of several types (PCE 1 and PCE 2), as well as rock outcrops or other talus features (PCE 3) distributed throughout the unit with little habitat fragmentation. Alameda whipsnake records occur within the unit and are uniformly distributed throughout the unit (Swaim 2005a). The dates of Alameda whipsnake records span a time period from before the subspecies' listing to after the time of listing (1986 to present). Habitat fragmentation is minimal. Very limited development has occurred within the unit, with the exception of a few structures presumably associated with livestock management. The distribution of essential features throughout the unit and low fragmentation allows Alameda whipsnakes to utilize and freely disperse within the unit, making the overall population less vulnerable to local extirpation which could result from fire, landslide, or some other natural event (e.g., drought, disease). The unit is designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is currently occupied, and represents the northwestern portion of the subspecies' range and one of five population centers. The special management actions that may be required within the unit include prescribed burns and management of grazing activities to maintain a mosaic of open habitat. Additional special management actions that may be required for this unit include management of trespass, unauthorized trail construction, dumping, and/or feral animals, and other activities or situations associated with the urban or recreational interface.

Unit 2: Oakland-Las Trampas; Contra Costa and Alameda Counties (24,436 ac (9,889 ha)). Unit 2 is located south of State Route 24, north of Interstate 580, east of State Route 13, and west of Interstate 680 and the cities of Danville, San Ramon, and Dublin. The North edge of Unit 2 abuts Unit 6. Land ownership includes 4,386 ac (1,775 ha) of EBRPD and East Bay Municipal Utilities District lands and 20,050 ac (8,114 ha) under private ownership. Unit 2 contains a range of vegetation (PCE 1 and PCE 2), soil types, and rocky features (PCE 3) essential to the conservation of the subspecies, supports viable Alameda whipsnake populations, and has minimal development such as roads and structures (Swaim 2005a). Areas with development or reduced soil and vegetation characteristics have not been included in the critical habitat for this unit. Unit 2 essential features that contain more dense woodland habitat may be subject to special management considerations, such as prescribed burns, to improve the habitat quality and enhance the potential for Alameda whipsnake movement between units. Additional special management actions that may be required throughout this unit include management of trespass, unauthorized trail construction, dumping, and/or feral animals, and other activities or situations associated with the urban or recreational interface. Alameda whipsnake occurrences have been documented by multiple records within the unit as well as adjacent to the unit (Swaim 2005a). Dispersal of snakes between Units 2 and 1 is possible only through Unit 6, and impediments to such movement do not appear to be present. Unit 2 is included in the critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is currently occupied by the subspecies, and represents the central distribution of Alameda whipsnake and one of the five population centers.

Unit 3: Hayward-Pleasanton Ridge; Alameda County (25,966 ac (10,508 ha)). Unit 3 is located immediately to the west of Interstate 680 and to the south of Interstate 580. Land ownership includes 404 ac (163 ha) of EBRPD land and 25,562 ac (10,345 ha) privately owned land. We have excluded the Stonebrae Country Club project site from critical habitat in this unit (see Relationship of Critical Habitat to Approved Management Plans— Exclusions Under Section 4(b)(2) of the Act, below). Unit 3 contains the mosaic of scrub and chaparral vegetation and rocky outcrops (PCE 1, PCE 3) considered essential to the conservation of the subspecies. The unit also includes variation in vegetation patch size, abundant edge between grassland and woodland, and a minimal amount of development or planned development. The area supports scrub and rock outcrop features essential for Alameda whipsnake. The Alameda whipsnake records within this unit are associated with Gaviota rocky sandy loams in particular, which likely provide talus (PCE 3), and appear to coincide in aerial imagery to scrub or chaparral vegetation preferred by Alameda whipsnake. Vegetation is largely of oak woodland community of variable densities (PCE 2) and statures (trees, shrubs) interspersed with grassland. Some peripheral portions of habitat around this unit were not included as critical habitat due to the high degree of development-related disturbance and fragmentation of the habitat. The unit is included in the designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake; is currently occupied by the subspecies (Swaim 2005a); and represents the southwestern portion of the subspecies' range and one of the five population centers. The special management actions that may be required throughout this unit include management of controlled burns and grazing, trespass, unauthorized trail and road construction, dumping, and/or feral animals, and other activities or situations associated with the urban or recreational interface.

Unit 4: Mount Diablo-Black Hills; Contra Costa and Alameda Counties (23,225 ac (9,399 ha)). This unit encompasses Mount Diablo State Park and surrounding lands, and is largely within Contra Costa County except a small portion that is within Alameda County. Lands are owned by the Bureau of Land Management (23 ac (9 ha)), State Department of Parks and Recreation (13,855 ac (5,607 ha)), and private landowners (9,348 ac (3,783 ha)). We have excluded East Bay Regional Park District lands and lands covered by the draft East Contra Costa County Habitat Conservation Plan and Natural Community Conservation Plan from critical habitat in this unit (see Relationship of Critical Habitat to Approved Management Plans— Exclusions Under Section 4(b)(2) of the Act'', below). Numerous Alameda whipsnake observations (i.e., greater than 90 records from 1972 to 2004) occur throughout the area, many of which are associated with dense rock outcrops (PCE 3) and chaparral, scrub, and oak woodland (PCE 1, PCE 2). The pattern of woody vegetation with grassland and rock outcrops forms an intricate landscape mosaic that is highly functional habitat for the Alameda whipsnake. The vegetation and soil characteristics, the mosaic habitat pattern, the abundance of Alameda whipsnake records, and the lack of surrounding development and relative absence of roadways, together indicate that this unit likely provides some of the very highest quality and largest contiguous blocks of habitat within the range of the subspecies, as well as some of its most robust populations. Special management, such as prescribed burns, may be required for portions of the unit with dense vegetation. The special management actions which may be required throughout this unit include management of controlled burns and grazing, trespass, unauthorized trail and road construction, dumping, and/or feral animals, and other activities or situations associated with the urban or recreational interface. The unit is included in designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is occupied by the subspecies (Swaim 2005a), and represents the northeastern portion of the subspecies' range and one of the five population centers.

Unit 5A: Cedar Mountain; Alameda and San Joaquin Counties (24,723 ac (10,005 ha)). Unit 5A is located east of Lake Del Valle along Cedar Mountain Ridge and Crane Ridge to Corral Hollow west of Interstate 580. Land ownership within this unit includes approximately 2,492 ac (1,008 ha) of Department of Energy land, 246 ac (99 ha) of EBRPD land, and 21,986 ac (8,897 ha)) are privately owned. The vegetation pattern within this unit consists of various woodland, scrub, and/or chaparral communities on northeast-facing slopes (PCE 1, PCE 2). Rock bearing soils which are associated with multiple Alameda whipsnake records (e.g. Vallecitos rocky loam) as well as rock lands are abundant, indicating the presence of PCE 3. Open, grassland-dominated communities are prominent on southwest-facing slopes, but there is also a significant component of woodland habitat on these slopes. Significant areas of vegetation types known to support Alameda whipsnake are present, including coastal oak, chamise-chaparral, mixed chaparral, blue-oak-foothill pine woodland, blue oak woodland, valley oak woodland, and montane hardwood. About 50 Alameda whipsnake records from 1973 through 2002 are known in this unit (Swaim 2005a). In most instances, the boundaries for critical habitat designation correspond to natural breaks in plant communities, habitat quality, and/or landform (ridgelines, water features). A moderate number of light duty roads (e.g., paved or unpaved lightly used) are present within the unit, although there are very few structures or other land modifications. Special management, such as prescribed burns, may be required for portions of the unit with dense vegetation. The special management actions that may be required throughout this unit include management of grazing, trespass, unauthorized trail and road construction, dumping, and/or feral animals, and other activities or situations associated with urban or recreational interface. The unit is included in designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is currently occupied by the subspecies, and represents the southernmost and easternmost distribution of Alameda whipsnake and one of five population centers for the subspecies. Unit 5B: Alameda Creek; Alameda and Santa Clara Counties (18,214 ac (7,371 ha)). This unit is located northeast of Calaveras Reservoir, south of the town of Sunol, including the area along Wauhab Ridge in Alameda County and Oak Ridge in Santa Clara County. Alameda Creek is located at the west margin of the unit, and the unit contains the Sunol Regional Wilderness and Camp Ohlone Regional Park (approximately 361 ac (146 ha)), which are managed by the East Bay Regional Park, with the remaining 17,854 ac (7,225 ha) in private ownership. Vegetation is a mix of blue oak—foothill pine and annual grassland with a significant amount of woodland patches. Coastal live oak is present in the vicinity of Lleyden Creek. Soil types in which Alameda whipsnakes are found dominate the unit. This subunit contains six Alameda whipsnake records documented between 1972 and 2000 (Swaim 2005a). Significant areas of vegetation types known to support Alameda whipsnake are present, including coastal oak, chamisechaparral, mixed chaparral, blue oak— foothill pine woodland, blue oak woodland, valley oak woodland, and montane hardwood interspersed with rock outcrops or talus (PCEs 1, 2, 3). The boundaries for critical habitat designation correspond to natural breaks in plant communities, soil type, and or landform. A moderate number of light roads are present within the unit, although there are very few structures or other land modifications. Development within or adjacent to the unit is minimal. As a result of this low development pressure, the survey efforts for the Alameda whipsnake in this unit have not been as extensive as in the other units. Special management, such as prescribed burns, may be required for portions of the unit with dense vegetation. Other special management actions which may be required throughout this unit includes management of grazing, unauthorized trail and road construction, dumping, and/or feral animals, control and other activities or situations associated with urban or recreational interface. The unit is included in designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is currently occupied, and represents the southern most distribution of Alameda whipsnake and one of the five population centers for the subspecies.

Unit 6: Caldecott Tunnel; Contra Costa and Alameda Counties (4,151 ac (1,680 ha)). This critical habitat unit lies between Units 1 and 2, along the Alameda and Contra Costa County lines. Land ownership within this unit includes 265 ac (107 ha) of East Bay Regional Park lands, 720 ac (291 ha) of State, and 3,166 ac (1,281 ha) in private lands. The unit is bounded by dense urban development to the east and west. However, the vegetation and soil types that are known to support Alameda whipsnake are dominant throughout the unit (PCEs 1, 2, 3). About eight Alameda whipsnake records are known from the unit between 1990 and 2002 (Swaim 2005a). Special management considerations in this unit include possible consolidation of existing roads, or limiting additional road construction in order to preserve a corridor function in this unit as a consequence of the restricted width of the unit and the current presence of a moderate number of roads. Prescribed burns may also be required to maintain the habitat mosaic considered essential. The unit is included in designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is currently occupied, and represents the last remaining habitat connecting Unit 1 and Unit 2, which are two of the five population centers for the subspecies. Maintaining connectivity between units allows for dispersal between units for the subspecies and allows for genetic exchange among all three units.

Unit 5B—Alameda Creek Unit - Alameda and Santa Clara Counties (18,214 ac (7,371 ha)) This unit is located northeast of Calaveras Reservoir, south of the town of Sunol, including the area along Wauhab Ridge in Alameda County and Oak Ridge in Santa Clara County. Alameda Creek is located at the west margin of the unit, and the unit contains the Sunol Regional Wilderness and Camp Ohlone Regional Park (approximately 361 ac (146 ha)), which are managed by the East Bay Regional Park, with the remaining 17,854 ac (7,225 ha) in private ownership. Vegetation is a mix of blue oak—foothill pine and annual grassland with a significant amount of woodland patches. Coastal live oak is present in the vicinity of Lleyden Creek. Soil types in which Alameda whipsnakes are found dominate the unit. This subunit contains six Alameda whipsnake records documented between 1972 and 2000 (Swaim 2005a). Significant areas of vegetation types known to support Alameda whipsnake are present, including coastal oak, chamisechaparral, mixed chaparral, blue oak— foothill pine woodland, blue oak woodland, valley oak woodland, and montane hardwood interspersed with rock outcrops or talus (PCEs 1, 2, 3). The boundaries for critical habitat designation correspond to natural breaks in plant communities, soil type, and or landform. A moderate number of light roads are present within the unit, although there are very few structures or other land modifications. Development within or adjacent to the unit is minimal. As a result of this low development pressure, the survey efforts for the Alameda whipsnake in this unit have not been as extensive as in the other units. Special management, such as prescribed burns, may be required for portions of the unit with dense vegetation. Other special management actions which may be required throughout this unit includes management of grazing, unauthorized trail and road construction, dumping, and/or feral animals, control and other activities or situations associated with urban or recreational interface. The unit is included in designated critical habitat because it contains features essential to the conservation of the Alameda whipsnake, is currently occupied, and represents the southern most distribution of Alameda whipsnake and one of the five population centers for the subspecies.

Primary Constituent Elements/Physical or Biological Features

Critical habitat units are designated for Alameda, Contra Costa, San Joaquin, and Santa Clara counties, California. The primary constituent elements (PCEs) of critical habitat for the Alameda whipsnake (Masticophis lateralis euryxanthus) are the habitat components that provide:

(i) Scrub/shrub communities with a mosaic of open and closed canopy: Scrub/shrub vegetation dominated by low- to medium-stature woody shrubs with a mosaic of open and closed canopy, as characterized by the chamise, chamise-eastwood manzanita, chaparral whitethorn, and interior live oak shrub vegetation series occurring at elevations from sea level to approximately 3,850 feet (1,170 meters). Such scrub/shrub vegetation within these series form a pattern of open and closed canopy used by the Alameda whipsnake for shelter from predators; temperature regulation, because it provides sunny and shady locations; prey-viewing opportunities; and nesting habitat and substrate. These features contribute to support a prey base consisting of western fence lizards and other prey species such as skinks, frogs, snakes, and birds.

(ii) Woodland or annual grassland plant communities contiguous to lands containing PCE 1: Woodland or annual grassland vegetation series comprised of one or more of the following: Blue oak, coast live oak, California bay, California buckeye, and California annual grassland vegetation series. This mosaic of vegetation supports a prey base consisting of western fence lizards and other prey species such as skinks, frogs, snakes, and birds, and provides opportunities for: Foraging, by allowing snakes to come in contact with and visualize, track, and capture prey (especially western fence lizards, along with other prey such as skinks, frogs, birds); short and long distance dispersal within, between, or adjacent to areas containing essential features (i.e., PCE 1 or PCE 3); and contact with other Alameda whipsnakes for mating and reproduction.

(iii) Lands containing rock outcrops, talus, and small mammal burrows. These areas are used for retreats (shelter), hibernacula, foraging, and dispersal, and provide additional prey population support functions.

Special Management Considerations or Protections

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

Special management may be needed to reduce the effects of development projects that remove or reduce the quality of features essential to the subspecies' conservation.

Special management may be required to manage fuel loads to minimize the risk of catastrophic fire within the six critical habitat units.

Special management may be needed to manage grazing practices so they do not result in incompatible losses of scrub, and to restore scrub habitat to areas within the six critical habitat units that have been adversely affected by past overgrazing or associated land management.

Special management may be needed to ensure that the locations and densities of such features and activities within all six critical habitat units are managed so effects on the Alameda whipsnake and its habitat are minimized.

Special management of nonnative predators may be required within all six critical habitat units.

Life History

Feeding Narrative

Adult: Alameda whipsnakes are opportunistic and active daytime predators. They prey extensively on western fence lizards (Sceloporus occidentalis), and are often used as an example of a feeding specialist (USFWS 2005). When hunting, the Alameda Whipsnake commonly moves with its head held high and occasionally moves it from side to side to peer over grass or rocks for potential prey (USFWS 2005). Prey is apprehended quickly, pinioned under loops of the body, and engulfed without constriction. In addition to western fence lizards, Alameda whipsnakes feed on a variety of secondary prey; frogs (Pseudacris sp. and Lithobates sp.), skinks (Scincidae sp.), alligator lizards (Elgaria sp.), snakes, small birds, amphibians, single-slender salamanders (Batrachoseps attenuatus), small mammals, fish, and insects are also important in the whipsnake's diet (NatureServe 2015; USFWS 2005; USFWS 2011).The Alameda whipsnake is semi-arboreal and can escape into or hunt in shrubs or trees. Adult Alameda whipsnakes have a bimodal seasonal activity pattern, with peaks during the spring mating season and smaller peak during late summer and early fall. They generally retreat to winter hibernacum in November and emerge in March; however, short periods of aboveground activity such as basking in the immediate vicinity of the hibernaculum may occur during this time. The Alameda is an active daytime predator (USFWS 2011). Rock outcrops are an important feature of their habitat, because they provide retreat opportunities for whipsnakes and promote lizard populations (USFWS 2005).

Reproduction Narrative

Adult: Alameda whipsnakes are ovoviviparous and have been observed in polyandrous partnerships. Courtship and mating occur from late March through mid-June. During this time, males have been found to move throughout their home range, and females have been found to remain at or near their hibernaculum until mating is complete. A female was observed copulating with more than one male during a mating season, but the extent to which females mate with multiple males (polyandry) is unknown. Suspected egg-laying sites were located in patches of grassland, within 3 to 6 m (10 to 20 ft.) of coastal scrub, and were also found in areas of low density scattered scrub intermixed with grassland. Rock outcrops or talus, small rodent burrows, brush piles, and deep soil crevices are essential for normal behaviors such as breeding, reproduction, and foraging, because they provide egg-laying sites, refuge from predators, thermal cover, shelter, winter hibernacula, and increased foraging opportunities (USFWS 2011).Sperm is stored by the male over winter, and copulation commences after emergence from winter hibernacula. Females begin yolk deposition in mid-April, and intervals of 47, 50 and 55 days have been recorded between dates of first known mating and first egg laid. The average clutch size was found to be 7.21 (with a range of 6 to 11), with a significant correlation between body size and clutch size. Incubation lasts about 3 months, and young appear in late summer and fall (USFWS 2011).Hatchlings have been observed or captured above ground from August through November. Hatchlings have been observed with prey in their stomachs prior to winter hibernation, indicating parental care. California whipsnakes (Masticophis lateralis) reach maturity in 2 to 3 years, with adults growing to nearly 1.5 m (5 ft.). Based on a study of captive California whipsnakes, they may live for 8 years (USFWS 2011).

Geographic or Habitat Restraints or Barriers

Adult: Habitat was directly lost to urban growth; fragmentation due to freeway construction and commercial and residential developments also created barriers to species dispersal, further isolating populations and subpopulations (USFWS 2011).

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Community with all key requirements

Tolerance Ranges/Thresholds

Adult: Moderate

Site Fidelity

Adult: Moderate

Dependency on Other Individuals or Species for Habitat

Adult: Whipsnakes require small mammal burrows for temperature regulation, egg-laying sites, refuge from predators, and winter hibernaculum (winter residence where the snakes hibernate (65 FR 12155).

Habitat Narrative

Adult: Alameda whipsnakes are typically associated with small to large patches of chaparral or coastal scrub vegetation, interspersed with other native vegetation types and rock lands (areas containing large percentage of rocks, rocky features, and/or rock-bearing soil types). Alameda whipsnakes were also observed using adjacent vegetation types, including grassland, oak savanna, and oak-bay woodland, up to 150 m (500 ft.) from coastal scrub and chaparral. Alameda whipsnakes use all slope aspects and brush community canopy closures, but were found to be concentrated on slopes facing south, southwest, southeast, east, or northeast. Alameda whipsnakes usually had more than one core area, separated by more northerly aspects. Northerly aspects were used on a regular basis to move between core areas. Selection for southerly and easterly aspects is likely related not only to consistently warmer temperatures, but is also associated with the availability of morning sun, which promotes emergence earlier in the day and maximizes the activity period for foraging, mate finding, and digestion (USFWS 2011).Chaparral and coastal scrub vegetation serve as the center of home ranges, providing for foraging opportunities and concealment from predators. Core areas have been found to center around patches of coastal scrub or chaparral as small 0.2 hectare (ha) (0.5 acre [ac.]) embedded in a mosaic of other dominant vegetation types (USFWS 2011).Whipsnakes also require rock outcrops or talus. Small rodent burrows are important retreats, and brush piles and deep soil crevices can also serve as important habitat features. These habitat features are essential for normal behaviors such as breeding, reproduction, and foraging, because they provide egg-laying sites, refuge from predators, thermal cover, shelter, winter hibernacula, and increased foraging opportunities. Whipsnake habitat was directly lost to urban growth; fragmentation due to freeway construction and commercial and residential developments also created barriers to species dispersal, further isolating populations and subpopulations (USFWS 2011).

Dispersal/Migration

Motility/Mobility

Adult: High mobility

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory (NatureServe 2015)

Dispersal

Adult: Moderate

Immigration/Emigration

Adult: Unlikely

Dispersal/Migration Narrative

Adult: Alameda whipsnakes are nonmigratory species with a home range varying in size from 1.9 to 9.7 ha (4.7 to 24 ac.). Individuals monitored for nearly an entire activity season appeared to maintain stable home ranges. Movements of these individuals were multi-directional, and they returned to specific areas and retreat sites after long intervals of non-use. Alameda whipsnakes have been found to have one or more core areas (areas of primary use) within their home range, with large areas of the home range receiving little use. Core areas of the Alameda whipsnake most commonly occur on slopes facing east, south, southeast, and southwest. However, recent information indicates that whipsnakes do make use of north-facing slopes in more open stands of scrub habitat. Core areas have been found to center around patches of coastal scrub or chaparral as small 0.2 ha (0.5 ac.) embedded in a mosaic of other dominant vegetation types (USFWS 2011).Little to no habitat connectivity occurs between the Mount Diablo Area population and any other population. Interstate Highway 680 and associated urban development constitute barriers to dispersal between the Mount Diablo Area and the East Bay Hills; Interstate Highway 580 and the expansive grasslands of the Tri-Valley constitute barriers to dispersal between the Mount Diablo Area and the northern Hamilton Range (USFWS 2011). Compared to the much more common chaparral whipsnake, the Alameda subspecies' historic range has always had a very restricted distribution. It most likely included all of the coastal scrub and oak woodland communities in the East Bay in Contra Costa, Alameda, and parts of San Joaquin and Santa Clara counties (USFWS 2005).

Additional Life History Information

Adult: Little to no habitat connectivity occurs between the Mount Diablo Area population and any other population. Interstate Highway 680 and associated urban development constitute barriers to dispersal between the Mount Diablo Area and the East Bay Hills; Interstate Highway 580 and the expansive grasslands of the Tri-Valley constitute barriers to dispersal between the Mount Diablo Area and the northern Hamilton Range. Within the five populations, there are varying degrees of isolation due to natural and human-caused barriers. Therefore, there may be some subpopulations within each population that are geographically and genetically isolated, and others that may contribute to gene flow within each population. The boundaries of these five populations and the two corridors represent the extent of suitable habitat that includes known Alameda whipsnake locations (USFWS 2011). Movement is multi-directional; individuals return to specific areas and retreat sites after long intervals of non-use. Alameda whipsnakes have been found to have one or more core area (area of concentrated use) within their home range, with large areas of the home range receiving little use. Core areas of the Alameda whipsnake most commonly occur on slopes facing east, south, southeast, and southwest. However, recent information indicates that whipsnakes do make use of north-facing slopes in more open stands of scrub habitat. Core areas have been found to center around patches of coastal scrub or chaparral as small 0.2 ha (0.5 ac.) embedded in a mosaic of other dominant vegetation types (USFWS 2011).

Population Information and Trends

Population Trends:

Decline of 10 to 30 percent (NatureServe 2015).

Species Trends:

Declining (NatureServe 2015)

Resiliency:

Low

Representation:

Moderate

Redundancy:

Moderate

Number of Populations:

Five populations organized into recovery units: 1) Tilden–Briones; 2) Oakland–Las Trampas; 3) Hayward–Pleasanton Ridge; 4) Mount Diablo–Black Hills; and 5) Sunol–Cedar Mountain (USFWS 2002).

Resistance to Disease:

Moderate

Adaptability:

Moderate

Additional Population-level Information:

In the five populations, there are varying degrees of isolation due to natural and human-caused barriers; these result in varied gene flow within populations and little to none between populations. The boundaries of these five populations and two associated dispersal corridors represent the extent of suitable habitat that includes known Alameda whipsnake locations. Remaining natural habitat in these areas may provide movement corridors for the Alameda whipsnake, but it is as yet unknown whether whipsnakes are able to use these corridors in a manner that would promote gene flow (USFWS 2002; USFWS 2011).

Population Narrative:

The current population size, trend levels, and minimum viable population size are undescribed. There are five populations (corresponding to the species' recovery units) within a fragmented regional metapopulation: 1) Tilden–Briones; 2) Oakland–Las Trampas; 3) Hayward–Pleasanton Ridge; 4) Mount Diablo–Black Hills; and 5) Sunol–Cedar Mountain. Two additional recovery units are associated with movement corridors: Caldecott Tunnel Corridor and Niles Canyon/Sunol Corridor (USFWS 2002; USFWS 2011). Population and species-level trends are assumed to be in decline (a short-term decline of 10 to 30 percent), based on the continued habitat loss, alteration, and fragmentation of known extant habitat (NatureServe 2015; USFWS 2011). In the five populations, there are varying degrees of isolation due to natural and human-caused barriers; these result in varied gene flow within populations and little to none between populations. The boundaries of these five populations and two associated dispersal corridors represent the extent of suitable habitat that includes known Alameda whipsnake locations.

Remaining natural habitat in these areas may provide movement corridors for the Alameda whipsnake, but it is as yet unknown whether whipsnakes are able to use these corridors in a manner that would promote gene flow (USFWS 2002; USFWS 2011).Little population abundance data exists for the Alameda whipsnake. However, Alameda whipsnakes have been found to be locally abundant and the dominant snake species when habitat quality is high. Almost all trapping studies targeting this species have been designed to determine presence or absence for regulatory purposes and assessing impacts to potential habitat. Monitoring is therefore most often habitat based, assuming snake abundance is positively correlated with the amount of coastal scrub or chaparral vegetation and rock lands present. No studies have been performed that have quantified Alameda whipsnake densities relative to habitat quality or quantity (USFWS 2011).

Threats and Stressors

Stressor: Urban development and loss of habitat
Exposure: Direct
Response: Mortality and reduced habitat.
Consequence: Reduction in population numbers.
Narrative: Urbanization and habitat destruction are the greatest threats to the Alameda whipsnake throughout much of its range. Environmental impacts associated with urbanization are loss of habitat, reduction of grassland habitat, alteration of natural fire regimes, water diversion, fragmentation of habitat due to road construction, and degradation of habitat due to pollutants. Substantial losses of coastal scrub and chaparral vegetation have resulted from urban development that expanded into these vegetation types from lower elevation valleys and coastal cities. Urbanization increasingly threatens the viability of Alameda whipsnake populations as urban landscapes and transportation corridors encroach on ever-diminishing habitats. The historic loss of habitat from encroaching urban development pressures surrounding the East Bay Hills and the highly fragmented state of these areas were the primary threats leading to the listing of the Alameda whipsnake (USFWS 2011).

Stressor: Water development projects
Exposure: Water storage reservoirs
Response: Fragmentation and loss of habitat.
Consequence: See narrative.
Narrative: Numerous water storage reservoirs were constructed throughout the range of the Alameda whipsnake (i.e., San Pablo, Briones, Lake Chabot, and Upper San Leandro reservoirs). These reservoirs resulted in the inundation and large scale losses and fragmentation of Alameda whipsnake habitat. In the East Bay Municipal Utility District's Water Supply Management Program 2040, the option was considered of building a dam and reservoir along 7 miles of Buckhorn Canyon for the purpose of increasing water supply in the San Francisco East Bay. Although this option was eliminated early on due to numerous environmental concerns by stakeholders, including the loss of Alameda whipsnake habitat, the option to inundate Buckhorn Canyon or other areas occupied by the Alameda whipsnake could become less controversial and be a viable solution to meet water demand for local water districts if a lack of water supply threatened the economic livelihood and welfare of the public (USFWS 2011).

Stressor: Wildfire fuel reduction treatments
Exposure: Direct

Response: Increased wildfires throughout whipsnake habitat.
Consequence: Loss of habitat, increased habitat fragmentation, and in some cases mortality.
Narrative: Fire suppression indirectly threatens the Alameda whipsnake by allowing plants to establish a closed canopy that tends to create relatively cool conditions that are less suitable to the Alameda whipsnake, which maintains a relatively high active body temperature. The East Bay Regional Park District developed a Wildfire Hazard Reduction and Resource Management Plan (WHRRMP) to reduce fuel loads in the Wildland Urban Interface of the Oakland/Berkeley Hills. According to the WHRRMP, core Alameda whipsnake habitat will be mechanically treated to reduce fuel loads. Loss of Alameda whipsnake core habitat from wildfire fuel reduction treatments represents a moderate threat to the species. The threat of closed canopied stands represents a greater threat on cooler sites. In addition, because chaparral and coastal scrub can be converted to other vegetation types by increasing fire frequency, a too frequent fire return interval also represents a threat to the species (USFWS 2011).

Stressor: Fire frequency
Exposure: Indirect
Response: Changes in suitable habitat.
Consequence: See narrative.
Narrative: It has been determined that the natural fire return interval for the San Francisco East Bay is 10 to 30 years, and that fire suppression has exacerbated the effects of wildfires by allowing a buildup of fuels, creating the conditions for hotter fires that may directly kill Alameda whipsnakes that do not find retreat in burrows or rock crevices. The effects of fire suppression indirectly threaten the Alameda whipsnake by allowing plants to establish a closed canopy that will tend to create relatively cool conditions that are less suitable to the Alameda whipsnake, which maintains a relatively high active body temperature. There is much debate over the potential effect to the whipsnake caused by irregular fire regimes. The whipsnake's desired chaparral habitat should not be considered a fire-adapted vegetation type, but rather one adapted to a particular fire regime. Determining the natural fire regime is also complicated because humans have set fires in the region for hundreds to thousands of years. Although the natural fire regime has proven difficult to determine, extremely short intervals between fire events can threaten the persistence of some shrub species or irreversibly convert chaparral to other vegetation types, such as coastal scrub or nonnative annual grasslands. Based on analysis of fire frequency in California shrubland ecosystems and the effects of fire suppression on stand structure and fire behavior, it is no longer believed that fire suppression significantly exacerbates the effects of wildfires in chaparral and coastal scrub vegetation types. Based on this, it does not appear that prescribed fire can be effectively used to maintain open canopied stands of chaparral or coastal scrub. However, because periodic wildfire is considered necessary to maintain a full suite of native chaparral and scrub plant species, and because many of these species depend on fire cues (heat, smoke, and/or charate) for germination, fire suppression remains a threat to the Alameda whipsnake (USFWS 2011).

Stressor: Nonnative invasive species
Exposure: Indirect
Response: Decreased ability to forage and regulate body temperature.
Consequence: Reduction in population numbers.
Narrative: Alameda whipsnake habitat has become fragmented, isolated, and otherwise degraded by human activities; increased predatory pressure may become excessive, especially where alien species, such as rats (Rattus species), feral pigs (Sus scrofa), and feral and domestic

cats (Felis domestica) and dogs (Canis familiaris), are introduced (USFWS 2011). The presence of nonnative plant species is also a significant concern for the Alameda whipsnake. Chaparral and coastal scrub ecosystems are composed of plant species that are most often shade-intolerant. The ability of nonnative trees and shrubs to colonize chaparral, coastal scrub, and grassland ecosystems has led to inhibited growth of native plants, vegetation type conversion, changes in microclimates and soil chemistry, increased sediment mobilization, increased fuel loads, an overall reduction in habitat quality, and overall reductions in quantity of core habitat and peripheral dispersal and foraging habitat. Nonnative invasive plant species represent a substantial threat to the habitat of the Alameda whipsnake (USFWS 2011).

Stressor: Succession
Exposure: Indirect
Response: Increase in unsuitable habitat.
Consequence: Decreased dispersal and an increase in unsuitable habitat.
Narrative: Succession of core Alameda whipsnake habitat is occurring, from coastal scrub and chaparral to other native vegetation types. It is hypothesized this succession is due to the removal of disturbance regimes. This threat is greatest on more mesic sites where fire and grazing have been removed, particularly on sites in the fog belt in the East Bay Hills. However, the rate of succession and the possibility of a net loss in coastal scrub or chaparral that has or is likely to occur are unknown at this time. In some locations, mosaics of grassland, oak woodland, coastal scrub, and chaparral have been reported to correlate with geological substrate and soil characteristics. Although stands of coastal scrub and chaparral are succeeding to other vegetation types, it is also true that grasslands are succeeding to coastal scrub in the San Francisco East Bay. These changes lead to decreased dispersal and an increase in unsuitable habitat. The effect of succession represents a moderate threat to the Alameda whipsnake and warrants further research (USFWS 2011).

Stressor: Grazing
Exposure: Indirect
Response: Increase the invasive abilities of nonnative plants.
Consequence: Increased loss of Alameda whipsnakes and their prey to predation.
Narrative: Because Alameda whipsnakes forage in grasslands between stands of scrub, livestock grazing that significantly reduces or eliminates plant cover in these grasslands could lead to an increased loss of Alameda whipsnakes and their prey to predation. It is also indicated that livestock grazing, if appropriately managed, could benefit the Alameda whipsnake. At this time, a moderate threat to the species is posed by incompatible grazing practices that result in significant and long-term losses of scrub vegetation or a loss of hiding cover, such as overgrazing or bulldozing and burning to prepare lands for grazing. Overgrazing may also negatively affect Alameda whipsnakes by damaging the rodent burrows these snakes use for cover. Grazing animals can also act as vectors for nonnative invasive plant species and increase the invasive abilities of nonnative plants through ground disturbance and the removal of native vegetation. However, through appropriate timing and stocking levels, grazing can be used to target and control some nonnative invasive plant species (USFWS 2011).

Stressor: Roads, off-highway vehicles, and trails
Exposure: Direct
Response: Increased human interactions.
Consequence: Physical injury, loss of suitable habitat, and mortality.

Narrative: Loss and fragmentation of habitat as a result of road and trail construction is a stressor for the Alameda whipsnake. Roads can impede gene flow and dispersal. Networks of roads and trails fragment habitat, reduce patch size, and increase the ratio of edge to interior habitat. Road variables that potentially affect wildlife, both directly and indirectly, include size, substrate, age, accessibility, and density. The potential environmental effects of roads on wildlife include pollutants, noise, light, increased spread of invasive species, and human access. Snakes are particularly vulnerable to motor vehicle mortality associated with roads, due to their propensity to thermoregulate on road surfaces and to humans intentionally killing snakes when observing them on road surfaces. Road placement in the surrounding landscape is possibly the most important factor determining the severity of road impacts, because it influences road-kill locations and the rate of mortality. Although the presence of hiking and bicycling trails do not result in motor-vehicle-associated mortality of Alameda whipsnakes, heavily trafficked and high-density hiking and bicycling trails can result in harassment or harm by causing snakes to flee and hide when humans are present, thus reducing the overall quality and quantity of habitat. Alameda whipsnakes can also be killed or injured in collisions with cyclists. In addition to the general effects of roads on the Alameda whipsnake, Off-Highway Vehicles continually damage and destroy large patches of habitat and generate high levels of noise that can cause animals to change their behavior, or can result in hearing damage (USFWS 2011).

Stressor: Climate change
Exposure: Indirect
Response: Inability to adapt to changing environmental conditions, and range shifts precluded by lack of habitat.
Consequence: Local extinction.
Narrative: Global climate change increases the frequency of extreme weather events, such as heat waves, droughts, and storms. Extreme events, in turn, may cause mass mortality of individuals and significantly contribute to determining which species will remain or occur in natural habitats. As the global climate warms, terrestrial habitats are moving northward and upward; but in the future, range contractions are more likely than simple northward or upslope shifts. Climate change threatens to disrupt annual weather patterns, and may result in a loss of habitats and/or prey. Where populations are isolated, a changing climate may result in local extinction, with range shifts precluded by lack of habitat (USFWS 2011).

Recovery

Reclassification Criteria:
A final recovery plan has not been issued; however, a draft recovery plan was issued in November 2002 (USFWS 2002). No reclassification criteria have been identified.

Delisting Criteria:
A final recovery plan has not been issued; however, a draft recovery plan was issued in November 2002 (USFWS 2002). Delisting criteria included below are from the draft recovery plan.

Specified recovery areas are secured and protected from incompatible uses (USFWS 2002). a) Protection for 75 to 100 years of 90 percent of “long-term protection” habitat; and b) Permanent protection of 100 percent of focus areas (“protection in perpetuity” habitat, as refined based on spatial analysis and surveys. Areas include population centers, connectivity areas, corridors, and buffer areas).

Management plans oriented to species conservation (and adaptively updated based on current research) are approved and implemented for recovery areas (USFWS 2002). Management plans that have the survival and recovery of the species as objectives are: a) Approved and implemented on 100 percent of all focus areas; b) Approved and implemented on 30 percent of lands outside of focus areas but within the recovery unit boundaries; c) Approved, and implementation has begun in an additional 20 percent of the recovery units outside the focus areas; and d) Assured of adequate funding for long-term management.

Monitoring in recovery areas demonstrates stable or improving trends in species populations and successional diversity of natural habitat (USFWS 2002). a) Representative populations or subpopulations representing the genetic variation and geographic extent of the species, as identified by surveys and genetic study, are stable or increasing with evidence of natural recruitment for a period of 1.5 fire cycles (approximately 60 years) that include normal disturbances; and b) Habitat monitoring shows a mosaic of multi-age class stands, and that habitat fragmentation has not appreciably increased (less than 5 percent) in any recovery unit over current (2002) conditions.

Threats are ameliorated or eliminated, and fire techniques for habitat management are studied and implemented (USFWS 2002).

Achieve a mosaic of habitats, ideally through reestablishment of natural fire frequency (USFWS 2002).

Increased public awareness in the four county area on urban/wildland issues (USFWS 2002).

Recovery Actions:
- A final recovery plan has not been issued; however, a draft recovery plan was issued in November 2002 and contained draft recovery actions. The 2011 5-Year Review also contains recommended actions. Both the draft recovery actions and the recommended actions are presented below (USFWS 2002; USFWS 2011).
- Form a Recovery Implementation Team that cooperatively implements specific management actions necessary to recover the species (USFWS 2002).
- Conduct public outreach and education; and develop and implement a regional cooperative program (USFWS 2002).
- Conduct mapping, assessment, and analysis exercise (USFWS 2002).
- Protect and conserve the ecosystems upon which the species depends (USFWS 2002).
- Protect and secure existing populations and habitat (USFWS 2002).
- Survey historical locations and other potential habitat where this species may occur (USFWS 2002).
- Conduct necessary biological research and use results to guide recovery/conservation efforts (USFWS 2002).
- Prepare management plans and implement appropriate management in areas inhabited by this special-status species (USFWS 2002).
- Augment, reintroduce, and/or introduce this species (USFWS 2002).

- Develop a tracking process for the completion of recovery tasks and the achievement of delisting criteria (USFWS 2002).
- Refine delisting criteria (USFWS 2002)
- Conduct status reviews of the species to determine whether listing as endangered or threatened is necessary (USFWS 2002).
- Assess the applicability, value, and success of this recovery plan to the recovery of Alameda whipsnake every 5 years until the recovery criteria are achieved (USFWS 2002).
- Promote the eradication of blue gum (Eucalyptus globules), Monterey pine (Pinus radiata), Monterey cypress (Cupressus macrocarpa), and French broom (Genista monspessulana), and other nonnative invasive species in the San Francisco East Bay (USFWS 2011).
- Focus land protection efforts on undeveloped parcels in the Wildland Urban Interface to reduce urban sprawl into chaparral and coastal scrub vegetation, and to reduce the need for fuel reduction treatments in Alameda whipsnake habitat (USFWS 2011).
- Conduct a genetic study, using nuclear DNA, to determine the genetic basis for the phenotype and to determine whether there is a geographic boundary separating the Central and the Southern California clades, whether individuals from each of these clades coexist, and whether gene exchange between the two clades occurs (USFWS 2011).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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SPECIES ACCOUNT: *Neoseps reynoldsi* (Sand skink)

Species Taxonomic and Listing Information

Listing Status: Threatened; Southeast Region (R4) (USFWS, 2015)

Physical Description

The sand skink reaches a maximum length of about 5 inches. The tail makes up about half the total body length. The body is shiny and usually gray to grayish-white in color, although the body color may occasionally be light tan. Hatchlings have a wide black band located along each side from the tip of the tail to the snout. This band is reduced in adults and may only occur from the eye to snout on some individuals (Telford 1959). Sand skinks contain a variety of morphological adaptations for a fossorial lifestyle. The legs are vestigial and practically nonfunctional, the eyes are greatly reduced, the external ear openings are reduced or absent (Greer 2002), the snout is wedge-shaped, and the lower jaw is countersunk.

Taxonomy

Recent morphological (Griffith et al. 2000) and molecular studies (Schmitz et al. 2004, Brandley et al. 2005) have demonstrated that the scincid lizard genus Eumeces, Weigmann (1834) is paraphyletic and that Plestiodon, Dumeril and Bibron (1839) has nomenclatural priority for the American species formally referred to as Eumeces, except for those now placed in the genus Mesoscincus (Smith 2005). Molecular analysis of ribosomal RNA gene sequences also show “Eumeces” egregius and Neoseps reynoldsi are closely related sister species (Schmitz et al. 2004, Brandley et al. 2005). Schmitz et al. (2004) suggested the amount of genetic differentiation between the two species (5 percent) is similar to other species of North American skinks and Neoseps (Stejneger 1910) should be synonymized. They argue sand skinks are a striking example of morphological adaptation for burrowing, where the rate of morpho-ecological change exceeds phylogenetic change. The sand skink is believed to have evolved on the central LWR and radiated from there (Branch et al. 2003). Analysis of mitochondrial DNA (mtDNA) indicates populations of the sand skink are highly structured with most of the genetic variation partitioned among four lineages: three subpopulations on the LWR characterized by high haplotype diversity and a single, unique haplotype detected only on the MDR (Branch et al. 2003). Under the conventional molecular clock, the 4.5% divergence in sand skinks between these two ridges would represent about a 2-million-year separation; the absence of haplotype diversity on the MDR would suggest that this population was founded by only a few individuals or severely reduced by genetic drift of a small population (Branch et al. 2003).

Current Range

The range is restricted to central Florida, USA, where the species is locally abundant on high sandy ridges of Lake, Marion, Orange, Polk, Highlands, and Osceola counties (Christman 1992, Krysko et al. 2011). Formerly this skink was more widespread throughout the Lake Wales Ridge region. It is most common on the Lake Wales and Winter Haven ridges in Highlands, Polk, and Lake counties, and less common on the Mount Dora Ridge, including sites within the Ocala National Forest (see USFWS 1998). (NatureServe, 2015)

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The sand skink is highly adapted for life in the sand. It spends the majority of its time below the surface where it burrows through loose sand in search of food, shelter, and mates. Sand skinks feed on a variety of hard and soft-bodied arthropods that occur below the ground surface. The diet consists largely of beetle larvae and termites (Prorhinotermes spp.). Spiders, larval ant lions, lepidopteran larvae, roaches, and adult beetles are also eaten (Myers and Telford 1965, Smith 1982).

Reproduction Narrative

Adult: The literature states sand skinks lay two eggs typically in May or early June (Ashton 2005) under logs or debris, approximately 55 days after mating (Telford 1959). However, there have been observations of three to four eggs per clutch at times (Mushinsky, personal communication, 2007). The eggs hatch from June through July. Sand skinks first reproduce at 2 years of age and females produce a single clutch in a season, although some individuals reproduce biennially or less frequently (Ashton 2005). Sand skinks can live to at least 10 years of age (Meneken et al. 2005).

Habitat Narrative

Adult: Specific physical structures of habitat that sustain sand skink populations, and likely blue-tailed mole skink populations as well, include a well-defined leaf litter layer on the ground surface and shade from either a tree canopy or a shrub layer, but not both. Leaf litter likely provides important skink foraging opportunities. Shade provided by a tree canopy or a shrub layer likely helps skinks regulate body temperature to prevent overheating. However, having both a tree canopy and a shrub layer appears to be detrimental to skinks (McCoy 2011, University of South Florida, pers. comm.). The sand skink is widespread in native xeric uplands with excessively well-drained soils (Telford 1996), principally on the ridges listed above at elevations greater than 25 m above mean sea level. Various authors have attempted to characterize optimal sand skink habitat (Telford 1959, Campbell and Christman 1982, Christman 1978, 1992a, Service 1993a), but McCoy et al. (1999) have argued these notions are “educated guesswork” (Burgman et al. 1993) with little empirical basis. Commonly occupied native habitats include Florida scrub, variously described as sand pine scrub, xeric oak scrub, rosemary scrub and scrubby flatwoods, as well as high pine communities that include sandhill, longleaf pine/turkey oak, turkey oak barrens and xeric hammock (see habitat descriptions in Myers 1990 and Service 1999). Coverboard transects extended from scrub or high pine (sandhill) through scrubby flatwoods to pine flatwoods revealed sand skinks left more tracks in scrub than the other three habitats and did not penetrate further than 40 m into scrubby flatwoods or 20 m into pine flatwoods (Sutton et al. 1999). Activity – Sand skinks are most active during the morning and evening in spring and at mid-day in winter, the times when body temperatures can easily be maintained between 28°C and 31°C in open sand (Andrews 1994). During the hottest parts of the day, sand skinks move under shrubs to maintain their preferred body temperatures in order to remain active near the surface (Andrews 1994). With respect to season, Telford (1959) reported skinks were most active from early March through early May, whereas Sutton (1996) found skinks were most active from mid-February to late April. Based on monthly sampling of pitfall traps, Ashton and Telford (2006) found captures peaked in March at ABS, but in May at Ocala National Forest (ONF). All of these authors suggested the spring activity peak was associated with mating. At ABS, Ashton and Telford (2006) noted a secondary peak in August that corresponded with the emergence of hatchling sand skinks.

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: > 240 meters

Dispersal/Migration Narrative

Adult: Information on sand skink dispersal and movement patterns is limited. Sand skink studies in the early 2000s documented dispersal distances of more than 140 m (Mushinsky et al. 2001, Penney 2001, Penney et al. 2001) to more than 240 m (Penney 2001). Evidence suggested smaller sand skinks might move greater distances than larger individuals. Researchers believed these documented sand skink dispersal distances likely underestimated dispersal capability. Information suggests that sand skinks can move more than 1 kilometer (km) at appropriate elevations where suitable soils are contiguous and there are no natural or manmade barriers to movement (Mushinsky et al. 2011a). More recent studies documented the longest sand skink movement at 8 km and an average movement of 1.6 km in naturally fragmented scrubby flatwoods at the Archbold Biological Station (Mushinsky et al. 2011a). Sand skink dispersal distances documented in field studies are supported by sand skink genetic research. Genetic relatedness of sand skinks was similar between individuals captured as far as 1 to 2 km from one another (Schrey et al. 2010). Sand skink genetic relatedness tended to decline beyond the 1 km distance, although it appeared to be influenced by the time since fire (Schrey et al. 2010, Mushinsky et al. 2011b). Fires that occur too frequently could negatively decrease sand skink genetic diversity.

Population Information and Trends

Population Narrative:

The Service has little information on the population dynamics of sand skinks within their extant ranges. The skinks' diminutive size and secretive habits make their study difficult. As noted above, sand skinks can reach densities of up to 650 individuals/ha (263/ac) in high quality habitat, particularly on the LWR. Delayed maturity (2 years), a small clutch size (two eggs) of relatively large eggs, low frequency of reproduction, and a long lifespan in sand skinks are life-history traits that also characterize a number of other fossorial lizards that occur in high densities (Ashton 2005). Such character traits may reflect high intra-specific competition and/or predation (Ashton 2005). In contrast, blue-tailed mole skinks often seem absent or rare on the same LWR study sites where sand skinks are common, and when present, are patchily distributed (Christman 1988, 1992b; Mushinsky and McCoy 1995). Mount (1963) noted peninsula mole skinks also are patchily distributed and mostly occurred on xeric sites greater than 100 acres (40 ha) in size. Early maturity (1 year in laboratory) and a large clutch size (maximum = nine eggs) of relatively small eggs (Mount 1963) suggest the population dynamics of mole skinks are different from sand skinks.

Threats and Stressors

Stressor:
Exposure:
Response:
Consequence:
Narrative: The modification and destruction of xeric upland communities in central Florida were primary considerations in listing the sand skink as threatened under the Act in 1987 (52 FR 42662). By some estimates, as much as 90 percent of the scrub ecosystem has already been lost to residential development and conversion to agriculture, primarily citrus groves (Florida Department of Natural Resources 1991, Kautz 1993). Xeric uplands remaining on private lands are especially vulnerable to destruction because of increasing residential and agricultural pressures. It is likely continued residential and agricultural development of xeric upland habitat in central Florida has destroyed or degraded habitat containing sand skinks. Approximately 60 to 90 percent of xeric upland communities historically used by sand skinks on the LWR are estimated to have been lost due to development (Christman 1988, Christman and Judd 1990, Kautz 1993, Center for Plant Conservation 1995). More recently, Turner et al. (2006) calculated 12.9 percent of this habitat remains.

Recovery

Recovery Actions:
- Protection of the sand skink from further habitat loss and degradation provides the most important means of ensuring its continued existence. Existing protection of occupied skink habitat consists primarily of private preserves such as ABS, Hendry Ranch, Tiger Creek Preserve, and Saddle Blanket Lakes Scrub Preserve, coupled with publicly owned lands such as Lake Arbuckle State Park and State Forest, Lake Louisa State Park, and Highlands Hammock State Park (Service 1993a). Current efforts to expand the system of protected xeric upland communities on the LWR, coupled with implementation of effective land management practices, represent the most likely opportunity for assuring the sand skink's survival (Turner et al. 2006). It will also be important to preserve the genetic diversity of sand skinks by protecting sites in each of the four genetically distinct populations, from the MDR, the northern LWR, the central LWR, and the southern LWR. It is likely that a substantial sand skink population is present on existing private and public conservation lands on the LWR. As of 2003, about 21,597 acres (8,740 ha) of Florida scrub and high pine on the LWR have been protected, which represents almost half of the remaining xeric habitat on this ancient ridge, but only 6.3% of its estimated historic extent (Turner et al. 2006). Sand skinks are present on sites that total 87.4% of the currently protected xeric acreage (Turner et al. 2006), but many of the other conserved sites have not been surveyed adequately. Recovery of the sand skink also may require rehabilitation of suitable but unoccupied habitat or restoration of potentially suitable habitat. Because sand skinks do not readily disperse, introductions into restored or created unoccupied habitat may be necessary. Sand skinks relocated to two former citrus groves in Orange County have persisted for at least 5 years (Hill 1999, Mushinsky et al. 2001).

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SPECIES ACCOUNT: *Nerodia clarkii taeniata* (Atlantic salt marsh snake)

Species Taxonomic and Listing Information

Commonly-used Acronym: ASMS

Listing Status: Threatened; 12/29/1977; Southeast Region (R4) (USFWS, 2016)

Physical Description

The Atlantic salt marsh snake (N. c. taeniata) is a partially striped salt marsh snake that reaches a maximum length of at least 82 cm (32 in.), although it is typically less than 65 cm (26 in.) in length. The pattern consists of a gray to pale olive background with black to dark brown stripes anteriorly, the stripes breaking up into rows of spots posteriorly. The extent of the striping is variable, but most individuals from the coastal marshes of Volusia County are striped on at least the anterior 30 percent of the body. The venter is black with a central row of large cream to yellowish spots. As in the case of the dorsal striping, this ventral pattern is best developed anteriorly and tends to break down posteriorly. The red pigmentation characteristic of mangrove water snakes is conspicuously lacking in Atlantic salt marsh snakes from the vicinity of Edgewater, Volusia County, and northward (i.e., the area from which the form was described) (USFWS, 1993).

Taxonomy

The Atlantic salt marsh snake has a complex taxonomic history, having been known under various combinations of generic, specific, and subspecific names. The North American water snakes were long included within the genus Natrix, but Rossman and Eberle (1977) restricted that genus to Eurasia and erected the genus Nerodia to include many of the North American species previously included within Natrix. At the species level, the salt marsh snakes have at various times been treated as a separate species or as subspecies of two related freshwater species. Both the Gulf salt marsh snake (Nerodia clarkii clarkii) and the mangrove water snake (N. clarkii compressicauda) were initially described as separate species. Based at least partly on reports of hybrids between N. c. clarkii and the freshwater broad-banded water snake (N. fasciata confluens), Clay (1938) reduced the salt marsh snakes to subspecies of N. sipedon, a name that at the time applied to all of the banded water snakes of eastern North America. Subsequently, Conant (1963) elevated the subspecies of N. fasciata to species status to include the three salt marsh snakes and the three southern freshwater subspecies: N. f. fasciata, N. f. confluens, and N. f. pictiventris. At the time that the Atlantic salt marsh snake was listed as threatened, it was regarded as a subspecies of the southern water snake, N. fasciata (fide Conant, 1963). More recently, Lawson et al. (1991) conducted an extensive electrophoretic analysis of the N. fasciata - N. clarkii complex, including specimens from three hybrid swarms. They found no genetic introgression between the salt marsh snakes and the adjacent freshwater snakes and concluded that the salt marsh snakes warrant recognition as a separate species, N. clarkii. Hence, the appropriate name for the Atlantic salt marsh snake is now Nerodia clarkii taeniata. At the subspecific level, the Atlantic salt marsh snake has alternately been treated as a separate subspecies or synonymized with the mangrove water snake. It was described by Cope (1895) as Natrix compressicauda taeniata, a subspecies of the mangrove water snake. It was synonymized with N. compressicauda by Barbour and Noble (1915), but then resurrected as a separate subspecies by Carr and Goin (1942). Dunson (1979) again proposed that taeniata should be relegated to synonymy with compressicauda, although he never examined any specimens of taeniata nor visited the taeniata localities. The form that the U.S. Fish and Wildlife Service (Service) listed as threatened is the Atlantic salt marsh snake, Nerodia fasciata taeniata (now N. clarkii taeniata). The taxonomic status of the Atlantic salt marsh snake will remain controversial until a thorough, rigorous systematic assessment is conducted. The Endangered Species Act (Act) defines the term species as including ". . . any subspecies of fish or wildlife or plants, and any distinct population or segment of any species or vertebrate fish or wildlife which interbreeds when mature." Final resolution of the taxonomic status of the Atlantic salt marsh snake will provide further insight into proper management but continued protection under the Act appears justified whether it remains a distinct subspecies or a distinct population. Regardless of its taxonomic status, the Atlantic salt marsh snake is a relict of historical and/or ecological processes unique to Florida and should be preserved (Kochman 1992) (USFWS, 1993).

Historical Range

Restricted to the salt marshes of Volusia, Brevard, and possibly Indian River Counties, Florida (USFWS, 1993).

Current Range

Recent studies restrict the range of this subspecies to coastal areas of Volusia County, Florida, USA (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: It feeds primarily on small fish, but it readily takes frogs when available (USFWS, 1993).

Reproduction Narrative

Adult: This species is ovoviviparous. Captive individuals have given birth to 3 to 9 young from August to October (Kochman 1992) (USFWS, 1993).

Spatial Arrangements of the Population

Adult: Clumped (inferred from NatureServe, 2015)

Environmental Specificity

Adult: Narrow/Specialist (inferred from NatureServe, 2015)

Tolerance Ranges/Thresholds

Adult: Low (inferred from NatureServe, 2015)

Site Fidelity

Adult: High (inferred from NatureServe, 2015)

Habitat Narrative

Adult: Atlantic salt marsh snakes are restricted to brackish, tidal marshes. They most often have been found in association with saltwort flats and salt grass-bordered tidal creeks. It is not known if they occur in the adjacent black needlerush (Juncus roemerianus) habitat. Atlantic salt marsh snake use of marsh habitats may be limited by water level; with extreme fluctuations making the marsh too hydric or xeric (G. Goode pers. comm.). When inactive or pursued, they frequently retreat into one of the numerous fiddler crab (Uca pugilator) burrows that riddle the edge of the marsh and the banks of the tidal creeks (Carr and Goin 1942, Kochman 1992, P. Moler pers. obs.) (USFWS, 1993) (USFWS, 1993). Clumped spatial arrangement of the population, narrow environmental specificity, high ecological integrity of the community, low tolerance ranges and high site fidelity are inferred based on the specific habitat needs of this species along with the few and somewhat isolated populations that are known to occur.

Dispersal/Migration

Motility/Mobility

Adult: High (inferred from NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from NatureServe, 2015)

Dispersal

Adult: Low (inferred from NatureServe, 2015)

Immigration/Emigration

Adult: Unlikely (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: High mobility is based on the fact that most snakes are highly mobile. Non-migratory is inferred based on the species habitat description and known populations. Low dispersal is inferred based on specific habitat needs as is unlikely immigration/emigration (inferred from NatureServe, 2015).

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:

Low (inferred from NatureServe, 2015)

Representation:

Low (inferred from NatureServe, 2015)

Redundancy:

Low (inferred from NatureServe, 2015)

Number of Populations:

1 to 20 (NatureServe, 2015)

Population Size:

250 - 100,000 (NatureServe, 2015)

Population Narrative:

Population size is just an estimate as no substantial data exist (NatureServe, 2015). Population and range have declined because of habitat alteration. The U.S. Fish and Wildlife Service (USFWS 1990) categorized the status as "declining." (NatureServe, 2015). Low resiliency, representation and redundancy are inferred based on low number of populations and specific habitat requirements.

Threats and Stressors

Stressor: Habitat loss (USFWS, 2008).
Exposure:
Response:
Consequence: Decrease in populations
Narrative: The loss of saltwater habitat from upland construction projects appears to have slowed in the 1990s (Service 1999), a preliminary GIS analysis of Volusia County salt marshes suggests that 2,000 acres (14%) have been lost since listing (L. White, USFWS, pers. comm., 2007). On a positive note, most of the habitat where ASMS likely occurs is publicly owned and/or sovereign submerged lands of the State of Florida, and thus future development in these area will likely be limited. There is also a major initiative underway in Volusia County to restore all the disturbed salt marsh systems that were dragline ditched during the 1950s and 1960s. To date over 1,000 acres of disturbed salt marsh areas within the Mosquito Lagoon and Tomoka River/Bulow Creek areas have been restored and enhanced and are likely improving habitat conditions for the ASMS. Overall, however, loss and modification off salt marsh habitat continues to be a threat to ASMS recovery. An overall assessment of rates of loss, restoration, conversion, fragmentation, and creation of salt marsh wetlands of value to ASMS has not been compiled, it is not known whether the current habitat base will support a population at levels sufficient to prevent extinction long term (USFWS, 2008).

Recovery

Delisting Criteria:

If there is no evidence of significant genetic introgression (genetic exchange limited to a very narrow hybrid zone) from the Florida banded water snake (Nerodia fasciata pictiventris) into adjacent populations of the Atlantic salt marsh snake (Nerodia clarkia taeniata) (USFWS, 1993, USFWS, 2008).

Maintain adequate habitat protection and maintain habitat loss at or below current levels for the next 5 years (USFWS, 1993, USFWS, 2008).

Establish self-sustaining populations of 100-200 adult snakes at each of 10 secure, discrete sites dispersed throughout Volusia County. These numerical goals are subject to revision as more information becomes available on the biology of the Atlantic salt marsh snake (USFWS, 1993, USFWS, 2008).

These populations should be monitored for at least 5 years before considering delisting. If delisted, these populations will continue to be periodically monitored as required by the Act (USFWS, 1993, USFWS, 2008).

Recovery Actions:

- Conduct basic ecological studies of the Atlantic salt marsh snake population in the northern Indian River Lagoon of Volusia County (USFWS, 1993).
- Determine and map distribution of the Atlantic salt marsh snake (USFWS, 1993; USFWS, 2008).
- Identify and implement appropriate habitat protection measures (USFWS, 1993; USFWS, 2008).
- Conduct a taxonomic assessment of the salt marsh snakes in Volusia. Brevard. And Indian River Counties (USFWS, 1993; USFWS, 2008).
- Determine relative abundance within occupied habitats, identify the most important populations and habitat, and develop a population censusing technique (USFWS, 1993; USFWS, 2008).
- Determine extent of genetic introgression at one or more sites where hybridization with N. fasciata is known to have occurred (USFWS, 1993; USFWS, 2008).
- Development of a contingency plan (USFWS, 1993).
- Disseminate information about Atlantic salt marsh snakes (USFWS, 1993).

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SPECIES ACCOUNT: *Nerodia erythrogaster neglecta* (Copperbelly water snake)

Species Taxonomic and Listing Information

Listing Status: Threatened; 01/29/1997; Great Lakes-Big Rivers Region (R3) (USFWS, 2016)

Physical Description

A water snake in which adult total length usually is about 76 - 122 cm. Dorsum is dark, sometimes black; orange-red belly is often heavily invaded by dorsal ground color; young are with the dorsal spots often irregular and running together; keeled scales; anal scale is usually divided; total length is usually 76 - 122 cm, up to about 158 cm (Conant and Collins 1991). Minton (1972) reported that total length of seven females ranged from 73 to 142 cm, and five males were 66 - 82 cm. Newborns generally are about 22 - 26 cm in total length (Conant 1938, Minton 1972) (NatureServe, 2015).

Taxonomy

The copperbelly water snake is a subspecies of the plain-bellied water snake (Nerodia erythrogaster) (Conant 1949). There are currently five additional recognized subspecies of N. erythrogaster in North America (Gibbons and Dorcas 2004). The yellowbelly water snake (Nerodia erythrogaster flavigaster) is geographically the next closest subspecies, with a contact zone between copperbellies and yellowbellies in southern Illinois. More recently, the taxonomic revision of the water snakes resulted in a change in the North American forms of Natrix to Nerodia (Rossman and Eberle 1997) (USFWS, 2008).

Historical Range

The original range and distribution of copperbelly water snake is not precisely known. Although some early authors such as Wright and Wright (1957) depicted the northern populations as connected continuously across much of Indiana to populations further south, a notable gap exists in actual location records between the southern and northern populations (USFWS, 2008).

Current Range

Two populations occur within the area of the West Branch of St. Joseph River in Ohio and Michigan, a population occurs in the area of the Clear Fork of the East Branch of St. Joseph River in Michigan, and two populations occur within the Fish Creek watershed of Indiana and Ohio (USFWS 1997; 2010).

Distinct Population Segments Defined

Yes; Michigan, Ohio, and Indiana north of 40° N. latitude

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Diet includes primarily aquatic species such as frogs, tadpoles, salamanders, crayfish, fishes, and other aquatic invertebrates. Fishes are not a common item in the diet, probably evidently because they are uncommon or absent from the snake's typical temporary-water habitat (Minton 1972). Active from about March to October. Basks by day, forages probably mostly in evening and at night (NatureServe, 2015). Fishless wetlands that have high anuran (frog and toad) productivity are required to provide habitat and a suitable prey base. Growth is rapid, and most individuals appear to reach adult size within two full seasons of activity. They are opportunistic and will eat a variety of small fish and amphibians. Copperbellies forage both aquatically and terrestrially (USFWS, 2008).

Reproduction Narrative

Adult: Courtship and mating occur from late April to early June; birth occurs in early fall (generally September-October); litter size about 8 - 37, averages about 18 (see USFWS 1993). Mating occurs typically on structures near or in a pond, lake, or swamp (Sellers 1991). Births occur in or near the hibernation site (USFWS 1993) (NatureServe, 2015).

Geographic or Habitat Restraints or Barriers

Adult: Occurs only in wetlands and associated upland habitat (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: 35/km density, groups in spring and fall (NatureServe, 2015)

Environmental Specificity

Adult: Narrow (NatureServe, 2015)

Habitat Narrative

Adult: Inhabits lowland swamps, oxbow lakes in floodplains, brushy ditches, and other warm, quiet waters; wooded lakes, streams, or other permanent waters; and wooded corridors between these habitats (USFWS 1993). Willow-buttonbush or cypress swamps adjacent to wooded cover are needed for access to permanent wetlands and to wooded upland hibernation sites (Sellers 1991). Seeks permanent wetlands when woodland swamps seasonally begin to dry, or may stay near shallow swamp or move throughout surrounding woodland (USFWS 1993). About 500 - 600 acres of continuous swamp-forest is needed to sustain a viable population (about 50 individuals with 12 breeding pairs) (USFWS 1993). Basks on partially submerged logs and similar sites near shallow wetland edges in woodlands. Deep underground chambers in wooded uplands are the most favorable hibernation sites but the snakes also may use felled tree root networks in bottomlands, dense brushpiles, fieldstone piles, and perhaps beaver and muskrat lodges (USFWS 1993). In Indiana, density based on line transects was 4 - 26/km of shoreline; when coupled with mark-recapture results, density estimate increased to 35/km (Lacki et al. 1994). Commonly observed in groups in spring and fall (USFWS 1993). The environmental specificity is narrow; this species depends on a relatively scarce set of habitats, substrates, food types, or other abiotic and/or biotic factors within the overall range (NatureServe, 2015). The species needs habitat complexes of isolated wetlands distributed in a forested upland matrix, floodplain wetlands fed by seasonal flooding, or a combination of both. Copperbellies prefer shallow wetlands, such as shrub-scrub wetlands dominated by buttonbush (Cephalanthus occidentalis), emergent wetlands, or the margins of palustrine open water wetlands (Kingsbury 1996, Herbert 2003, Kingsbury et al. 2003, Laurent and Kingsbury 2003). Copperbellies use buttonbush swamps as basking or "loafing" areas. hibernacula are typically burrows of crayfish of the family Cambaridae, in palustrine forested wetlands and the immediately adjacent upland forest (Kingsbury 1996, Kingsbury and Coppola 2000, Hyslop 2001, Kingsbury et al. 2003) (USFWS, 2008).

Dispersal/Migration

Motility/Mobility

Adult: High (USFWS, 2008)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Migratory (NatureServe, 2015)

Dispersal

Adult: Moderate (USFWS, 2008)

Dispersal/Migration Narrative

Adult: Migrates between summer and winter habitats (NatureServe, 2015). Individuals move hundreds of meters or more between wetlands and routinely use multiple wetlands over the course of an active season. Uplands are necessary for copperbellies to traverse to adjacent wetlands (USFWS, 2008).

Population Information and Trends

Population Trends:

50 - 70 % decline (NatureServe, 2015)

Species Trends:

Declining (USFWS, 2008)

Resiliency:

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

Redundancy:

Low (inferred from USFWS, 2010)

Number of Populations:

4 - 5 (USFWS, 2010)

Population Size:

< 400 (inferred from USFWS, 2010)

Minimum Viable Population Size:

500 adults (USFWS, 2010)

Population Narrative:

Has been undergoing a long-term decline (50 - 70%). Now occurs in only about half of the counties from which it was once known (e.g., see Evers 1992, USFWS 1993). Regionally, the destruction of wetlands and fragmentation of intervening upland continues, promising little remittance in decline in near future. (NatureServe, 2015). None of the extant populations meet the minimum population criterion of 500 adults. During extensive survey work in the 1980s, Sellers (1987a, 1987b, 1991) reported copperbellies from 16 sites within the range of what is now the northern population segment. Surveys during the ten years prior to listing in 1997 indicated eight local populations in this range, but at the time of listing, copperbelly water snakes were found in only five local populations. Despite repeated efforts to locate copperbellies at historic or new sites (Kingsbury et al. 2003, Lee et al. 2002, Lee et al. 2005, Lee et al. 2007), only four of these populations have been confirmed since the copperbelly's listing. The best available information indicates that the copperbelly water snake northern DPS population is in the low hundreds. In the most recent surveys (2005-2006), fewer copperbelly water snakes were observed at several wetlands than had been found during previous surveys in the 1980s and 1990s and by MNFI from 2001- 2003. At its current level, the copperbelly water snake population meets both criteria set forth in the recovery plan for reclassification from threatened to endangered status (USFWS, 2010). Conclusions from surveys and mark-recapture efforts indicate that populations continue to be lost, and those that remain are in decline (USFWS, 2008).

Threats and Stressors

Stressor: Habitat loss and fragmentation (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Primary threat is habitat loss and fragmentation, which may lead to declines or local extirpations (USFWS 1993; Federal Register, 29 January 1997; Harding 1997). Specific examples include clearcutting woodlands, brush and land clearing, widescale draining of wetlands (especially those with seasonal water, Laurent and Kingsbury 2003), habitat constriction via surrounding development, wetland succession, and road construction (USFWS 1993). Surface mining, oil exploration and extraction, river dams that cause flooding of shallow wetlands and wooded areas, timber clearcutting, row crop expansion, and stream channelization and dredging are threats in the lower Ohio River valley and Wabash River valley (USFWS 1993). In Indiana, a population is threatened by coal mine expansion (USFWS 1993) (NatureServe, 2015).

Stressor: Pesticide use (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Pesticide use may be detrimental if it negatively impacts aquatic food resources. Westrate (1988) suggested that the decline in frogs and salamanders in southwestern Michigan over the past 25 years may have adversely affected populations of this subspecies (NatureServe, 2015).

Stressor: Collection and human-induced mortality (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Collecting may be a moderate problem in a few local areas (USFWS 1993). This snake if often killed by people who mistake it for a cottonmouth (Phillips et al. 1999). Road mortality is

an additional threat (Harding 1997) (NatureServe, 2015). The copperbelly water snake is collected because of its rarity, large size, unique coloration, and value in the pet trade (Sellers 1991). During the first 30 years after its discovery and formal publication of its description, many copperbellies were collected as specimens for museums. Although museums have abandoned this practice, amateur collectors may continue to take wild snakes (USFWS 1997; 2008).

Stressor: Climate change (USFWS, 2010)
Exposure:
Response:
Consequence:
Narrative: climate change may constitute a significant new threat for the copperbelly water snake. In the Great Lakes region, the climate will likely grow warmer and probably drier overall during the 21st century (Kling et al. 2003). Although average annual precipitation may increase slightly by the end of the century, seasonal precipitation cycles are predicted to become more extreme, with winter and spring rains increasing and summer rain decreasing by up to 50 percent. These projected declines in summer rainfall will cause drying of ephemeral wetlands, threatening the reproductive success of amphibians, such as wood frogs and salamanders (Kling et al. 2003). Copperbelly water snakes feed primarily on amphibians and are adapted to foraging in ephemeral wetlands that dry out in the summer months when copperbellies then shift to uplands (Kingsbury et al. 2003). The potential changes to ephemeral wetlands and amphibian populations, as discussed in Kling et al. (2003), may have consequences for the copperbelly, which relies on foraging for amphibians in ephemeral wetlands (USFWS, 2010).

Stressor: Predation (USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Copperbellies are susceptible to a host of predators (Harding 1997). Predators include egrets and herons hunting in shallow water, and raptors hunting from the air. Raccoons, skunks, opossums, snapping turtles, and large fish represent additional predators. Predation by itself is not a threat to the population as a whole; however, when it occurs concurrently with or in addition to habitat fragmentation or other threats, predation can become a threat. During their migrations, copperbellies are vulnerable to predators (e.g., skunks, raccoons, raptors, and snapping turtles), especially when cleared areas such as roads, mowed areas, and farmlands interrupt their migration routes (USFWS, 2008).

Stressor: Disease (USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: During recent surveys (2004-2006), several copperbelly water snakes were observed with blisters and other skin abnormalities indicative of blister disease (Lee, pers. comm. 2006, Lee et al. 2007). Blister disease may occur in captive snakes and is typically associated with very humid or wet conditions. During surveys in 2004 - 2006, several wild copperbellies were observed with bumps or lesions on the body and face (Herbert, pers. comm. 2006, Lee, pers. comm. 2006). Occasional blistering is a fairly common and generally benign condition in copperbellies and other wild snakes, particularly in snakes recently emerged from hibernation (Kingsbury, pers. comm. 2007, Lee et al. 2007). Snakes often recover from blister disease after

several sheds, but in more extreme and rare cases, some individuals may be unable to recover from this condition. In some cases, blister disease can result in adverse effects to the snake (e.g., facial deformities, especially around the eyes and mouth, could affect ability to forage) (Lee et al. 2007). The prevalence and degree to which this is a potential threat to the species needs further investigation (USFWS, 2008).

Stressor: Small population size/stochastic events (USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: The small, isolated nature of the copperbelly NPS makes them especially vulnerable to extirpation due to chance events. Any population is subject to stochastic (random) events of an environmental or demographic nature. The former is exemplified by unusually cold winters or dry summers, while an example of the latter might be that, by chance, a female had a smaller or larger than average litter size. The smaller the population, the more possible that all of these random events and their outcomes might tip the population to extirpation. In fact, Sellers (1991) felt that a severe drought in the late 1980s may have adversely impacted population sizes of copperbelly water snake, due to reduced wetland availability (i.e., fewer wetlands and shorter hydroperiods) and reduced prey base. Small populations can also suffer from inbreeding depression effects. Mating of related individuals may lead to expression of deleterious alleles, causing declines in health or reproductive output. While the research on reptiles is limited, work on other vertebrates shows increased risk of mortality from severe winters in inbred birds (Keller et al. 1994) and mice (Jimenez et al. 1994) (USFWS, 2008).

Stressor: Rusty crayfish (USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Rusty crayfish (Orconectes rusticus), a species native to the Ohio River drainage, has been found at sites in southern Michigan. This invasive species is more aggressive than other crayfish and can displace native crayfish or hybridize with them (Taylor and Redmer 1996, Klocker and Strayer 2004). Rusty crayfish typically inhabit permanent pools and fast moving streams; they do not construct burrows or chimneys. At this time, the potential for rusty crayfish to displace the native crayfish population within the copperbelly's range, and the resulting impact to copperbelly hibernacula, is not known (USFWS, 2008).

Stressor: Natural resource management conflicts (USFWS, 2008)
Exposure:
Response:
Consequence:
Narrative: Conflicting natural resource management efforts may also threaten copperbellies. Radiotelemetry studies (Kingsbury 1995, 1996, 1998; Hyslop 2001; Herbert 2003) have repeatedly shown that copperbellies rarely venture far into upland (terrestrial) areas that lack tree or shrub canopy. This is the case despite an affinity for small forest gaps and forest/field margins. Thus, planting and maintenance of row crops, placed next to or between wetlands, may create risks and barriers for copperbellies. Managing large areas as grassland for upland birds also likely negates use of those areas by copperbellies. Wetland management practices that stabilize and/or deepen water levels in wetlands remove key shallow and ephemeral wetland

components from the landscape. Adding game fish to wetlands inhibits amphibian reproduction, thus impacting the prey base for copperbellies. Impacts from other management efforts, such as ash tree removal or chemical applications to control the emerald ash borer, are unknown (USFWS, 2008).

Recovery

Reclassification Criteria:
1. There are no known populations of more than 500 adults (USFWS, 2010).

2. The cumulative population size is estimated at less than 1000 adults (USFWS, 2010).

Delisting Criteria:
1. Multiple population viability is assured: a) Five geographically distinct populations have population sizes of more than 500 adults, with at least one population exceeding 1000 adults; or three populations must have a total population size of 3000 adults, with none less than 500, and b) These populations must persist at these levels for at least ten years (USFWS, 2010).

2. Sufficient habitat is conserved and managed: a) Wetland/upland habitat complexes sufficient to support the populations described in Criterion 1 are permanently conserved. 1) A population of 1,000 adults will require at least five square miles of landscape matrix with a high density and diversity of shallow wetlands embedded in largely forested uplands. 2) A population of 500 adults will require at least three square miles of the same type of habitat. b) Multiple (two or more) hibernacula for each population are permanently conserved. A minimum of two hibernacula will be available within one kilometer of all suitable summer habitat included above (USFWS, 2010).

3. Significant threats due to lack of suitable management, adverse land features and uses, collection, and persecution have been reduced or eliminated: a) Habitat management and protection guidelines have been developed, distributed, and maintained. b) Adverse land features and uses, such as row crops, roads and accompanying traffic have been removed, minimized or managed within occupied Criterion 1 landscape complexes to the extent possible. c) A comprehensive education and outreach program, including persecution and collection deterrence, has been developed and implemented (USFWS, 2010).

Recovery Actions:
- Identify and conserve habitat complexes sufficient for recovery (USFWS, 2008).
- Monitor known copperbelly water snake populations and their habitat (USFWS, 2008).
- Improve baseline understanding of copperbelly water snake ecology (USFWS, 2008).
- Develop recovery approaches to enhance recruitment and population size (USFWS, 2008).
- Develop and implement public education and outreach efforts (USFWS, 2008).
- Review and track recovery progress (USFWS, 2008).
- Develop a plan to monitor copperbelly water snake after it is delisted (USFWS, 2008).
- Recommend uplisting to Endangered (USFWS, 2018).

Conservation Measures and Best Management Practices:

- Identify and conserve habitat complexes sufficient for recovery ? Develop guidelines for habitat restoration and enhancement ? Restore suitable wetlands and associated uplands for the copperbelly ? Develop and implement habitat conservation programs (e.g., landowner contact, voluntary registration, and conservation agreements with landowners) ? Prioritize properties for conservation easements and acquisition; purchase, protect, and/or manage these properties based on priority and availability ? Develop landscape-level habitat characterization of copperbelly habitat (USFWS, 2010).
- Identify, assess, and reduce threats at known sites and focal management areas ? Clarify the influence of roads on migration of individual snakes and the connectivity of subpopulations ? Research and implement techniques to create road crossings for snakes to reduce road mortality and remove barriers to movement (USFWS, 2010).
- Improve baseline understanding of copperbelly water snake ecology ? Clarify characteristics of high quality hibernacula ? Clarify gestation site requirements (USFWS, 2010).
- Monitor known copperbelly water snake populations and their habitat ? Develop standard techniques for estimating population size for copperbelly water snake populations ? Monitor West Branch (OH, MI) ? Monitor Clear Fork (MI) ? Monitor Fish Creek (IN, OH) (USFWS, 2010).
- Develop and implement public education and outreach efforts ? Develop and deliver educational presentations about the copperbelly water snake ? Establish mechanisms for dissemination of information (USFWS, 2010).

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SPECIES ACCOUNT: *Pituophis melanoleucus lodingi* (Black pine snake)

Species Taxonomic and Listing Information

Listing Status: Threatened; 11/5/2015; Southeast Region (R4) (USFWS, 2016)

Physical Description

Pinesnakes (genus Pituophis) are large, non-venomous, oviparous (egglaying) constricting snakes with keeled scales and disproportionately small heads (Conant and Collins 1991, pp. 201–202). Their snouts are pointed. Black pinesnakes are distinguished from other pinesnakes by being dark brown to black both on the upper and lower surfaces of their bodies. There is considerable individual variation in adult coloration (Vandeventer and Young 1989, p. 34), and some adults have russet-brown snouts. They may also have white scales on their throat and ventral surface (Conant and Collins 1991, p. 203). In addition, there may also be a vague pattern of blotches on the end of the body approaching the tail. Adult black pinesnakes range from 48 to 76 inches (in) (122 to 193 centimeters (cm)) long (Conant and Collins 1991, p. 203; Mount 1975, p. 226). Young black pinesnakes often have a blotched pattern, typical of other pinesnakes, which darkens with age (USFWS, 2015).

Taxonomy

A form intermediate between the black pine snake (P. m. lodingi) and the Florida pine snake (P. m. mugitus) occurs in Baldwin and Escambia counties in Alabama and Escambia County in Florida. These snakes are separated from populations of the "true" black pine snake by the Mobile River Delta and the Alabama River (Duran 1998b). A phylogeographical study using genetic data is needed to determine whether P m. lodingi is a distinct evolutionary lineage. See also taxonomy comments for P. melanoleucus (NatureServe, 2015). Pinesnakes (Pituophis melanoleucus) are members of the Class Reptilia, Order Squamata, Suborder Serpentes, and Family Colubridae. There are three recognized subspecies of P. melanoleucus distributed across the eastern United States (Crother 2012, p. 66; Rodriguez-Robles and De JesusEscobar 2000, p. 35): The northern pinesnake (P. m. melanoleucus); black pinesnake (P. m. lodingi); and Florida pinesnake (P. m. mugitus). The black pinesnake was originally described by Blanchard (1924, pp. 531–532), and is geographically isolated from all other pinesnakes (USFWS, 2015).

Historical Range

There are historical records for the black pinesnake from one parish in Louisiana (Washington Parish), 14 counties in Mississippi (Forrest, George, Greene, Harrison, Jackson, Jones, Lamar, Lauderdale, Marion, Pearl River, Perry, Stone, Walthall, and Wayne Counties), and 3 counties in Alabama west of the Mobile River Delta (Clarke, Mobile, and Washington Counties). Historically, populations likely occurred in all of these contiguous counties; however, current records do not support the distribution of black pinesnakes across this entire area (USFWS, 2015).

Current Range

Range includes southwestern Alabama, southeastern Mississippi, and (at least formerly) extreme eastern Louisiana (Conant and Collins 1991). Current range is reduced. Surveys by Duran (1998b) indicate that black pine snakes have been extirpated from Louisiana (Washington Parish) and from two counties (Lauderdale and Walthall) in Mississippi. Black pine snakes have not been reported west of the Pearl River in either Mississippi or Louisiana in 24 years (Duran 1998b). There are no recent (post-1979) records for three additional Mississippi counties

(Greene, Jackson, and Lamar) where the snakes once occurred. Distribution of remaining populations has become highly restricted due to fragmentation of remaining longleaf pine habitat (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Adults and immatures are carnivores. This species exhibits diurnal, crepuscular, and hibernation activity (NatureServe, 2015). Black pinesnakes are active during the day but only rarely at night. Black pinesnakes are known to consume a variety of food, including nestling rabbits (Sylvilagus aquaticus), bobwhite quail (Colinus virginianus) and their eggs, and eastern kingbirds (Tyrannus tyrannus) (Vandeventer and Young 1989, p. 34; Yager et al. 2005, p. 28); however, rodents represent the most common type of prey. The majority of documented prey items are hispid cotton rats (Sigmodon hispidus), various species of mice (Peromyscus spp.), and, to a lesser extent, eastern fox squirrels (Sciurus niger) (Rudolph et al. 2002, p. 59; Yager et al. 2005, p. 28) (USFWS, 2015).

Reproduction Narrative

Adult: Lyman et al. (2007, p. 39) described the time frame of mid-May through mid-June as the period when black pinesnakes breed at Camp Shelby, and mating activities may take place in or at the entrance to armadillo burrows. However, Lee (2007, p. 93) described copulatory behavior in a pair of black pinesnakes in late September. Based on dates when hatchling black pinesnakes have been captured, the potential nesting and egg deposition period of gravid females extends from the last week in June to the last week of August (Lyman et al. 2009, p. 42). In 2009, a natural nest with a clutch of six recently hatched black pinesnake eggs was found at Camp Shelby (Lee et al. 2011, p. 301) at the end of a juvenile gopher tortoise burrow. Longevity of wild black pinesnakes is not well documented, but can be at least 11 years, based on recapture data from Camp Shelby (Lee 2014b, pers. comm.). The longevity record for a captive male black pinesnake is 14 years, 2 months (Slavens and Slavens 1999, p. 1). Recapture and growth data from black pinesnakes on Camp Shelby indicate that they may not reach sexual maturity until their 4th or possibly 5th year (Yager et al. 2006, p. 34) (USFWS, 2015).

Geographic or Habitat Restraints or Barriers

Adult: Thick forest mid-story (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: 10 adults /square kilometer (see population narrative)

Site Fidelity

Adult: High (USFWS, 2015)

Habitat Narrative

Adult: Black pine snakes are endemic to the upland longleaf pine forests that once covered the southeastern United States. Habitat consists of sandy, well-drained soils with an overstory of longleaf pine, a fire suppressed mid-story, and dense herbaceous ground cover (Duran 1998b). Duran (1998a) found that radio-tracked black pine snakes usually were on well-drained, sandy-loam soils on hilltops, ridges, and toward the tops of slopes. They were rarely found in riparian areas, hardwood forests, or closed canopy conditions. More than half of the time, snakes were underground, usually in the trunks or root channels of rotting pine stumps. In Mississippi, each of five hibernating black pine snakes was in a shallow chamber formed by the decay and burning of pine stumps and roots (Rudolph et al. 2007). Available data indicate that black pine snakes rarely use the burrows of gopher tortoises (Duran 1998b). Fire is needed to maintain the longleaf pine ecosystem. Lowered fire frequencies and reductions in average area burned per fire event (strategies often used in management of pine plantations) produce sites with thick mid-stories. These areas are avoided by black pine snakes (Duran 1998a) (NatureServe, 2015). While they used multiple habitat types periodically, they repeatedly returned to core areas in the longleaf pine uplands and used the same pine stump and associated rotted out root system from year to year, indicating considerable site fidelity (Yager, et al. 2006, pp. 34–36; Baxley 2007, p. 40) (USFWS, 2015).

Dispersal/Migration

Motility/Mobility

Adult: Moderate (inferred from USFWS, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (NatureServe, 2015); seasonal movements (USFWS, 2015)

Dispersal

Adult: Moderate (inferred from USFWS, 2015)

Dispersal/Migration Narrative

Adult: This species is non-migratory (NatureServe, 2015). Pinesnakes have shown some seasonal movement trends of emerging from overwintering sites in February, moving to an active area from March until September, and then moving back to their overwintering areas (Yager et al. 2006, pp. 34–36). The various areas utilized throughout the year may not have significantly different habitat characteristics, but these movement patterns illustrate that black pinesnakes may need access to larger, unfragmented tracts of habitat to accommodate fairly large home ranges while minimizing interactions with humans. Duran and Givens (2001, p. 4) estimated the average size of individual black pinesnake home ranges (Minimum Convex Polygons (MCPs)) at Camp Shelby, Mississippi, to be 117.4 acres (ac) (47.5 hectares (ha)) using data obtained during their radio-telemetry study. A more recent study conducted at Camp Shelby, a National Guard training facility operating under a special use permit on the De Soto National Forest (NF) in Forrest, George, and Perry Counties, Mississippi, provided home range estimates from 135 to 385 ac (55 to 156 ha) (Lee 2014a, p. 1) (USFWS, 2015).

Population Information and Trends

Population Trends:

> 70% decline (NatureServe, 2015)

Resiliency:
Low to moderate (inferred from NatureServe, 2015; see current range/distribution)

Redundancy:
Moderate (inferred from USFWS, 2015)

Number of Populations:
11 (USFWS, 2015)

Population Size:
Unknown; estimated at least 10,000 (NatureServe, 2015)

Adaptability:
Moderate (NatureServe, 2015)

Population Narrative:
This species has been extirpated from many formerly occupied areas in Louisiana, Mississippi, and Alabama (Duran 1998b, Nelson and Bailey 2004). Overall, throughout the southeastern United States, the longleaf pine ecosystem has been reduced to less than 5 percent of its historical extent. This species has experienced a long-term decline of > 70%. Total adult population size is unknown. Conservatively assuming an average of 0.1 adults per hectare (10/square kilometer) of suitable habitat and at least 1,000 square kilometers of occupied suitable habitat, estimated population size would be at least 10,000. This species is considered moderately vulnerable to current threats (NatureServe, 2015). The Service estimates that 11 of the 14 populations of black pinesnakes remain extant today (USFWS, 2015).

Threats and Stressors

Stressor: Fragmentation and degradation of longleaf pine habitat (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Historical distribution is highly correlated with the historical range of the longleaf pine ecosystem (Duran 1998b). Longleaf pine forest in the southeast has been reduced to less than 5 percent of its original extent (Frost 1993, Outcalt and Sheffield 1996). In the range of the black pine snake, longleaf pine is now largely confined to isolated patches on private land and the DeSoto National Forest (DNF) in Mississippi. Habitat has been eliminated through land use conversions, primarily urban development and conversion to agriculture and pine plantations. Most of the remaining patches of longleaf pine on private land are fragmented, degraded, second-growth forests. Conversion of longleaf pine forest to pine plantation often reduces the quality and suitability of a site for black pine snakes. Forest management practices such as fire suppression, increased stocking densities, and removal of downed trees and stumps, combined with younger harvest ages of trees, all contribute to degradation of preferred habitat attributes (Rudolph et al. 2007). Fragmentation and degradation of longleaf pine habitat are continuing. The coastal counties of southern Mississippi and Mobile County, Alabama, are being developed at a rapid rate due to increases in the human population. Urbanization appears to have greatly

reduced historical black pine snake populations in Mobile County, Alabama (Duran 1998b) (NatureServe, 2015).

Stressor: Road mortality (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Roads surrounding and traversing the remaining habitat pose a threat. Lalo (1987) estimated that one million individual vertebrates are killed per day on roads in the United States. Black pine snakes frequent the sandy hilltops and ridges where roads are most frequently sited. During Duran's (1998a) study. Seventeen percent of the black pine snakes with transimtters were killed while attempting to cross a road (NatureServe, 2015).

Stressor: Hunting (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: In many parts of Louisiana, Mississippi, and Alabama, there is a lack of understanding of the importance of snakes to a healthy ecosystem. Snakes are often killed intentionally when they are observed. Duran (1998a) found a dead black pine snake that had been shot. In another instance, the tracks of a 4-wheel drive vehicle could be seen swerving to the wrong side of the road and into a ditch where a flattened dead black pine snake was found. As development pressures increase on the remaining black pine snake habitat, especially in Mobile County, Alabama, human/snake interactions will increase and frequently result in the death of the snake (NatureServe, 2015).

Stressor: Low reproductive rates (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Duran (1998a) suggested that reproductive rates of wild black pine snakes may be low. Thus, the loss of mature adults, through road mortality or direct killing, increases in significance. As existing occupied habitat becomes reduced in quantity and quality, low reproductive rates threaten population viability (NatureServe, 2015).

Stressor: Pet trade (NatureServe, 2015)
Exposure:
Response:
Consequence:
Narrative: Direct take of black pine snakes for recreational, scientific, or educational purposes is not currently considered to be a threat. However, there is some indication that collecting for the pet trade may be a problem (Duran 1998b) (NatureServe, 2015).

Stressor: Predation (USFWS, 2015)
Exposure:
Response:
Consequence:

Narrative: Red imported fire ants (Solenopsis invicta), an invasive species, have been implicated in trap mortalities of black pinesnakes during field studies (Baxley 2007, p. 17). They are also potential predators of black pinesnake eggs, especially in disturbed areas (Todd et al. 2008, p. 544), and have been documented predating snake eggs under experimental conditions (Diffie et al. 2010, p. 294). In 2010 and 2011, trapping for black pinesnakes was conducted in several areas that were expected to support the subspecies; no black pinesnakes were found, but high densities of fire ants were reported (Smith 2011, pp. 44–45). However, the severity and magnitude of effects, as well as the long-term effects, of fire ants on black pinesnake populations are currently unknown. Other potential predators of pinesnakes include red-tailed hawks, raccoons, skunks, red foxes, and feral cats (Ernst and Ernst 2003, p. 284; Yager et al. 2006, p. 34). Lyman et al. (2007, p. 39) reported an attack on a black pinesnake by a stray domestic dog, which resulted in the snake's death. Several of these mammalian predators are anthropogenically enhanced (urban predators); that is, their numbers often increase with human development adjacent to natural areas (Fischer et al. 2012, pp. 810–811). However, the severity and magnitude of predation by these species are unknown (USFWS, 2015).

Stressor: Inadequacy of regulatory mechanisms (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Outside of the National Forest and the area covered by the INRMP, existing regulatory mechanisms provide little protection from the primary threat of habitat loss for the black pinesnake. Longleaf restoration activities on Forest Service lands in Mississippi conducted for other federally listed species do improve habitat for black pinesnake populations located in those areas, but could be improved by ensuring the protection of the belowground refugia critical to the snake (USFWS, 2015).

Stressor: Exotic plants (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Exotic plant species degrade habitat for wildlife. In the Southeast, longleaf pine forest associations are susceptible to invasion by the exotic cogongrass (Imperata cylindrica), which may rapidly encroach into areas undergoing habitat restoration, and is very difficult to eradicate once it has become established, requiring aggressive control with herbicides (Yager et al. 2010, pp. 229–230). Cogongrass displaces native grasses, greatly reducing foraging areas, and forms thick mats so dense that ground-dwelling wildlife has difficulty traversing them (DeBerry and Pashley 2008, p. 74) (USFWS, 2015).

Stressor: Erosion control blankets (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: On many construction project sites, erosion control blankets are used to lessen impacts from weathering, secure newly modified surfaces, and maintain water quality and ecosystem health. However, this polypropylene mesh netting (also often utilized for bird exclusion) has been documented as being an entanglement hazard for many snake species, causing lacerations and sometimes mortality (Stuart et al. 2001, pp. 162–163; Barton and

Kinkead 2005, p. 34A; Kapfer and Paloski 2011, p. 1). This netting often takes years to decompose, creating a long-term hazard to snakes, even when the material has been discarded (Stuart et al. 2001, p. 163). Although no known instance of injury or death from this netting has been documented for black pinesnakes, it has been demonstrated to have negative impacts on other terrestrial snake species of all sizes and thus poses a potential threat to the black pinesnake when used in its habitat (USFWS, 2015).

Stressor: Stochastic events (USFWS, 2015)
Exposure:
Response:
Consequence:
Narrative: Random environmental events may also play a part in the decline of the black pinesnake. Two black pinesnakes were found dead on the De Soto NF during drought conditions of midsummer and may have succumbed due to drought-related stress (Baxley 2007, p.41) (USFWS, 2015).

Recovery

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

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

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

Conservation Measures and Best Management Practices:
- The largest known populations of black pinesnakes (5 of 11) occur in the De Soto NF, which is considered the core of the subspecies' known range. The black pinesnake likely receives benefit from longleaf pine restoration efforts, including prescribed fire, implemented by the U.S. Forest Service in accordance with its Forest Plan, in habitats for the federally listed gopher tortoise, dusky gopher frog, and redcockaded woodpecker. (USDA 2014, pp. 60–65). Within the recently revised Forest Plan, black pinesnakes are included on lists of species dependent on fire to maintain habitat, species sensitive to recreational traffic, species that are stump and stump-hole associates, and species sensitive to soil disturbance (USDA 2014, Appendix G– 85, G–92, G–100). The management strategies described within the Forest Plan provide general guidance that states project areas should be reviewed to determine if such species do occur and if so to develop mitigation measures to ensure sustainability of the species, such as, in general, not removing dead and downed logs or other woody debris from rare communities (USFWS, 2015).
- The MSARNG updated its INRMP in 2014, and outlined conservation measures to be implemented specifically for the black pinesnake on lands owned by the DoD and the State of Mississippi on Camp Shelby. Planned conservation measures include: Supporting research and surveys on the subspecies; habitat management specifically targeting the black pinesnake, such as retention of pine stumps and prescribed burning; and educational programs for users of the training center to minimize negative impacts of vehicular mortality on wildlife (MSARNG 2014, pp. 93–94). However, the INRMP addresses integrative management and conservation measures only on the lands owned and managed by DoD and the State of Mississippi (15,195 ac (6,149 ha)), which make up approximately

10 percent of the total acreage of Camp Shelby (132,195 ac (53,497 ha)). Most of this land is leased to DoD and owned by the Forest Service, which manages the land in accordance with its Forest Plan (see explanation above). Only 5,735 ac (2,321 ha) of the acreage covered by the INRMP provides habitat for the black pinesnake (USFWS, 2015).

- Longleaf pine habitat restoration projects have been conducted on selected private lands within the range historically occupied by the black pinesnake and likely provide benefits to the subspecies (U.S. Fish and Wildlife Service 2012, pp. 12–13). Additionally, restoration projects have been conducted on wildlife management areas (WMAs) (Marion County WMA in Mississippi; Scotch, Fred T. Stimpson, and the area formerly classified as the Boykin WMAs in Alabama) occupied by or within the range of the black pinesnake, and on three gopher tortoise relocation areas in Mobile County, Alabama. The gopher tortoise relocation areas are managed for the open canopied, upland longleaf pine habitat used by both gopher tortoises and black pinesnakes, and there have been recent records of black pinesnakes on the properties; however, the managed areas are all less than 700 ac (283 ha) and primarily surrounded by urban areas with incompatible habitat (USFWS, 2015).

References

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USFWS 2015. Endangered and Threatened Wildlife and Plants

Threatened Species Status for Black Pinesnake With 4(d) Rule. 80 Federal Register 193. October 6, 2015. Pages 60467 - 60489.

USFWS. 2015. Endangered and Threatened Wildlife and Plants

SPECIES ACCOUNT: *Pituophis ruthveni* (Louisiana pine snake)

Species Taxonomic and Listing Information

Listing Status: Threatened

Physical Description

Pine snakes (genus Pituophis) are large, short-tailed, non-venomous, powerful constricting snakes with keeled scales, a single anal plate (the scale covering the cloaca) and disproportionately small heads (Conant and Collins 1991, pp. 201-202). Their snouts are pointed and they are good burrowers. The Louisiana pine snake (P. ruthveni) has a buff to yellowish background color with dark brown to russet dorsal blotches covering its total length (Vandeventer and Young 1989, p. 35; Conant and Collins 1991, p. 203). The belly of the Louisiana pine snake is unmarked or boldly patterned with black markings. The Louisiana pine snake is variable in both coloration and pattern, but a characteristic feature is that its body markings are always conspicuously different at opposite ends of its body. Blotches run together near the head, often obscuring the background color, and then become more separate and well-defined towards the tail. Typically, there are no noticeable head markings, although rarely a light bar or stripe may occur behind the eye. The length of adult Louisiana pine snakes ranges from 122 to 142 centimeters (cm) (48 to 56 inches (in)) (Conant and Collins 1991, p. 203). The largest reported specimen was 178 cm (5.8 feet (ft)) long (Davis 1971, p. 145; Conant and Collins 1991, p. 203).

Taxonomy

The Louisiana pine snake is a member of the Class Reptilia, Order Squamata, Suborder Serpentes, and Family Colubridae. Stull (1929, pp. 2-3) formally described the Louisiana pine snake as a pine snake subspecies (P. melanoleucus ruthveni) based on two specimens taken in Rapides Parish, Louisiana. Reichling (1995, p. 192) reassessed this snakes taxonomic status and concluded that the Louisiana pine snake was geographically isolated and phenotypically distinct, and thus a valid evolutionary species. The Louisiana pine snake has subsequently been accepted as a full species, P. ruthveni (Crother 2000, p. 69; Rodriguez-Robles and Jesus-Escobar 2000, p. 46; Collins and Taggert 2002, p. 33).

Historical Range

See current range/distribution

Current Range

Louisiana: Bienville, Beauregard, Jackson, Natchitoches, Rapides, Sabine, and Vernon counties; Texas: Angelina, Cherokee, Haradin, Houston, Jasper, Nacogdoches, Newton, Polk, Sabine, San Augustine,Shelby, Trinity, and Wood counties. The Louisiana pine snake historically occurred in portions of northwest and west-central Louisiana and extreme east-central Texas (Conant 1956, p. 19). It is extremely likely that undocumented populations of this species historically occurred but were lost before the 1930s, since virtually all virgin timber in the south was cut during intensive logging from 1870 to 1920 (Frost 1993, p. 38).

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Louisiana pine snakes appeared to be most active March-May and September-November (especially November) and least active December-February and summer (especially August) (Himes 1998, p. 12). Louisiana pine snakes were observed by Ealy et al. (2004, p. 391) to be semi-fossorial and essentially diurnal. Ealy et al. (2004, p. 390) documented that the species spent 59 percent of daylight hours (sunrise to sunset) below ground and moved an average of 163 meters (m) (541 ft) per day. Furthermore, Louisiana pine snakes in east Texas were relatively immobile (i.e., moved less than 10 m (33 ft)) on 54.5 percent of days monitored and all recorded movements occurred during daytime (Ealy et al. 2004, p. 391). Adult males in Louisiana moved an average of 150 m (495 ft) daily, adult females 106 m (348 ft), and juveniles 34 m (112 ft) (Himes 1998, p. 18). Additionally, Bair'ds pocket gophers are the primary prey of the Louisiana pine snake (Himes 2000, p. 97; Rudolph et al. 2002, p. 58) comprising an estimated 53 percent of available individual prey records (Rudolph et al. 2012, p. 243), although the species has also been known to eat eastern moles (Scalopus aquaticus), cotton rats (Sigmodon hispidus), deer mice (Peromyscus sp.), harvest mice (Reithrodontomys sp.), and turtle (probably Trachemys scripta) eggs (Rudolph et al. 2002, p. 59, Rudolph et al. 2012, p. 244).

Reproduction Narrative

Adult: Louisiana pine snake sexual maturity is attained at an approximate length of 120 cm (4 ft) and an age of approximately three years (Himes et al. 2002, p. 686). The Louisiana pine snake is oviparous, with a gestation period of about 21 days (Reichling 1988, p. 77), followed by 60 days of incubation. Having the smallest clutch size (3 to 5) of any North American colubrid snake, the Louisiana pine snake is limited by a remarkably low reproductive rate (Reichling 1990, p. 221). However, the Louisiana pine snake produces the largest eggs (generally 12 cm (5 in) long and 5 cm (2 in) wide) of any U.S. snake (Reichling 1990, p. 221). It also produces the largest hatchlings reported for any North American snake, ranging 45 to 55 cm (18 to 22 in) in length, and up to 107 grams (g) in weight (Reichling 1990, p. 221). Captive Louisiana pine snakes can live over 30 years, but females have not reproduced beyond the age of 18 years (Reichling 2008a, p. 4, Appendix A).

Geographic or Habitat Restraints or Barriers

Adult: Busy highway or highway with obstructions such that snakes rarely if ever cross successfully; major river, lake, pond, or deep marsh (this barrier pertains only to upland species and does not apply to aquatic or wetland snakes); densely urbanized area dominated by buildings and pavement (NatureServe).

Environmental Specificity

Adult: Narrow; specialist or community with key requirements common (NatureServe)

Site Fidelity

Adult: High fidelity to hibernacula

Dependency on Other Individuals or Species for Habitat

Adult: Bairds pocket gopher burrows

Habitat Narrative

Adult: Louisiana pine snakes are endemic to the westerly extent of the longleaf pine (Pinus palustris) ecosystem that historically existed in Louisiana and Texas. Louisiana pine snake habitat consists of sandy, well-drained soils in open pine forest (especially longleaf-pine savanna), a sparse midstory, and well-developed herbaceous ground cover dominated by grasses and forbs (Rudolph and Burgdorf 1997, p. 117). Abundant ground-layer herbaceous vegetation is important for the Louisiana pine snake and their primary prey, the Bairds pocket gopher (Geomys breviceps). These fire-climax park-like conditions are created and maintained by recurrent low-intensity ground fires that occur on a 3 to 5 year return interval. In the absence of recurrent fire, suitable Louisiana pine snake habitat conditions are lost due to vegetative succession. Louisiana pine snakes have also been found in grasslands and pine plantations that contain sufficient herbaceous ground cover and sandy soils (Reichling et al. 2008, p. 9).

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory

Dispersal

Adult: Low

Dispersal/Migration Narrative

Adult: It has been documented that the species spends 59 percent of daylight hours (sunrise to sunset) below ground and moves an average of 163 meters (m) (541 ft) per day) (Ealy et al. 2004, p. 390). Furthermore, Louisiana pine snakes in east Texas were observed to be relatively immobile (i.e., moved less than 10 m (33 ft)) on 54.5 percent of days monitored and all recorded movements occurred during daytime (Ealy et al. 2004, p. 391). Adult males in Louisiana moved an average of 150 m (495 ft) daily, adult females 106 m (348 ft), and juveniles 34 m (112 ft) (Himes 1998, p. 18).

Population Information and Trends

Population Trends:

Declining

Species Trends:

Declining

Representation:

Low

Redundancy:

Low

Number of Populations:

6

Population Size:

Adult population size is unknown, but relatively small and presumably at least a few thousand (NatureServe).

Population Narrative:

The Louisiana pine snake is recognized as one of the rarest snakes in North America (Young and Vandeventer 1988, p. 203; Himes et al. 2006, p. 114). The Louisiana pine snake was classified in 2007 as endangered on the IUCN (World Conservation Union) Red List of Threatened Species (version 3.1; http://www.iucnredlist.org/). Because basic life history information is lacking for this species and current sampling methodology cannot determine population density, no estimates exist regarding the acreage or population size necessary to support a viable Louisiana pine snake population. Without management, the current and future status of the Louisiana pine snake will be influenced by the likelihood that all remnant Louisiana pine snake populations will remain demographically and genetically isolated into the future. Due to its semi-fossorial habits, rarity, and secretive nature, Louisiana pine snakes are difficult to locate and trap, even in areas where they are known to occur (Ealy et al. 2004, p. 384). To date, most Louisiana pine snake records have been from trapping and opportunistic sightings. Trapping effort data are used to estimate trap success (i.e., the number of trap days required to catch one snake) for each population. Trapping has provided important information on Louisiana pine snake occurrences. However, population densities cannot be reliably estimated from trapping data because mark-recapture analyses cannot be conducted without sufficient numbers of Louisiana pine snake recaptures. Consequently, no estimates of Louisiana pine snake population densities exist. However, the current, best available indices of estimated Louisiana pine snake abundance are trap successand other types of occurrence records.

Threats and Stressors

Stressor: Habitat fragmentation from historical loss and degradation
Exposure:
Response:
Consequence:
Narrative: The historical loss, degradation, and fragmentation of the longleaf pine ecosystem across the entire Louisiana pine snake historical range have resulted in six naturally extant Louisiana pine snake populations that are isolated and small. Habitat fragmentation on private lands in the matrix between extant populations has essentially eliminated the potential for successful dispersal among remnant populations, as well as the potential for natural re-colonization of vacant or extirpated habitat patches. Currently, the amount of habitat required to support viable Louisiana pine snake populations, and the necessary distribution of this habitat over the landscape, is not known.

Stressor: Fire suppression
Exposure:
Response:
Consequence:
Narrative: The disruption of natural fire regimes, due to fire suppression and inadequate, infrequent prescribed burning, is the leading factor responsible for the degradation of the small amount of remaining longleaf pine forest (Rudolph and Burgdorf 1997, p. 118), and may

represent one of the greatest threats to existing Louisiana pine snake habitat quality in recent years (Rudolph 2000, p. 7). In the absence of frequent and effective fires, upland pine savannah ecosystems rapidly develop a mid-story of hardwoods and off-site species which suppress or eliminate any herbaceous understory. Since the presence of pocket gophers is directly related to the extent of herbaceous vegetation available to them, their population numbers and distribution decline as such vegetation declines. The resulting reduction of pocket gophers and their distribution directly impacts the number and distribution of Louisiana pine snakes. The use of prescribed burning is heavily reduced on private timberlands because of the expense of liability insurance, legal liability, the planting of off-site pinespecies which have a reduced tolerance to fire, limited funds and personnel, and smoke management issues.

Stressor: Herbicides
Exposure:
Response:
Consequence:
Narrative: Industrial pine plantations containing off-site pine species are often managed with herbicides instead of prescribed burning. Most of these forests have sparse and poorly structured understory plant communities, an early successional trait that is present throughout the rotation, rendering them generally unsuitable for pocket gophers. Herbicide-use may alter the composition and/or density of the ground cover vegetation in a way that causes pocket gopher decline thus affecting Louisiana pine snake numbers as well (Rudolph and Burgdorf 1997, p. 118).

Stressor: Demographic and genetic factors
Exposure:
Response:
Consequence:
Narrative: The Louisiana pine snake has an extremely low reproductive rate, producing a very small clutch of four eggs on average (Reichling 1990, p. 221). The Louisiana pine snakes low fecundity and low population growth rate magnifies the effect of all other threats and increases the likelihood of local extirpations. The minimum population size required to maintain self-sustaining populations of the Louisiana pine snake is unknown. However, small, isolated populations are vulnerable to the threats of decreased demographic viability, increased susceptibility of extirpation from stochastic environmental factors (e.g., weather events, disease), and the potential loss of valuable genetic resources resulting from genetic isolation and subsequent inbreeding depression and genetic drift. Additionally, it is extremely unlikely that habitat corridors linking extant populations will be secured and restored; therefore, the loss of any extant population will be permanent without future reintroduction of captive-bred individuals.

Stressor: Road mortality
Exposure:
Response:
Consequence:
Narrative: Roads and associated vehicular traffic have been identified as important causes of snake mortality and population declines (Rudolph et al. 1999, p. 130; Himes et al. 2002, p. 686). Himes et al. (2002, p. 686) documented the death of 15 Louisiana pine snakes during their radio-telemetry study in Louisiana and Texas. Three of the 15 (20 percent) deaths could be attributed to vehicle mortality. Roads with moderate to high traffic levels reduce adjacent snake

populations by 50 to 75 percent and measurable impacts extend up to 850 m (approximately 0.5 mi) from the roads (Rudolph et al. 1999, p. 130). The threat of road mortality may be highest in the Longleaf Ridge Area of the south Angelina National Forest (Compartments 74 through 77, 79 through 92, and south portions of 73 and 78). Off-road vehicle use may also cause significant impacts to the Louisiana pine snake. However, no significant data exists to quantify the impact of off-road vehicle use.

Stressor: Entanglement in erosion control blankets
Exposure:
Response:
Consequence:
Narrative: A recently identified threat for many snake species is entanglement in filamentous mesh (particularly synthetic, non-biodegradable types) used in erosion control blankets (ECBs) installed on pipeline and road construction rights-of-ways and has been documented by Kapfer and Paloski (2011, p. 1). ECBs can result in direct Louisiana pine snake mortality due to entanglement. Rudolph (2011b in litt.) demonstrated that synthetic ECB material caused immediate entanglement and snakes were unable to extract themselves after exposure. Extensive pipeline construction associated with Haynesville shale gas and oil exploration activities, and the subsequent increase in the use of ECBs, is a particular threat to the Bienville, LA population (Rudolph 2011a in litt.).

Stressor: Intentional killing
Exposure:
Response:
Consequence:
Narrative: Malicious killing of snakes by humans is a significant issue in snake conservation because snakes arouse fear and resentment from the general public (Bonnet et al. 1999, p. 40). Intentional killing of black pine snakes (Pituophis melanoleucus) by humans along the Gulf Coast has been documented (USFWS 2007, p. 8). The intentional killing of Louisiana pine snakes by humans is likely, but the extent of the impact of this stressor isunknown. The USFWS does not have information related to the implementation, compliance, or enforcement of the existing regulatory mechanisms by the states or Federal land managers.

Stressor: Collection for pet trade
Exposure:
Response:
Consequence:
Narrative: In Texas, the Louisiana pine snake is listed as state threatened and prohibited from unauthorized collection. As of February 2013, unpermitted killing or removal from the wild is prohibited in Louisiana. Collection or harassment of Louisiana pine snakes is prohibited on USFS properties in Louisiana (USFS 2002, p. 1). The capture, removal, or killing of non-game wildlife from Fort Polk and Peason Ridge (DOD lands) is prohibited without a special permit (U.S. Department of the Army 2008, p. 6; U.S. Department of the Army 2013, p. 51). However, those regulations do not protect the habitat of the species which has declined.

Recovery

Recovery Actions:

- Ensure that habitat will be managed long-term for the benefit of this snake by continuing to present the option of CCAAs to willing landowners in significant portions of the Louisiana pine snake's range.
- Develop a Conservation Strategy to outline the highest priority conservation efforts for the Louisiana pine snake.
- Improve status assessment by continuing or re-establishing Louisiana pine snake trapping within the known OHMCPs and additional areas that the LRSF Model has shown to be preferable to snakes outside of the OHMCPs.
- Improve assessment of Louisiana pine snake population status and range by continuing to pursue access to survey additional private lands across the historical range of the species, facilitated by the LRSF Model.
- Increase the potential observation of this difficult-to-trap species by continuing to pursue potentially better methods of occurrence monitoring, such as pressure-activated or time-lapse camera traps.
- Begin field evaluation of and actual surveys with the two scent-detection dogs that are currently being trained under the guidance of the Memphis Zoo and Louisiana Department of Wildlife and Fisheries.
- Enhance existing and/or establish longleaf pine forests within occupied and preferable Louisiana pine snake habitat.
- Within occupied and preferable Louisiana pine snake habitat, reduce and/or remove the midstory component within pine forest stands to a level that allows maintenance by prescribed burning.
- Implement a prescribed-burning program (typical 3 to 5-year intervals once the forest is in a maintenance condition) to reduce the midstory forest component and maintain the herbaceous layer within occupied and preferable Louisiana pine snake habitat.
- Reduce timber stand density through selective thinning to allow sunlight to reach the ground thereby enhancing the herbaceous layer and pocket gopher habitat within occupied and preferable Louisiana pine snake habitat.
- Manage timber primarily for ecological restoration or on longer rotations and for higher end products such as saw timber and poles within occupied and preferable Louisiana pine snake habitat.
- Limit off-road vehicular use and consider/continue road closures within occupied and preferable Louisiana pine snake habitat.
- Provide conservation education to the general public, and to managers, hunters and other recreational users to avoid killing or otherwise impacting snakes in the wild.
- Educate collectors and other members of the public on the rarity of the Louisiana pine snake and the need to refrain from removing the species from the wild.
- Continue captive breeding and experimental reintroduction program to enhance populations within suitable habitat actively managed for Louisiana pine snake.
- Continue to progress on the assessment of captive-breeding stock and wild-caught specimen genetics to attempt to determine long-term viability of the species.
- Guide decision-making for management of captive stocks and the reintroduction program through the use of genetics assessment and analysis results.
- Acquire funding and encourage research on pocket gophers through an addition to the Louisiana Wildlife Action Plan.
- Recovery Priority Number: 8C (USFWS, 2018)

- Recovery actions (not in priority order) include: 1. Identify better methods to locate unknown inhabited areas and initiate searches for new populations to include other areas (for example those referenced in the listing rule). We have begun communications to the public for citizen science efforts. 2. Reevaluate unconventional search methods like scent dogs and find solutions to previously identified obstacles to securing those services. 3. Evaluate terrestrial eDNA methods for detection of the species. 4. Identify large unfragmented tracts ofland in Louisiana and Texas for additional reintroduction efforts. Must have relatively few roads and preferable or suitable soils. 5. Consider the development ofHCPs, SHAs, and other means of voluntary habitat improvement with private landowners, especially in Texas where a CCAA was not available prior to listing. 6. Use section 4(d) of the Endangered Species Act to allow specific exemptions that will facilitate cooperation and beneficial habitat stewardship with private citizens. 7. Conduct research to further the knowledge of life history requirements of the Louisiana pinesnake and apply the results toward management and protection of the species. Refine life history investigations to include aspects of environmental temperature tolerances, nesting requirements in the wild, required habitat patch size and degree of connectivity, and viability of populations. 8. Continue to refine and implement technology for maintaining and propagating the Louisiana pinesnake in captivity. Investigate the potential use of captive-reared or translocated Louisiana pinesnakes to augment existing natural populations or repopulate a previously occupied habitat where suitable conditions exist or can be restored. 9. Cooperate and assist with planned efforts to use wild caught male snakes as donors for artificial insemination of captive females in order to increase the genetic variability of the captive population which was grown from relatively few founders. 10. Continue to closely monitor incidence of SFD in populations and develop and implement procedures during trapping and other handling to reduce spreading of the fungus to uninfected individuals. 11. Determine causes for lack of evidence of population increases in areas where suitable habitat has been restored and is currently maintained. 12. Reevaluate and modify trapping methods or increase trapping efforts. 13. Develop a more accurate and efficient method to determine pocket gopher abundance 14. Determine the recruitment rate to, and amount of pocket gophers in newly created suitable habitat and explore the feasibility of artificial enrichment of pocket gophers in those areas. 15. Research the specific requirements (i.e., high value forage species, minerals, etc.) needed for optimum growth and reproduction of the pocket gopher and potentially further enhance newly created habitat. 16. Investigate methods to reduce vehicle mortality (e.g., fencing, culvert crossings, reduced speed zones) in occupied areas in near proximity to roads. 17. Encourage and work with all landowners to restore, enhance, and manage habitat to expand suitable habitat for the Louisiana pinesnake, particularly within and adjacent to estimated occupied habitat areas. 18. Continue to closely monitor existing Louisiana pinesnake populations (USFWS, 2018).

Conservation Measures and Best Management Practices:

- Improve status assessment by continuing or re-establishing Louisiana pine snake trapping within the known OHMCPs and additional areas that the LRSF Model has shown to be preferable to snakes outside of the OHMCPs.
- Enhance existing and/or establish longleaf pine forests within occupied and preferable Louisiana pine snake habitat.
- Within occupied and preferable Louisiana pine snake habitat, reduce and or remove midstory component within pine forest stands to a level that allows maintenance by prescribed burning.

- Implement a prescribed-burning program (typical 3 to 5-year intervals once the forest is in a maintenance condition) to reduce the midstory forest component and maintain the herbaceous layer within occupied and preferable Louisiana pine snake habitat.
- Reduce timber stand density through selective thinning to allow sunlight to reach the ground thereby enhancing the herbaceous layer and pocket gopher habitat within occupied and preferable Louisiana pine snake habitat.
- Manage timber primarily for ecological restoration or on longer rotations and for higher end products such as saw timber and poles within occupied and preferable Louisiana pine snake habitat.
- Limit off-road vehicular use and consider/continue road closures within occupied and preferable Louisiana pine snake habitat.
- Provide conservation education to the general public, and to managers, hunters and other recreational users to avoid killing or otherwise impacting snakes in the wild.
- Educate collectors and other members of the public on the rarity of the Louisiana pine snake and the need to refrain from removing the species from the wild.
- Continue captive breeding and experimental reintroduction program to enhance populations within suitable habitat actively managed for Louisiana pine snake.
- Continue to progress on the assessment of captive-breeding stock and wild-caught specimen genetics to attempt to determine long-term viability of the species.
- Guide decision-making for management of captive stocks and the reintroduction program through the use of genetics assessment and analysis results.
- Acquire funding and encourage research on pocket gophers through an addition to the Louisiana Wildlife Action Plan.

References

USFWS 2014. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Pituophis ruthveni (Louisiana Pine Snake). U.S. Fish and Wildlife Service, Region 4 (Southeast Region)

April 23, 2014

34 p.

USFWS. 2014. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Pituophis ruthveni (Louisiana Pine Snake). U.S. Fish and Wildlife Service, Region 4 (Southeast Region)

U.S. Fish and Wildlife Service. 2018. Recovery Outline For Louisiana pinesnake (Pituophis ruthveni). 6 pp.

SPECIES ACCOUNT: *Pseudemys alabamensis* (Alabama red-belly turtle)

Species Taxonomic and Listing Information

Listing Status: Endangered; June 16, 1987; Southeast region (R4)

Physical Description

This is a relatively large, freshwater, herbivorous turtle attaining a carapace length of 33 centimeters (13 inches). It normally has an orange to red plastron and at the tip of the upper jaw a prominent notch bordered on each side by a toothlike cusp. The elongate carapace is high-domed, its highest point often anterior to midbody, where the carapace is widest. The background carapace coloration is brown, olive, or black with yellow, orange, or red distinct vertical markings. The skin is olive to black with yellow to light orange striping (USFWS, 1989).

Taxonomy

Characteristics most useful for distinguishing this species from other members of its genus include the number and configuration of stripes on the head (Ernst and Barbour 1972, Mount 1975, Dobie 1985a, 1986) and the presence of flanking cusps on each side of a terminal notch in the upper jaw. The Alabama red-bellied turtle has more stripes than the Florida red-bellied turtle (Pseudemys nelsoni), and both the former and latter have a prefrontal arrow normally absent in the river cooter (Pseudemys concinna) and the Florida cooter (Pseudemys floridana) (USFWS, 1989).

Historical Range

Formerly throughout the lower part of the Mobile River system below David Lake, Baldwin and Mobile counties, Alabama; as far north as the Little River State Park in southern Monroe County, and perhaps east into the Florida Panhandle as far as Apalachee Bay (NatureServe, 2015).

Current Range

Mobile Bay and tributary streams, Baldwin and Mobile counties, Alabama; apparently most abundant from Hurricane Landing on Tensaw River south to northern part of Mobile Bay north of Interstate Highway 10 (Dobie and Bagley 1988) (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

<u>Adult:</u> Eats primarily aquatic plants (Mount 1975) (NatureServe, 2015).

Reproduction Narrative

<u>Adult:</u> Lays clutch or clutches of 3-9 eggs, May to July (Behler and King 1979, Dobie and Bagley 1988) (NatureServe, 2015).

Tolerance Ranges/Thresholds

Adult: Moderate (inferred from NatureServe, 2015)

Site Fidelity

Adult: Low (inferred from NatureServe, 2015)

Habitat Narrative

Adult: Most abundant in quiet backwaters of upper Mobile Bay in areas with dense submerged vegetation, in water generally 1-2 m deep; also in river channels; occurs only as a straggler in brackish water and salt marsh areas of lower Mobile Bay (McCoy and Vogt 1985). Uses dense beds of aquatic vegetation for basking (NatureServe, 2015). Moderate ecological integrity tolerance ranges and site fidelity are inferred based on the species ability to inhabit Mobile bay, which is not pristine, and radio telemetry studies (NatureServe, 2015) which indicate individuals can move long distances (up to 17.9km) but most remain in the same vicinity they were tagged (inferred from NatureServe, 2015).

Dispersal/Migration

Motility/Mobility

Adult: High (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from NatureServe, 2015)

Dispersal

Adult: Moderate (inferred from NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Nelson (1998) radiotagged 43 individuals on Gravine Island and tracked them from November, 1997 to October, 1998. Most remained in the vicinity of the Island, but others moved long distances. The researchers recorded straight-line movements as far as 17.9 km north (Negro Lake Basin) and 15.8 km south (Big Bay John) (NatureServe, 2015). Available literature does not indicate this species is migratory. Inferred as moderately able to disperse based on high mobility but information on dispersal is lacking.

Population Information and Trends

Population Trends:

Stable (USFWS, 2015)

Resiliency:

Moderate (inferred from USFWS, 2015 and NatureServe, 2015)

Representation:

Low (inferred from USFWS, 2015 and NatureServe, 2015)

Redundancy:

Low (inferred from USFWS, 2015 and NatureServe, 2015)

Number of Populations:

1 to 5 (NatureServe, 2015)

Population Size:

1000 to 10,000 (NatureServe, 2015)

Population Narrative:

NatureServe (2015) notes that the number of populations is between 1 and 5 and that these populations contain between 1,000 and 10,000 individuals. Moderate resiliency is inferred based on USFWS (2015) noting that trapping data indicates that populations are stable. Low representation and resiliency are inferred based on the low number of populations noted in NatureServe (2015).

Threats and Stressors

Stressor: Human Recreation (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced nesting success
Narrative: Human disturbance on the major nesting area in the form of recreational use of the island (USFWS, 2015).

Stressor: Reduced aquatic vegetation (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced food source
Narrative: Natural phenomena, such as the movement of saltwater wedges up into bays during hurricanes, were considered more likely sources of seasonal (temporary) reductions in vegetation. Periodic maintenance dredging, which currently occurs at the mouths of occupied channels in Mississippi, may also induce upstream movement of saltwater wedges and act to facilitate reductions in submerged aquatic vegetation (USFWS, 2015).

Stressor: Access to upland areas (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced nesting habitat
Narrative: Rip-rap and bulkheads on riverbanks and edges of bayous restrict access to upland areas by nesting females (Leary et al. 2008) (USFWS, 2015).

Stressor: Incidental harvest (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced numbers
Narrative: Incidental harvesting by commercial fishermen and shrimpers in gill, hoop, and trammel nets was also described as a threat under this factor in the final listing rule. This remains a potential threat to the species (Leary et al. 2008), although current state saltwater fishing regulations in Alabama and Mississippi are likely effective in limiting most incidental mortality

(Alabama Department of Conservation and Natural Resources (ADCNR) 2015; Mississippi Department of Marine Resources (MDMR) 2013) (see Factor D.) (USFWS, 2015).

Stressor: Shooting (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced numbers
Narrative: The shooting of basking or nesting turtles is considered a current threat (USFWS, 2015).

Stressor: Predation (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced numbers
Narrative: Fish crows, alligators, armadillos and raccoons are listed as known predators of this species. Fire ants are listed as potential predators (USFWS, 2015).

Stressor: Water Quality (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced food source
Narrative: An overall decline in water quality is thought to be the primary vector for the continued disappearance of submerged aquatic grasses (Moncreiff 2007) which provide food and habitat for the Alabama red-bellied turtle (USFWS, 2015).

Stressor: Roads (USFWS, 2015)
Exposure:
Response:
Consequence: Reduced numbers
Narrative: Roads near upland nesting sites are a threat to adult females and hatchlings. The U.S. Highway 90/98 causeway (Mobile Bay Causeway, Battleship Parkway) is an elevated roadbed constructed in the 1920s that crosses Mobile Bay and connects Baldwin and Mobile counties in Alabama (Godwin 2010). The aquatic habitat in this area supports an important population segment of the Alabama red-bellied turtle and due to the elevated nature of the roadbed, female turtles frequently attempt to nest in this area. Nelson and Scardamalia-Nelson (2014) have summarized the mortality data from 13 years of surveys of dead Alabama red-bellied turtles at this site. They documented 773 dead turtles that had been run over and killed on the causeway; these numbers are considered a minimum since it was unlikely all dead hatchlings were located. Most of the mortality was to hatchling turtles, but twenty-one percent of the mortality was of adult female turtles (USFWS, 2015).

Recovery

Reclassification Criteria:
Long-term protection has been established for three nesting habitats. This criterion has been partially met. Gravine Island, a known nesting site in Alabama, has been purchased by the U.S. Army Corps of Engineers and is protected as part of the Upper Delta Wildlife Management Area. Predation is still a major problem at Gravine Island; due to low juvenile recruitment, the site

may function as a population sink (see discussion under Factor A., below). In Alabama and Mississippi, the overall distribution of nesting areas remains unknown. Nesting sites in Mississippi have been identified along the West Pascagoula River, along the Escatawpa River and at the Grand Bay National Estuarine Reserve (Reserve), however only the Reserve site is under public ownership and protection (USFWS, 2015).

Basking, feeding and overwintering habitats have been protected. This criterion has not been met. Some basking, feeding, and overwintering habitats have been identified in Alabama and Mississippi. We are still working to accomplish recovery plan tasks like 2.0 and 3.0. No specific areas have been targeted for protection to secure basking, feeding, and overwintering habitat for Alabama red-bellied turtles (USFWS, 2015).

Fifteen years of data demonstrate that the population trend is increasing. This criterion has not been met. Survey/monitoring studies have been conducted at varying intervals since the late 1970s in Alabama. Populations in Mississippi were largely unknown before the mid-1990s, and were not formally considered conspecific with those in Alabama until 2003 (Leary et al. 2003). Existing data do not support a population trend that is increasing (see discussion below under Biology and Habitat: Abundance, population trends) (USFWS, 2015).

Recovery Actions:

- The stated Recovery Objective is to reclassify the Alabama red-bellied turtle from endangered to threatened status (USFWS, 2015). Therefore, see reclassification criteria.
- The stated Recovery Objective is to reclassify the Alabama red-bellied turtle from endangered to threatened status (USFWS, 2015). Therefore, see reclassification criteria.
- The stated Recovery Objective is to reclassify the Alabama red-bellied turtle from endangered to threatened status (USFWS, 2015). Therefore, see reclassification criteria.

References

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NatureServe Explorer (2015): An online encyclopedia of life [web application]. Version 7.1. NatureServe, Arlington, Virginia. Available http://explorer.natureserve.org. (Accessed: March 21, 2016)

SPECIES ACCOUNT: *Pseudemys rubriventris bangsi* (Plymouth Red-Bellied Turtle)

Species Taxonomic and Listing Information

Listing Status: Endangered; Northeast Region (R5) (USFWS, 2015)

Physical Description

The redbelly turtle, Pseudemys rubriventris, is a large basking turtle 10-12 inches (254- 305 mm) in carapace length when mature. Coloration and pattern are highly variable, but in general, the carapace is mahogany to black with light chestnut to reddish vertical bars on the laminae. The name rubriventris is from the Latin words rubidus for reddish, and venter for belly, referring to the reddish plastron (Graham 1991). Considerable sexual dimorphism exists in body size and scute proportions (Graham 1991). Female redbelly turtles are larger and have a longer plastron, higher shell, and wider bridge, and plastral scutes are relatively longer at the midline, except the femoral scute, which is slightly longer in males. Redbelly turtles, especially males, tend to become melanistic with age. Background color of the adult male plastron is pale pink overlaid with dark vermicular mottling; in females it is coral red with grey figures narrowly bordering the plates (Graham 1971b). The front of the upper jaw has a terminal notch flanked on each side by a distinct maxillary cusp. The presence of maxillary cusps distinguishes the redbelly group, which also includes the Florida redbelly turtle (P. nelsoni) and the Alabama redbelly turtle (P. alabamensis) (USFWS, 1994).

Taxonomy

The red-bellied cooter (Pseudemys rubriventris) was originally described by J. LeConte in 1830 as Testudo rubriventris based on a specimen that was collected near Trenton, New Jersey (Mitchell 1994). F. Lucas was the first to recognize the existence of these turtles within the State of Massachusetts in 1869 (USFWS 1994). By 1894, Lonnberg transferred the species to the geuns Pseudemys where it remains today (Mitchell 1994). Other scientific names previously applied to this species in the literature are Emys rubriventris, Ptchemys rugosa, Pseudemys rugosa, and Chrysemmys reubriventris (Mitchell 1994). Additional common names include Plymouth turtle, Plymouth terrapin, Plymouth red-bellied turtle, and Plymouth red-bellied terrapin (Schmidt 1953) (USFWS, 2007).

Current Range

Limited to about 17 ponds in and near the towns of Plymouth and Carver, Plymouth County, Massachusetts.

Critical Habitat Designated

Yes; 4/2/1980.

Legal Description

On April 2, 1980, the U.S. fish and Wildlife Service designated critical habitat for Pseudemys rubriventris bangsi pursuant to the Endangered Species Act of 1973, as amended (45 FR 21828 - 21833).

Critical Habitat Designation

Critical habitat for the Plymouth Red-Bellied Turtle is designated in Plymouth County, Masachusetts:

An area including Briggs Reservoir, Cooks Pond, Little South Pond, South Triangle Pond, Great South Pond, Powderhorn Pond, Boat Pond, Hoyte Pond, Gunners Exchange Pond, Crooked Pond and Island Pond as follows: Beginning at the intersection of the centerline of the right-of-way of the Boston Edison and New Bedford Gas and Edison Light Company transmission lines and the westerly right-of-way line of Long Pond Road, thence southeasterly, along the westerly rightof-way line of Long Pond Road, 10,370 feet to the intersection of the said rightof-way line and the boundary line of the Myles Standish State Forest: thence southerly and westerly, along the boundary line of the Myles Standish State Forest, crossing and re-crossing Snake Hill Road, 11.200 feet, more or less; thence westerly, leaving the boundary line of the State Forest, 1,530 feet, more or less, to the boundary line of the Myles Standish State Forest; thence westerly, along the boundary line of the Myles Standish State Forest, 9,180 feet, more or less, to the intersection of the boundary of the said State Forest and the easterly right-of-way line of the Algonquin Gas Transmission Company pipeline; thence northerly, along the easterly right-of-way line of the said pipeline, 6,223 feet, more or less, to the intersection of the easterly right-of-way line of the said pipeline and the northerly right-of-way line of Rings Pond Plain Road; thence northeasterly, along the northerly right-of-way line of said road 3,lUO feet to a point; thence northerly, 800 feet, more or less, to the sourtherly right-or-way line of the Boston Edison and new Bedford Gas and Edison Light Company transmission lines: thence northwesterly, along the southerly right-of-way base of the said transmission lines, 4,150 feet, more or ’ less, to the intersection of the southerly right-of-way line of the said transmission lines and the easterly right-of-way line of the Algonquin Gas Transmission Company pipeline; thence northerly, along the easterly right-of-way line of the said pipeline, 2,500 feet, more or less, to the intersection of the easterly right-of-way line of the said pipeline and the southerly right-of-way line of Black Cat Road; thence southeasterly, along the southerly right-of-way line of said road, crossing South Pond road and continuing southeasterly, along the southerly right-of-way line of an unnamed road, 10,370 feet, more or less, to a point; thence southerly 2,300 feet, more or less. to the northerly right-of-way line of the Boston Edison and New Bedford Gas and Edison Light Company transmission lines, thence easterly, along the northerly right-of-way line of the said transmission lines, 1,300 feet, more or l,ess, to the intersection of the northerly right-of-way line of the said transmission lines and the westerly right-of-way line of Long Pond Road; thence southerly, along the westerly right-of-way line of said road, 100 feet, more or less, the place of beginning.

Primary Constituent Elements/Physical or Biological Features

Not available

Special Management Considerations or Protections

Activities that may adversely modify critical habitat includes:

1. With regard to the Plymouth red-bellied turtle, a major threat to the continued existence of this Species is the adverse modification of the water quality and levels of the ponds on which it depends. Any tdgntficant alteration of the water levels, as by groundwater pumping, or reduction in water quality which would reduce or eliminate vegetation and aquatic prey items of this turtle could adversely modify critical Habitat since aquatic vegetation serves as both food and shelter to the turtle. Siltation resulting from land clearing adjacent to ponds or pollution of the groundwater could eliminate vegetation and aquatic invertebrates.

2. Because this species uses wetlands adjacent to the ponds, the draining of wetlands within the Critical Habitat could adversely affect the species.

3. Shoreline modification, filling, and dredging for beaches, dikes, real estate development or similar types of activity could be considered to adversely affect Critical Habitat since they could affect water quality, levels of shoreline, and nesting and overwintering sites for the species.

Life History

Feeding Narrative

Adult: Adults and large subadults apparently herbivorous (USFWS 1981). Also may consume crayfish and other small aquatic animals (Matthews and Moseley 1990).; Food Habits: Carnivore (Adult, Immature), Piscivore (Adult, Immature), Invertivore (Adult, Immature), Herbivore (Adult, Immature)Active from late March to October (USFWS 1981). Spends much of day basking.; (NatureServe, 2015)

Reproduction Narrative

Adult: The microclimate at redbelly turtle nests can affect the sex ratio of hatchlings (temperature dependent sex determination or TSD). Cool nests will produce more males and warm nests more females (USFWS, 1994). Lays clutch(es) of about 10-17 eggs in June-July. Eggs hatch in 73-80 days; hatchlings may overwinter in nest and emerge in spring. Females are sexually mature in 8-15 years (Matthews and Moseley 1990).; (NatureServe, 2015)

Spatial Arrangements of the Population

Adult: Clumped (NatureServe, 2015)

Environmental Specificity

Adult: Narrow/specialist (inferred from NatureServe, 2015)

Tolerance Ranges/Thresholds

Adult: Low (inferred from NatureServe, 2015)

Site Fidelity

Adult: High (inferred from NatureServe, 2015)

Habitat Narrative

Adult: Species inhabits deep, permanent ponds with nearby sandy areas for nesting; surrounding vegetation consists of pine barrens or mixed deciduous forest. Wanders on land, fall and spring. Inactive at pond bottom in winter. Eggs are laid in nests dug in soft soil in open areas usually within 100 yards of water (USFWS 1981). Often nests in tilled or disturbed soil (DeGraaf and Rudis 1983, Ernst and Barbour 1972). Burrowing in or using soil (NatureServe, 2015). High ecological integrity of the community and site fidelity as well as low tolerance ranges are inferred based on the specific habitat needs of this species and the limited number of known locations.

Dispersal/Migration

Motility/Mobility

Adult: Moderate (NatureServe, 2015)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory(NatureServe, 2015)

Dispersal

Adult: Low (NatureServe, 2015)

Dispersal/Migration Narrative

Adult: Nonmigrant (NatureServe, 2015). dispersal rates of headstarted turtles and non-headstarted juveniles from natal ponds appears to be very low (USFWS, 1994).

Population Information and Trends

Population Trends:

Unknown

Number of Populations:

6 - 20 (NatureServe, 2015)

Population Size:

250 - 1000 individuals (NatureServe, 2015)

Population Narrative:

Total population size was estimated at about 200 breeding individuals in 1985; about 100 young (reared from artificially incubated eggs) were added to the population each year beginning in 1987. In 1993, USFWS (Federal Register, 29 July 1993) stated that the population was "300-400 turtles." Clough (2001, Endangered Species Bulletin 25(4):27) reported the population size as 300 adults. Occurs in about 17 ponds. (NatureServe, 2015)

Threats and Stressors

Stressor: Residential development (USFWS, 2007)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Residential development is listed as a threat to this species (USFWS, 2007).

Stressor: Agricultural development (USFWS, 2007)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Cranberry production (water use) is a threat to this species (USFWS, 2007).

Stressor: Fire supression (USFWS, 2007)
Exposure:
Response:

Consequence: Loss of habiat
Narrative: Fires once set to control forest succession also created excellent nesting areas for this species. Recent fire suppression cause ponds to become surrounded by forest (USFWS, 2007).

Stressor: Predation (USFWS, 2007)
Exposure:
Response:
Consequence: Loss of individuals
Narrative: Predation of newly emerged cooters by the bullfrog, as well as raccoons (eggs and newly hatched), herons and bass is a threat to this species (USFWS, 2007).

Stressor: Inadequacy of existing regulatory mechanisms (USFWS, 2007)
Exposure:
Response:
Consequence: Loss of habitat
Narrative: Inadequacy of existing regulatory mechanisms is listed as a threat to this species (USFWS, 2007)

Stressor: Climate change (USFWS, 2007)
Exposure:
Response:
Consequence: Loss of habitat/competition
Narrative: Warmer weather in spring and summer may provide more favorable conditions for Massachusetts turtles to basek, feed and nest. Hatching success (absent predation) may be higher during warmer summers and a more equal sex ratio of hatchlings could result. On the other hand, the ranges of other species will be similarly influenced to some degree and new competitors, pathogens, and introduced invasive species (e.g. and aquatic plant that outcompetes native cooter foods) could become established (USFWS, 2007).

Recovery

Reclassification Criteria:
Reclassification to threatened status will be considered when: the Plymouth redbelly turtle (cooter) population level of approximately 300 breeding-age individuals to a total of 600 breeding-age individuals distributed among a minimum of 15 self-sustaining populations (USFWS, 2007).

Delisting Criteria:
The distribution of the species is expanded to 20 or more self-sustaining populations (in lakes, ponds, and possibly rivers) and numbers are increased to a total of 1,000 or more breeding age individuals (USFWS, 2007).

Sufficient habitat is protected to allow long-term maintenance of the populations (USFWS, 2007).

Knowledge about their life history, habitat requirements, and limiting factors is sufficient to effectively protect and manage the turtles and their habitat (USFWS, 2007).

Conservation Measures and Best Management Practices:

- Protection through fee acquisition, conservation easement, purchase of development rights or any other means, the most important pond shore habitats supporting the species in Plymouth County (USFWS, 2007).
- Conduct population estimate surveys of selected ponds and rivers, such as Federal Pond Assawompsett Pond, East Head Pond, Great South Pond, Hoyts-Gunners Exchange Pond, Island Pond, Sampson Pond, and the Nemasket and Weweantic Rivers. These waters are likely to support the greatest number of cooters in the Massachusetts population and have not been recently surveyed (USFWS, 2007).
- Prioritize and conduct basking site and nest site enhancement activities at ponds supporting the largest cooter populations (USFWS, 2007).
- Utilize the survival data provided in Table 2 to review the number of released turtles through the HS program and supplement selected ponds as appropriate (USFWS, 2007).
- Conduct research and identify if feasible means to mitigate high nest/egg and hatchling predation rates can be implemented (USFWS, 2007).
- Develop a monitoring plan what will efficiently track the status of the population both during the process of recovery and post-delisting (USFWS, 2007).

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SPECIES ACCOUNT: *Sistrurus catenatus* (Eastern massassauga rattlesnake)

Species Taxonomic and Listing Information

Listing Status: Threatened; 09/30/2016; Great Lakes-Big Rivers Region (R3) (USFWS, 2016a)

Physical Description

The eastern massasauga rattlesnake is a small, heavy-bodied snake with a heart-shaped head and vertical pupils. The average length of an adult is approximately 0.6 meters (two feet). Adult eastern massasaugas are gray or light brown with large, light-edged chocolate brown blotches on the back and smaller blotches on the sides. The snake's belly is marbled dark gray or black and there is a narrow, white stripe on its head. Its tail has several dark brown rings and is tipped by gray-yellow horny rattles. Young snakes have the same markings as adults, but are paler than adults, and the rattle is represented by a single terminal segment called a button.

Taxonomy

The eastern massasauga rattlesnake, described by Rafinesque in 1818, has a variety of common names: eastern massasauga rattlesnake, eastern massasauga, prairie rattlesnake, spotted rattler, and swamp rattler (Gloyd 1940, p. 44; Minton 1972, p. 315). The U.S. Fish and Wildlife Service previously recognized the eastern massasauga rattlesnake as a subspecies (Sistrurus catenatus catenatus) of a wider ranging species (Sistrurus catenatus). Due to recently published scientific information on the phylogenetic relationships of the massasaugas we now recognize the eastern massasauga rattlesnake as a distinct species (Sistrurus catenatus). The Service revised the range of the eastern massasauga rattlesnake to the states of New York, Pennsylvania, Ohio, Michigan, Indiana, Illinois, Wisconsin, Minnesota, the eastern half of Iowa, and the Canadian province of Ontario. Extant populations in Missouri and southwest Iowa, previously thought to be included in the eastern massasauga range, no longer are considered to include the eastern massasauga rattlesnake. Massasaugas in those two areas are now understood to be the western massasauga subspecies.

Historical Range

Canada and U.S. (states of Illinois, Indiana, Iowa, Michigan, Minnesota, New York, Ohio, Pennsylvania, Wisconsin). The historic range of the eastern massasauga rattlesnake included sections of western New York, western Pennsylvania, southeastern Ontario, the lower peninsula of Michigan, the northern two thirds of Ohio and Indiana, the northern three quarters of Illinois, the southern half of Wisconsin, extreme southeast Minnesota, and the eastern third of Iowa.

Current Range

Canada and U.S. (states of Illinois, Indiana, Iowa, Michigan, Minnesota (?), New York, Ohio, Pennsylvania, Wisconsin). Although the limits of the current range of the eastern massasauga rattlesnake resemble the boundaries of its historic range, the geographic distribution has been restricted by the loss of the populations from much of the area within the boundaries of that range. The eastern massasauga is probably extirpated from Minnesota (USFWS 1998, p. 7). Rangewide, approximately 40 percent of the counties that were historically occupied by eastern massasauga no longer support the species. The eastern massasauga is currently listed as endangered or threatened in every state or province where it occurs except for Michigan, where it is designated as a species of special concern (USFWS 1998).

Distinct Population Segments Defined

None. However,in the 1998 status assessment, the eastern massasauga rattlesnake was considered a distinct population segment of the wider ranging massasauga rattlesnake. However, since the DPS almost completely overlaid the range of the previously recognized subspecies, we treated this entity as a subspecies in subsequent assessments and Candidate Notices of Review. Recognition of the distinct population segment is no longer warranted because the range of the eastern massasauga rattlesnake no longer includes extant massasauga populations in Missouri and extreme southwest Iowa. These populations were included in the eastern massasauga DPS because they were of uncertain taxonomic status (USFWS 1998, p. 1-3).

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The eastern massasaugas is a carnivore/invertivore. Small mammals (voles, deermice, shrews) dominate the diet of the eastern massasaugas, with snakes and birds of lesser importance (Keenlyne and Beer 1973; Hallock 1991; Ernst 1992; Anton, in Johnson and Menzies 1993). In Missouri, massasaugas are known to feed mainly on rodents and snakes (Seigel 1986). These snakes also sometimes eat other small animals, and there is one report of consumption of bird (bobwhite) eggs (Applegate, 1995, Herpetol. Rev. 26:206). In Illinois, prey recovered from free-ranging neonates consisted primarily of southern short-tailed shrews (Blarina carolinensis). In feeding trials, neonates demonstrated a preference for snake prey, disinterest in anuran and insect prey, and indifference toward mammal prey (Shepard et al. 2004). Activity is often diurnal in spring and fall, more nocturnal-crepuscular in hot summer weather; the species is mainly diurnal in Pennsylvania, where most activity occurs between 0900 and 1500 hours (Reinert, cited by Ernst 1992). In the north-central part of the range, most activity occurs from about April to October or November; cold weather enforces inactivity. In Missouri, massasaugas are most active from April to mid-May and in October (Seigel 1986).

Reproduction Narrative

Adult: Breeding and births occur in late summer in northern New York, where most females breed apparently every 2 years (Johnson 1992); biennial breeding s apparently occurs also in Missouri and Pennsylvania, but annual breeding evidently occurs in Wisconsin (see Ernst 1992). In Michigan, massasaugas give birth in late July or August (Moran, in Johnson and Menzies 1993); rangewide, births occur between late July and late September. Litter size is 2-19, usualy around 8-10, with smaller litters in the south than in the north. Growth rates, estimated from size-frequency data, suggest an age of maturity of 3-4 years for females in Missouri (Seigel 1986). Longevity in the wild is poorly known, but captives may live up to 20 years or more. (NatureServe 2009)

Geographic or Habitat Restraints or Barriers

Adult: Busy highway or highway with obstructions such that snakes rarely if ever cross successfully; major river with consistently fast flow; densely urbanized area dominated by buildings and pavement.

Site Fidelity

Adult: High (USFWS, 2016b)

Habitat Narrative

Adult: The eastern massasauga rattlesnake generally occupies shallow wetlands and adjacent upland habitat, though this species has a wide range and shows some variation in the types of habitats it occurs in across this range. Suitable wetland habitat includes peat lands, marshes, sedge meadows, and swamp forest; typical upland habitat includes open savannas, prairies, wet open woodlands, and old fields. A high water table with places to hibernate, such as crayfish burrows or rock crevices, is an important habitat component of this species. Seasonal use of these habitats also varies greatly across the range of the species. More specifically, the habitat varies regionally (Ernst and Ernst 2003). Habitat in the eastern part of the range includes sphagnum bogs, fens, swamps, marshes, peatlands, wet meadows, and floodplains; also open sanannas, prairies, old fields, and dry woodland; the snakes often occur in wetlands in fall, winter, and spring, in drier adjacent uplands in summer. In Ontario, this snake is strongly associated with wetlands and coniferous forest; it avoided open areas (roads, trails), open water, and mixed forest; hibernation sites were in wetlands and coniferous forest (Weatherhead and Prior 1992). At Cicero Swamp in New York, massasaugas used openings in a shrub swamp, hibernated in peatland under a thick blanket of sphagnum moss formed into raised hummocks that overlie often partly water-filled spaces created by a branching network of shrub roots (Johnson 1992, 2000). In Michigan, habitat generally includes a wintering area of low woods, bogs, fens, or marshes, and a summering area of drier ground, usually grassy with low shrubs; hibernation occurs in mammal burrows, crayfish burrows, rock crevices, or tree root systems, or sometimes under partially submerged trash, barn floors, or in basements (Moran, in Johnson and Menzies 1993). In southeastern Michigan, massasaugas selected areas with disproportionate quantities of emergent wetland, scrub/shrub wetland, and lowland hardwood habitats, whereas upland hardwood and all human-altered landscapes were rarely used, even though they were available (Moore and Gillingham 2006). Near Chicago, Illinois, massasaugas tend to be associated with forest edge situations near rivers and shrubby old fields (Mierzwa, in Johnson and Menzies 1993). In Missouri, massasaugas shifted from prairie in spring to upland old fields and deciduous woods in summer, returned to prairie in spring (Seigel 1986).During their active season (after they emerge from hibernacula), they require sparse canopy cover and sunny areas (intermixed with shaded areas) for thermoregulation (basking and retreat sites), abundant prey (foraging sites), and the ability to escape predators (retreat sites). Habitat structure, including early successional stage and low canopy cover, appears to be more important for eastern massasauga rattlesnake habitat than plant community composition or soil type. Individual eastern massasauga rattlesnakes often return to the same hibernacula year after year (USFWS, 2016b).

Dispersal/Migration

Migratory vs Non-migratory vs Seasonal Movements

Adult: Local migrant between winter and summer habitats

Dispersal/Migration Narrative

Adult: This snake has been reported to move seasonally between adjacent wetland and upland habitats. In northwestern Missouri, massasaugas moved seasonally among different habitats (see Johnson and Figg, in Johnson and Menzies 1993). Individuals traveled a few kilometers or more between winter and summer habitats (Johnson and Menzies 1993). In Ontario, activity ranges averaged 0.25 square kilometers (up to 0.76 square kilometers); daily movements were frequent (moved on average of 60 percent of the days) and averaged 56 meters per episode (Weatherhead and Prior 1992). In Pennsylvania, mean home range area was about 1 hectare, and mean home range length was 89 meters (Reinert and Kodrich 1982). Also in Pennsylvania, activity range size of neonates prior to hibernation averaged 0.36 hectares; mean daily distance moved averaged 5.3 meters; neonates returned to their general birthing area to overwinter (Jellen and Kowalski 2007). In New York, estimates of mean activity range (minimum convex polygon) were 2.0 hectares for gravid females (n=2), 27.8 hectares for males (n=11), and 41.4 hectares for nongravid females (n=2) (Johnson 2000). In Michigan, 100 percent minimum convex polygon home ranges averaged 1.3 hectares (range 0.25-4.5 hectares), and daily movement rate averaged 6.9 meters per day (Moore and Gillingham 2006).

Population Information and Trends

Population Trends:

38% decline (USFWS, 2016b)

Representation:

High (USFWS, 2016b)

Redundancy:

Very high (inferred from USFWS, 2016b)

Number of Populations:

263 (USFWS, 2016b)

Minimum Viable Population Size:

50 adult females (USFWS, 2016b)

Population Narrative:

In the SSA report, a self-sustaining population of eastern massasauga rattlesnakes is defined as one that is demographically, genetically, and physiologically robust (a population with 50 or more adult females and a stable or increasing growth rate), with a high level of persistence (a probability of persistence greater than 0.9) given its habitat conditions and the risk or beneficial factors operating on it. A reasonable conclusion from the composite of genetic studies that exist (Gibbs et al. 1997, entire; Andre 2003, entire; Chiucchi and Gibbs 2010, entire; Ray et al. 2013, entire) is that there are broadscale genetic differences across the range of the eastern massasauga rattlesnake, and within these broad units, there is genetic diversity among populations comprising the broad units. Rangewide, there are 558 known historical eastern massasauga rattlesnake populations, of which 263 are known to still be extant, 211 are likely extirpated or known extirpated, and 84 are of unknown status. The rangewide number of presumed extant populations has declined from the number that was known historically by 38 percent (and 24 percent of the presumed extant populations have unknown statuses) (USFWS, 2016b).

Threats and Stressors

Stressor: Development and agricultural practices
Exposure:
Response:
Consequence:
Narrative: Habitat loss is an important factor in the decline of eastern massasauga. The effects of past, widespread wetland loss continue to impact eastern massasauga populations. Development and agriculture practices continue to perpetuate habitat loss, although to a lesser degree than in the past. The majority of extant populations of the eastern massasauga occur on public preserves or other land that is protected (USFWS 1998). However, recent information indicates that fragmentation and loss of suitable habitat area is continuing even on such sites, and especially where invasive woody vegetation is altering the vegetative structure of massasauga habitat. In general, habitat loss increases the distance between populations and can isolate seasonally used habitats within individual populations. Consequently, eastern massasauga populations become more susceptible to road mortality, predation, and persecution as snakes disperse from populations or make their seasonal movements between habitat types.

Stressor: Nonnative plants (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Degradation of eastern massasauga rattlesnake habitat typically happens through woody vegetation encroachment or the introduction of nonnative plant species. These events alter the structure of the habitat and make it unsuitable for the eastern massasauga rattlesnake by reducing and eventually eliminating thermoregulatory and retreat areas (USFWS, 2016b).

Stressor: Poaching and collection (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: Because of the fear and negative perception of snakes, many people have a low interest in snakes or their conservation and consequently large numbers of snakes are deliberately killed (Whitaker and Shine 2000, p. 121; Alves et al. 2014, p. 2). Human-snake encounters frequently result in the death of the snake (Whitaker and Shine 2000, pp. 125–126). Given the species' site fidelity and ease of capture once located, the eastern massasauga rattlesnake is particularly susceptible to collection. Poaching and unauthorized collection of the eastern massasauga rattlesnake for the pet trade is a factor contributing to declines in this species (for example, Jellen 2005, p. 11; Baily et al. 2011, p. 171) (USFWS, 2016b).

Stressor: Disease (USFWS, 2016b)
Exposure:
Response:
Consequence:

Narrative: Disease (whether new or currently existing at low levels but increasing in prevalence) is another emerging and potentially catastrophic stressor to eastern massasauga rattlesnake populations. In the eastern and Midwestern United States, the eastern massasauga rattlesnake is specifically vulnerable to disease due to Ophidiomyces fungal infections (snake fungal disease (SFD)). The emergence of SFD has been recently documented in the eastern massasauga rattlesnake (Allender et al. 2011, pp. 2383–2384) and many other reptiles (Cheatwood et al. 2003, pp. 333–334; Clark et al. 2011, p. 890; Pare´ et al. 2003, pp. 12–13; Rajeev et al. 2009, pp. 1265–1267; Sigler et al. 2013, pp. 3343–3344; Sleeman 2013, p. 1), and is concerning because of its broad geographic and taxonomic distributions (USFWS, 2016b).

Stressor: Climate change (USFWS, 2016b)
Exposure:
Response:
Consequence:
Narrative: This species is vulnerable to the effects of climate change through increasing intensity of winter droughts and increasing risk of summer floods, particularly in the southwestern part of its range (Pomara et al., undated; Pomara et al. 2014, pp. 95–97) (USFWS, 2016b).

Recovery

Recovery Actions:
- Restore wetlands and other habitat to improve and create habitat for massasaugas.
- Control invasive species to improve habitat for massasaugas.
- Conduct strategic roadside mowing to discourage snake use of areas around roads.
- Adjust prescribed burn prescriptions or other land management activities for times when massasaugas are dormant to reduce the likelihood of mortality.
- Increase outreach activities to lessen the public's persecution of massasaugas.
- Encourage private landowners to explore entering Candidate Conservation Agreements (CCA) or Candidate Conservation Agreements with Assurances (CAAA) with the Service so that partner agencies and landowners will work cooperatively with the Service to identify land management measures that would be beneficial to the species.

Conservation Measures and Best Management Practices:
- Restore wetlands and other habitat to improve and create habitat for massasaugas.
- Control invasive species to improve habitat for massasaugas.
- Conduct strategic roadside mowing to discourage snake use of areas around roads.
- Adjust prescribed burn prescriptions or other land management activities for times when massasaugas are dormant to reduce the likelihood of mortality.
- The eastern massasauga rattlesnake is State-listed as endangered in Iowa, Illinois, Indiana, New York, Ohio, Pennsylvania, and Wisconsin, and is listed as endangered in Ontario. In Michigan, the species is listed as ‘‘special concern,’’ and a Director of Natural Resources Order (No. DFI– 166.98) prohibits take except by permit (USFWS, 2016b).
- Of the 263 sites with extant eastern massasauga populations rangewide, 62 percent (164) occur on land (public and private) that is considered protected from development; development at the other 38 percent of sites may result in loss or fragmentation of habitat. Signed candidate conservation agreements with assurances (CCAAs) with the Service exist for one population in Ohio, one population in Wisconsin, and populations on State-owned lands in Michigan. These CCAAs include

actions to mediate the stressors acting upon the populations and provide management prescriptions to perpetuate eastern massasauga rattlesnakes on these sites. The Wisconsin Department of Natural Resources (DNR) developed a CCAA for one population in Wisconsin. Through the agreement, existing savanna habitat on State land, especially important to gravid (pregnant) females, will be managed to maintain and expand open canopy habitat, restore additional savanna habitat, and enhance connectivity between habitat areas. In Ohio, a CCAA for a State Nature Preserve population addresses threats from habitat loss from the prevalence of late-stage successional vegetation, the threat of fire both pre- and postemergence of eastern massasauga rattlesnakes, and limited connectivity through habitat fragmentation (USFWS, 2016b).

- The State of Michigan developed a CCAA that will provide for management of eastern massasauga rattlesnakes on State-owned lands. This area includes 33 known eastern massasauga occurrences, which represents approximately 34 percent of the known extant occurrences within the State and 10 percent rangewide. In addition, other eastern massasauga rattlesnake sites on county- or municipally owned land, as well as on privately owned land, could be included in the CCAA through Certificates of Inclusion issued by the Michigan Department of Natural Resources (MI DNR) prior to the effective date of listing (see DATES, above). The CCAA includes management strategies with conservation measures designed to benefit the eastern massasauga rattlesnake; these management strategies will be implemented on approximately 136,311 acres (55,263 hectares) of State-owned land. Many of these management actions are ongoing, but we do not have site-specific data on these management actions to include them in our analysis in the SSA. Nonetheless, we determine that the management actions proposed will address some of the threats (for example, habitat loss, vegetative succession) impacting populations on State lands in Michigan (USFWS, 2016b).
- The Service has information that at an additional 22 sites (that are not covered by a CCAA), habitat restoration or management, or both, is occurring; however, the Service does not have enough information for these sites to know if habitat management has mediated the current stressors acting upon the populations. The Faust model, however, did include these kinds of activities in the projections of trends, and, thus, future condition analyses are based on the assumption that ongoing restoration would continue into the future. Lastly, an additional 18 populations have conservation plans in place. Although these plans are intended to manage for the eastern massasauga rattlesnake, sufficient site-specific information is not available to assess whether these restoration or management activities are currently ameliorating the stressors acting upon the population. Thus, the Service was unable to include the potential beneficial impacts into our quantitative analyses (USFWS, 2016b).

References

USFWS 2013. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Sistrurus catenatus (Eastern Massasauga). 04/29/2013. Region 3, Great Lakes-Big Rivers Region. 19 p.

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USFWS. 2016b. Endangered and Threatened Wildlife and Plants

Threatened Species Status for the Eastern Massasauga Rattlesnake

Final rule. 81 Federal Register 190. September 30, 2016. Pages 67193 - 67214.

USFWS. 2013. U.S. Fish and Wildlife Service Species Assessment and Listing Priority Assignment Form for Sistrurus catenatus (Eastern Massasauga). 04/29/2013. Region 3, Great Lakes-Big Rivers Region. 19 p.

SPECIES ACCOUNT: *Sternotherus depressus* (Flattened musk turtle)

Species Taxonomic and Listing Information

Commonly-used Acronym: FMT

Listing Status: Threatened; 06/11/1987; Southeast Region (R4)

Physical Description

The flattened musk turtle is a small aquatic turtle having a distinctly flattened carapace up to 12 centimeters or 4.7 inches long, with keels virtually, if not altogether, lacking (Mount 1981). The carapace varies from very dark brown to orange with dark bordered seams and is slightly serrated behind (Ernst and Barbour 1972). The plastron is pink to yellowish. The head is greenish with a dark reticulum that often breaks up to form spots on the top of the snout (Mount 198]). Stripes on the top and sides of the neck, if present, are narrow. There are two barbels on the chin, all four feet are webbed, and males have thick, long, spine-tipped tails (Ernst and Barbour 1972) (USFWS, 1990).

Taxonomy

The genus Sternotherus was merged into the genus Kinosternon by Ernst and Barbour (1989) (based on protein electromorph data of Seidel et al. 1986). This change not adopted in subsequent taxonomic lists (King and Burke 1989, Collins 1990). However, Iverson (1991) evaluated protein and morphological data for kinosternine turtles and concluded that there presently exists no adequate basis for recognizing Sternotherus as a genus distinct from Kinosternon. Nevertheless, Ernst et al. (1994) treated Kinosternon and Sternotherus as distinct genera (NatureServe, 2015).

Historical Range

See current range/distribution.

Current Range

Historically restricted to upper Black Warrior River system, northern Alabama, upstream from Fall Line; largest known population is in Sipsey Fork in north-central Alabama (NatureServe, 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: Flattened musk turtles feed primarily on mollusks (Marion, et al. 1986) (USFWS, 1990).

Reproduction Narrative

Adult: This turtle does not mature sexually until 4-8 years of age, and normally deposits only 1 to 2 clutches of eggs per year with 1 to 3 eggs per clutch (Close 1982) (USFWS, 1990).

Environmental Specificity

Adult: Narrow/Specialist (inferred from USFWS, 1990)

Tolerance Ranges/Thresholds

Adult: Low (inferred from USFWS, 1990)

Site Fidelity

Adult: High (inferred from USFWS, 1990)

Habitat Narrative

Adult: The flattened musk turtle is found in a variety of streams and in the headwaters and around the margins of some impounded lakes. However, its optimum habitat appears to be free-flowing large creeks or small rivers having vegetated shallows from a few centimeters to about 0.6 meters (2 feet) deep, alternating with pools 1.1 to 1.5 meters (3.6 to 5 feet) deep. These pools have a detectable current and an abundance of crevices and submerged rocks, overlapping flat rocks, or accumulations of boulders. Other factors contributing to habitat quality for this turtle include abundant molluscan fauna, low silt load and deposits, low nutrient content and bacterial count, moderate temperature, and minimal pollution (Estridge 1970, Mount 1981). Ernst, et al. (1983) reported that S. depressus also inhabits stream stretches with sandy bottoms, alternating with suitable cover sites (USFWS, 1990). Environmental specificity, Ecological integrity, tolerance ranges and site fidelity are inferred based on habitat needs and Site fidelity are based on habitat needs.

Dispersal/Migration

Motility/Mobility

Adult: Low (inferred from USFWS, 2014)

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migratory (inferred from USFWS, 1990)

Dispersal

Adult: Low (inferred from USFWS, 1990)

Immigration/Emigration

Adult: Unlikely (inferred from USFWS, 1990)

Dispersal/Migration Narrative

Adult: Low mobility is inferred based on the species inability to swim well (USFWS, 2014). Non-migratory, low dispersal and unlikely immigration/emigration are based on specific habitat requirements and low numbers of populations (inferred from USFWS, 1990)

Population Information and Trends

Population Trends:

Decreasing (NatureServe, 2015)

Resiliency:
Low (inferred from USFWS, 1990 and NatureServe, 2015)

Representation:
Low (inferred from USFWS, 1990 and NatureServe, 2015)

Redundancy:
Low (inferred from USFWS, 1990 and NatureServe, 2015)

Population Growth Rate:
Low (inferred from USFWS, 1990 and NatureServe, 2015)

Number of Populations:
1 to 5 (NatureServe, 2015)

Resistance to Disease:
Low (inferred from USFWS, 1990 and NatureServe, 2015)

Population Narrative:
NatureServe (2015) notes that the short-term population trend is a decrease of 10 to 30%. Low resiliency is based on low number of populations and number of heathy populations (NatureServe, 2015). Representation and redundancy are inferred based on a low number of populations. Low resistance to disease is based on a number of turtles parasitized by turtle malaria protozoa and septicemia noted in the threats comments (USFWS, 1990).

Threats and Stressors

Stressor: Habitat Alteration (USFWS, 1990)
Exposure:
Response:
Consequence:
Narrative: Dodd, et al. (1988) concluded, after an intensive study, that siltation appears to have seriously impacted the flattened musk turtle. Possible adverse effects of silt include: (1) extirpation or reduction in populations of mollusks and other invertebrates on which the turtles feed; (2) physical alteration of the rocky habitats where the turtles seek food and cover; and (3) development of a substrate in which chemicals toxic to the turtles or their food sources may accumulate and persist. Activities and sources that have historically contributed to the siltation problem include agriculture, forestry, mining, and industrial and residential development. Recent passage of laws provide the means to regulate the amounts of silt that these activities can contribute to streams. Even if such regulation proves effective in stopping future flattened musk turtle habitat degradation, stream recovery is a slow process. That and the turtle's low reproductive rate will insure that meaningful improvement in its population status will require a long time. Pollution by organic and inorganic chemicals degrades water quality in the flattened musk turtle habitat and may affect its survival. Shell erosion and loss of invertebrate food organisms are possible adverse effects of such pollution (Mount 1981). Finally, hydrologic changes associated with mining (including declines in water level, creation of spoil aquifers, and

changes in streamflow characteristics); and various navigation and flood control projects may have adverse effects on the habitat of the flattened musk turtle. These activities cause range fragmentation which, according to Dodd et al. (1988), is a serious problem to the flattened musk turtle (USFWS, 1990)

Stressor: Overutilization (USFWS, 1990)
Exposure:
Response:
Consequence:
Narrative: The flattened musk turtle has been listed for sale on several dealer price lists at more than $80 each. Most of the formerly good populations have been considerably reduced through commercial collecting in recent years. “Collecting that permanently removes individuals from a population represents additional ‘mortality’ to the population which must be offset with higher than normal recruitment in order to maintain stable populations; however, recruitment appears low in flattened musk turtles” (Congdon, et al. 1987). A State law prohibiting the taking of flattened musk turtles was passed on May 21, 1984. This law and the Endangered Species Act provide a mechanism to control collecting (USFWS, 1990).

Stressor: Disease and parasites (USFWS, 1990)
Exposure:
Response:
Consequence:
Narrative: Estridge (1970) found three of seven specimens parasitized by a protozoan agent of turtle malaria. Ernst, et al. (1983) found some specimens heavily parasitized by a leech that carries the protozoan. A disease characterized by a mixed gram-negative septicemia has been noted in populations of the flattened musk turtle (Dodd 1988). Almost one-fourth of the turtles caught by Dodd, et al. (1988) in the last trap sample at one site were diseased; and more than one-half of all turtles of this species observed basking in the Dodd study were considered sick (USFWS, 1990).

Stressor: Altered pattern of Genetic Exchange (USFWS, 1990)
Exposure:
Response:
Consequence:
Narrative: Historically, the flattened musk turtle was found in the upper Black Warrior River system of Alabama upstream from the fall line, the break between interior provinces and the coastal plain (Tinkle 1959; Estridge 1970; Mount 1976, 1981; Ernst, et al. 1983). Beginning about 1930, several dams were built on the Black Warrior River below and near the fall line. The impoundments created behind those dams extend from well below to well above the steep gradient in streams as they cross the fall line. It has been hypothesized that creation of the impoundments allowed the range of S. m. peltifer (previously limited to below the fall line) to be functionally connected for the first time to the river above the fall line, and to have contact with the range of S. depressus (Iverson 1977a,b; Seidel and Lucchino 1981). This linkage eliminated a natural, environmental barrier to interbreeding between S. depressus and S. m. peltifer Iverson 1977a,b). Bankhead Dam, which was constructed in 1915 and prior to the impoundments near the fall line, is further upstream and now constitutes the primary physical barrier between the ranges of S. depressus and S. m. peltifer. As a result of these habitat modifications, the Black Warrior River system below Bankhead Dam but above the fall line may now contain hybrid

populations of Sternotherus turtles (Iverson 1977a,b; Mount 1981). Another interpretation is that the area from the fall line to where Bankhead Dam is now located was an area of natural intergradation between distinct taxon (Mount 1981). If hybridization or an altered pattern of natural intergradation is occurring due to habitat modification, the process may threaten the flattened musk turtle as a taxon if that modification continues (USFWS, 1990).

Stressor: Biological characteristics (USFWS, 1990)
Exposure:
Response:
Consequence:
Narrative: Several biological characteristics of the flattened musk turtle increase its vulnerability to the threats discussed previously. This turtle does not mature sexually until 4-8 years of age, and normally deposits only 1 to 2 clutches of eggs per year with 1 to 3 eggs per clutch (Close 1982). This low reproductive rate reduces the ability of the species to recover rapidly from anything that decimates the population or to respond rapidly to recovery activities. Since the flattened musk turtle occurs only in the upper Black Warrior River basin, it evidently has rather specific habitat requirements. This factor increases the likelihood of adverse impact from habitat modifications. Flattened musk turtles feed primarily on mollusks (Marion, et al. 1986), which are particularly susceptible to water pollution. The turtles also feed and spend virtually all of their time at the stream bottom and thus are in almost constant contact with any toxic sediments that may be present (USFWS, 1990)

Recovery

Delisting Criteria:
Improve habitat quality (USFWS, 1990)

Assess threats to turtle population and monitor its status (USFWS, 1990)

Reduce isolation of individual populations (USFWS, 1990)

Decrease incidence of disease, if significant (USFWS, 1990)

Reduce adverse genetic exchange above Bankhead Dam (USFWS, 1990)

Recovery Actions:
- Develop a habitat restoration plan and implement actions to restore habitat (USFWS, 1990).
- Develop a study plan, conduct studies and reduce on-going adverse actions (USFWS, 1990).
- Corrective action should emphasize restoring altered habitat areas to reestablish natural corridors. Isolated populations would then have the opportunity for reproductive contact again (USFWS, 1990).
- If study results indicate that the magnitude of disease is significant, efforts should be made to identify the causative agent and to take corrective action (USFWS, 1990).
- Hybridization of S. depressus with S. m. peltifer may have occurred below Bankhead Dam due to the construction of impoundments above and below the fall line, a former natural barrier. Altering this barrier with impoundments created a situation that may have allowed the two taxon to interbreed. If study results indicate the current pattern of genetic

exchange poses a threat to the listed population of the flattened musk turtle, the causative factor should be determined and corrective action taken (USFWS, 1990).

Conservation Measures and Best Management Practices:

- Revise recovery plan. The use of Guthrie (1986) in the recovery plan should be clarified or replaced with improved statistical means of determining habitat quality related to FMT population viability (USFWS, 2014).
- Continue implementing pertinent recovery actions from the FMT Recovery Plan (U.S. Fish and Wildlife Service 1990) (USFWS, 2014).
- Reengage FMT Recovery Group (USFWS, 2014).
- Define the species' current range by a range wide status survey of historically known range and any other possible stream reaches that have not been sampled (USFWS, 2014).
- Develop range wide population and habitat monitoring plan (USFWS, 2014).
- Establish collection metrics for PVA and minimum and maximum sustainable yield of the populations (USFWS, 2014).
- Determine and maintain instream flows within the habitat of the species (USFWS, 2014).
- Support the State of Alabama comprehensive conservation strategy efforts concerning the FMT (Alabama Department of Conservation and Natural Resources 2005) (USFWS, 2014).
- Support the Alabama Water Watch, Black Warrior River Keeper, Partners in amphibian and reptile conservation (Bailey et al. 2010) and other conservation efforts within the Black Warrior River Basin (Alabama River Alliance 2003; Alabama Water Watch 2002) (USFWS, 2014).
- Support actions for stream and riparian management for freshwater turtles as described by Bodie (2001) and Bailey et al (2006) (USFWS, 2014).
- Continue partnering with stakeholders (e.g. Forest Service, landowners, nongovernmental organizations) in protecting FMT habitat (USFWS, 2014).
- Restore degraded habitat especially with regard to storm water runoff and other nonpoint source pollution (USFWS, 2014).
- Develop protection and management plans for all watersheds sites as indicated by information acquired from habitat and population survey studies (USFWS, 2014).
- Develop and initiate captive head start and husbandry program at Atlanta/Birmingham Zoos or equivalent facility (Hill 2011, pers. comm. to Drennen) (USFWS, 2014).
- Support conservation, outreach and management practices with the Lewis Smith Lake Reservoir Homeowners association and watershed management group (USFWS, 2014).

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SPECIES ACCOUNT: *Thamnophis eques megalops* (Northern Mexican gartersnake)

Species Taxonomic and Listing Information

Listing Status: Threatened; July 8, 2014; Southwest Region (R2)

Physical Description

The northern Mexican gartersnake may occur with other native gartersnake species and can be difficult for people without herpetological expertise to identify. With a maximum known length of 44 inches (in) (112 centimeters (cm)), it ranges in background color from olive to olive-brown to olive-gray with three stripes that run the length of the body. The middle dorsal stripe is yellow and darkens toward the tail. The pale yellow to light-tan lateral stripes distinguish the Mexican gartersnake from other sympatric (co-occurring) gartersnake species because a portion of the lateral stripe is found on the fourth scale row, while it is confined to lower scale rows for other species.

Taxonomy

Prior to 2003, Thamnophis eques was considered to have three subspecies, T. e. eques, T. e. megalops, and T. e. virgatenuis (Rossman et al. 1996, p. 175). In 2003, an additional seven new subspecies were identified under T. eques: (1) T. e. cuitzeoensis; (2) T. e. patzcuaroensis; (3) T. e. insperatus; (4) T. e. obscurus; (5) T. e. diluvialis; (6) T. e. carmenensis; and (7) T. e. scotti (Conant 2003, p. 3).

Historical Range

Within the United States, the northern Mexican gartersnake historically occurred predominantly in Arizona at elevations ranging from 130 to 6,150 ft (40 to 1,875 m). It was generally found where water was relatively permanent and supported suitable habitat. The northern Mexican gartersnake historically occurred in every county and nearly every subbasin within Arizona, from several perennial or intermittent creeks, streams, and rivers as well as lentic (still, non-flowing water) wetlands such as cienegas, ponds, or stock tanks. Historically, the northern Mexican gartersnake had a limited distribution in New Mexico that consisted of scattered locations throughout the Upper Gila River watershed in Grant and western Hidalgo Counties, including the Upper Gila River, Mule Creek in the San Francisco River subbasin, and the Mimbres River (Price 1980, p. 39; Fitzgerald 1986, Table 2; Degenhardt et al. 1996, p. 317; Holycross et al. 2006, pp. 1–2). One record for the northern Mexican gartersnake exists for the State of Nevada, opposite Fort Mohave, in Clark County along the shore of the Colorado River that was dated 1911 (De Queiroz and Smith 1996, p. 155). The subspecies may have occurred historically in the lower Colorado River region of California, although we were unable to verify any museum records for California. Any populations of northern Mexican gartersnakes that may have historically occurred in either Nevada or California were likely associated directly with the Colorado River, and we believe them to be currently extirpated.

Current Range

U.S.: Apache, Cochise, Coconino, Gila, Graham, Greenlee, La Paz, Mohave, Navajo, Pima, Pinal, Santa Cruz, and Yavapai counties, AZ; Catron, Grant, and Hidalgo counties, NM; Mexico: Chihauhua, Durango, Guanajuato, Hidalgo, San Luis Potosi, and Sonora states. Fagan (2004, pp.

233–243). Based on museum records found in Holycross et al. (2006, Appendix F), we expect the northern Mexican gartersnake retained its entire historic distribution within the United States through the 1920s and likely into the 1930s. Currently, in southeastern Arizona, populations occur at the San Bernardino National Wildlife Refuge, Finley Tank (Audubon Society's Appleton-Whittell Research Ranch), Scotia Canyon (Huachuca Mountains), San Raphael Valley, Canelo Hills, Sonoita Grasslands, Babocomari, Ciénega Creek, Arivaca Cienega, sites on the San Pedro River, and Huachuca Mountain bajada. However, most of these populations are experiencing declines or are characterized by low density (Rosen et al. 2001). Camp Verde and Sonoita Grassland-Canelo Hills-San Raphael Valley are the only areas with substantial populations (Rosen et al. 2001). In New Mexico, this snake is currently known from the lower Gila River basin, along Duck and Mule creeks in Grant County and near Virden in Hildago County (Hubbard and Eley 1985, cited by New Mexico Department of Game and Fish 1997). It may now be eliminated from Duck Creek (New Mexico Department of Game and Fish 1997). A record from a single locality along Mule Creek is the only recent evidence of the presence of this species in New Mexico, but the current status of that population is unknown (Center for Biological Diversity 2003).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

<u>Adult:</u> The northern Mexican gartersnake is an active predator and is believed to heavily depend upon a native prey base (Rosen and Schwalbe 1988, pp. 18, 20). Northern Mexican gartersnakes forage generally along vegetated banklines, searching for prey in water and on land, using different strategies (Alfaro 2002, p. 209). Generally, its diet consists predominantly of amphibians and fishes, such as adult and larval native leopard frogs (e.g., lowland leopard frog (Rana yavapaiensis) and Chiricahua leopard frog (Rana chiricahuensis)), as well as juvenile and adult native fish species (e.g., Gila topminnow (Poeciliopsis occidentalis occidentalis), desert pupfish (Cyprinodon macularius), Gila chub (Gila intermedia), and roundtail chub (Gila robusta)) (Rosen and Schwalbe 1988, p. 18). Auxiliary prey items may also include young Woodhouse’s toads (Bufo woodhousei), treefrogs (Family Hylidae), earthworms, deermice (Peromyscus spp.), lizards of the genera Aspidoscelis and Sceloporus, larval tiger salamanders (Ambystoma tigrinum), and leeches (Gregory et al. 1980, pp. 87, 90–92; Rosen and Schwalbe 1988, p. 20; Holm and Lowe 1995, pp. 30–31; Degenhardt et al. 1996, p. 318; Rossman et al. 1996, p. 176; Manjarrez 1998). To a much lesser extent, this snake’s diet may include nonnative species, including larval and juvenile bullfrogs, and mosquitofish (Gambusia affinis) (Holycross et al. 2006, p. 23). Venegas- Barrera and Manjarrez (2001, p. 187) reported the first observation of a snake in the natural diet of any species of Thamnophis after documenting the consumption by a Mexican gartersnake of a Mexican alpine blotched gartersnake (Thamnophis scalaris).

Reproduction Narrative

<u>Adult:</u> Sexual maturity in northern Mexican gartersnakes occurs at 2 years of age in males and at 2 to 3 years of age in females (Rosen and Schwalbe 1988, pp. 16–17). Northern Mexican

gartersnakes are viviparous (bringing forth living young rather than eggs). Mating has been documented in April and May followed by the live birth of between 7 and 38 newborns (average is 13.6) in July and August (Rosen and Schwalbe 1988, p. 16; Nowak and Boyarski 2012, pp. 351–352). However, field observations in Arizona provide preliminary evidence that mating may also occur during the fall, but further research is required to confirm this hypothesis (Boyarski 2012, pers. comm.). Unlike other gartersnake species, which typically breed annually, one study suggests that only half of the sexually mature females within a population of northern Mexican gartersnake might reproduce in any one season (Rosen and Schwalbe 1988, p. 17). This may have negative implications for the species' ability to rebound in isolated populations facing threats such as nonnative species, habitat modification or destruction, and other perturbations. Low birth rates will impede recovery of such populations by accentuating the effects of these threats.

Geographic or Habitat Restraints or Barriers

Adult: Lack of wetland, riparian habitat

Environmental Specificity

Adult: High

Tolerance Ranges/Thresholds

Adult: Surface active at ambient temperatures ranging from 71 degrees Fahrenheit (°F) to 91 °F (22 degrees Celsius (°C) to 33 °C).

Site Fidelity

Adult: High

Habitat Narrative

Adult: The northern Mexican gartersnake is considered a riparian obligate (restricted to riparian areas when not engaged in dispersal behavior) and occurs chiefly in the following general habitat types: (1) Source-area wetlands [e.g., cienegas (mid-elevation wetlands with highly organic, reducing (basic, or alkaline) soils), stock tanks (small earthen impoundment), etc.]; (2) large river riparian woodlands and forests; and (3) streamside gallery forests (as defined by well-developed broadleaf deciduous riparian forests with limited, if any, herbaceous ground cover or dense grass). In the northern part of the range, the species is usually found in or near water in highland canyons with pine-oak forest and pinyon-juniper woodland, and it also enters mesquite grassland and desert areas, especially along valleys and stream courses (Stebbins 2003). The northern Mexican gartersnake is surface active at ambient temperatures ranging from 71 degrees Fahrenheit (°F) to 91 °F (22 degrees Celsius (°C) to 33 °C).

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migrant

Dispersal/Migration Narrative

Adult: No information other than the species is non-migratory and populations rely on recruitment through reproduction to be sustainable.

Population Information and Trends

Population Trends:
Declining

Species Trends:
Declining

Resiliency:
Low

Representation:
Low

Redundancy:
Low

Population Growth Rate:
Unknown

Number of Populations:
21 to 300 rangewide; roughly 29 occurrences remain in the United States (Rosen et al. 2001, Center for Biological Diversity 2003); many more exist in the major portion of the range in Mexico. (NatureServe 2015).

Population Size:
2,500 to 100,000 individuals rangewide; 1,763 to 2938 individuals in AZ

Minimum Viable Population Size:
Unknown

Resistance to Disease:
Unknown

Adaptability:
Unknown

Additional Population-level Information:
Variability in survey design and effort makes it difficult to compare population trends among sites and between sampling periods. Thus, for each of the sites considered in our analysis, we have attempted to translate and quantifysearch and capture efforts into comparable units (i.e., person-search hours and trap-hours) and have cautiously interpreted those results. Given the data provided, it is not possible to determine population densities at the sites.

Population Narrative:

Variability in survey design and effort makes it difficult to compare population trends among sites and between sampling periods. Thus, for each of the sites considered in our analysis, we have attempted to translate and quantifysearch and capture efforts into comparable units (i.e., person-search hours and trap-hours) and have cautiously interpreted those results. Given the data provided, it is not possible to determine population densities at the sites. A detailed status of the northernAt the northern fringe of the range, United States populations have disappeared or declined in a large portion of the historical range (USFWS 2008). In New Mexico, a highly peripherel part of the known range, the species was historically recorded in just a few locations in two drainage systems but apparently now occurs in just one locality at most (New Mexico Department of Game and Fish 1997, Center for Biological Diversity 2003, USFWS 2008). In Arizona, substantial range contraction has been noted and fairly well documented, with populations extirpated at several locations since 1950 (Kulby 1995, Arizona Game and Fish Department 1998, Rosen et al. 2001, USFWS 2008). In southeastern Arizona, Rosen et al. (2001) found major declines at 2 sites, negative trends at 14 sites, possible stability at 2, and recolonization of habitat at one site. Subsequent surveys summarized by USFWS (2008) confirm the ongoing decline in Arizona. We have concluded that in as many as 24 of 29 known localities in the United States (83 percent), the northern Mexican gartersnake population is likely not viable and may exist at low population densities that could be threatened with extirpation or may already be extirpated. In most localities where the species may occur at low population densities, existing survey data are insufficient to prove extirpation. Only five populations of northern Mexican gartersnakes in the United States are considered likely viable where the species remains reliably detected. When considering the total number of stream miles in the United States that historically supported the northern Mexican gartersnake that are now permanently dewatered (except in the case of temporary flows in response to heavy precipitation), we concluded that as much as 90 percent of historical populations in the United States either occur at low densities or are extirpated. Listed as threatened throughout its range in Mexico by the Mexican Government, our understanding of the northern Mexican gartersnake's specific population status throughout its range in Mexico is less precise than that known for its United States distribution because survey efforts are less, and sufficient, available records do not exist or are difficult to obtain.

Threats and Stressors

Stressor: Modification and loss of cienegas
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Cienegas are particularly important habitat for the northern Mexican gartersnake and are considered ideal for the species (Rosen and Schwalbe 1988, p. 14). Hendrickson and Minckley (1984, p. 131) defined cienegas as ‘‘midelevation (3,281–6,562 ft (1,000–2000 m)) wetlands characterized by permanently saturated, highly organic, reducing [lowering of oxygen level] soils.’’ Many of these unique communities of the southwestern United States, Arizona in particular, and Mexico have been lost in the past century to streambed modification, improper livestock grazing, woodcutting, artificial drainage structures, stream flow stabilization by upstream dams, channelization, and stream flow reduction from groundwater pumping and water diversions (Hendrickson and Minckley 1984, p. 161).

Stressor: Nonnative shrub species

Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Nonnative shrub species in the genus Tamarix, such as salt cedar, have been widely introduced throughout the western States and appear to thrive in regulated river systems (Stromberg and Chew 2002, pp. 210–213). Tamarix invasions may result in habitat alteration from potential effects to water tables, changes to canopy and ground vegetation structures, and increased fire risk, which hasten the loss of native cottonwood and willow communities and affect the suitability of the vegetation component to northern Mexican gartersnake habitat (Stromberg and Chew 2002, pp. 211–212; USFWS 2002b, p. H–9).

Stressor: Urban and rural development
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Development within and adjacent to riparian areas has proven to be a significant threat to riparian biological communities and their suitability for native species (Medina 1990, p. 351). Riparian communities are sensitive to even low levels (less than 10 percent) of urban development within a watershed (Wheeler et al. 2005, p. 142). Development along or within proximity to riparian zones can alter the nature of stream flow dramatically, changing once-perennial streams into ephemeral streams, which has direct consequences on the riparian community (Medina 1990, pp. 358–359) and, within occupied habitat, the northern Mexican gartersnake. Medina (1990, pp. 358–359) concluded that perennial streams had greater tree densities in all diameter size classes of Alnus oblongifolius (Arizona alder) and Acer negundo (box elder) as compared to ephemeral reaches where small-diameter trees were absent. Small diameter trees assist the northern Mexican gartersnake by providing additional habitat complexity and cover needed to reduce predation risk and enhance the usefulness of areas for maintaining optimal body temperature.

Stressor: Groundwater pumping, surface water diversions and flood control
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Water quality and quantity are being affected by ongoing activities in the United States and Mexico. Due to the reliance of the northern Mexican gartersnake on ecosystems and communities supported by permanent water sources, these threats are significant to the survival and viability of existing and future northern Mexican gartersnake populations.

Stressor: Improper livestock grazing and agricultural uses
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Poor livestock management causes a decline in diversity, abundance, and species composition of riparian herpetofauna communities from direct or indirect threats to the prey base, the habitat, or to the northern Mexican gartersnake. These effects include: (1) Declines in the structural richness of the vegetation community; (2) losses or reductions of the prey base; (3) increased aridity of habitat; (4) loss of thermal cover and protection from predators; and (5) a rise in water temperatures to levels lethal to larval stages of amphibian and fish development

(Szaro et al. 1985, p. 362; Schulz and Leininger 1990, p. 295; Belsky et al. 1999, pp. 8–11). Improper livestock grazing may also lead to desertification (the process of becoming arid land or desert as a result of land mismanagement or climate change) due to a loss in soil fertility from erosion and gaseous emissions spurred by a reduction in vegetative ground cover (Schlesinger et al. 1990, p. 1043).

Stressor: High intensity wildfires
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Existing wildfire suppression policies intended to protect the expanding number of human structures on forested public lands have altered the fuel loads in these ecosystems and increased the probability of devastating wildfires. The effects of these catastrophic wildfires include the removal of vegetation, the degradation of watershed condition, altered stream behavior, increased sedimentation of streams, and population explosions of nonnative grasses, which, in addition to having an effect on native vegetation communities, lead to increased fire frequency.

Stressor: Nonnative species interactions
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Nonnative species represent the most serious threat to the northern Mexican gartersnake through direct predation and predation on northern Mexican gartersnake prey (competition). Nonnative species, such as the bullfrog, the northern (virile) crayfish (Orconectes virilis) and red swamp (Procambarus clarki) crayfish, and numerous species of nonnative sport and bait fish species continue to be the most significant threat to the northern Mexican gartersnake and to its prey base from direct predation, competition, and modification of habitat

Stressor: Declines in native prey base (frogs and fish)
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Declines in the native leopard frog populations in Arizona have contributed to declines in the northern Mexican gartersnake as a primary native predator. Native ranid frog species such as lowland leopard frogs, northern leopard frogs, and federally threatened Chiricahua leopard frogs have all experienced significant declines throughout their distribution in the Southwest, partially due to predation and competition with nonnative species. Native fish species such as the federally endangered Gila chub, roundtail chub (a species petitioned for Federal listing), and federally endangered Gila topminnow historically were among the primary prey species for the northern Mexican gartersnake (Rosen and Schwalbe 1988, p. 18). Northern Mexican gartersnakes depend on native fish as a principle part of their prey base, although nonnative mosquitofish may also be taken as prey (Holycross et al. 2006, p. 23). Both nonnative sport and bait fish compete with the northern Mexican gartersnake in terms of its native fish and native anuran prey base. Collier et al. (1996, p. 16) note that interactions between native and nonnative fish have significantly contributed to the decline of many native fish species from direct predation and indirectly from competition (which has adversely affected the prey base for northern Mexican gartersnakes).

Stressor: Bullfrogs
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Bullfrogs are widely considered one of the most serious threats to the northern Mexican gartersnake throughout its range (Conant 1974, pp. 471, 487–489; Rosen and Schwalbe 1988, pp. 28–30; Rosen et al. 2001, pp. 21–22). Bullfrogs adversely affect northern Mexican gartersnakes through direct predation of juveniles and sub-adults and from competition with native prey species. Sub-adult and adult bullfrogs not only compete with the northern Mexican gartersnake for prey items, but directly prey upon juvenile and occasionally sub-adult northern Mexican gartersnakes (Rosen and Schwalbe 1988, pp. 28–31; 1995, p. 452; 2002b, pp. 223–227; Holm and Lowe 1995, pp. 29–29; Rossman et al. 1996, p. 177; AGFD In Prep, p. 12; 2001, p. 3; Rosen et al. 2001, pp. 10, 21–22; Carpenter et al. 2002, p. 130; Wallace 2002, p. 116).

Stressor: Nonnative crayfish
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Nonnative crayfish are a primary threat to many prey species of the northern Mexican gartersnake and may also prey upon juvenile gartersnakes (Fernandez and Rosen 1996, p. 25; Voeltz 2002, pp. 87–88; USFWS 2007, p. 22). Fernandez and Rosen (1996, p. 3) studied the effects of crayfish introductions on two stream communities in Arizona, a low elevation semi-desert stream and a high mountain stream, and concluded that crayfish can noticeably reduce species diversity and destabilize food chains in riparian and aquatic ecosystems through their effect on vegetative structure, stream substrate (stream bottom; i.e., silt, sand, cobble, boulder) composition, and predation on eggs, larval, and adult forms of native invertebrate and vertebrate species.

Stressor: Climate change
Exposure: Not assessed; see narrative.
Response: Not assessed; see narrative.
Consequence: Not assessed; see narrative.
Narrative: Changes to climatic patterns are predicted to have implications for the effect of, and management for, nonnative species within the distribution of the northern Mexican gartersnake. Based upon climate change models, nonnative species biology, and ecological observations, Rahel et al. (2008, p. 551) conclude that climate change could foster the expansion of nonnative aquatic species into new areas, magnify the effects of existing aquatic nonnative species where they currently occur, increase nonnative predation rates, and heighten the virulence of disease outbreaks in North America. Many of the nonnative species have similar, basic ecological requirements as our native species, such as the need for permanent or nearly permanent water. Therefore, it is likely that effects from changes to climatic patterns (such as a trend towards a more arid environment) that negatively affect nonnative species such as bullfrogs and nonnative fish may also negatively affect native prey species for the northern Mexican gartersnake. Changes to climatic patterns may warm water temperatures, alter stream flow events, and may increase demand for water storage and conveyance systems (Rahel and Olden 2008, pp. 521–522). Warmer water temperatures across temperate regions are predicted to expand the distribution of existing aquatic nonnative species by providing 31 percent more suitable habitat

for aquatic nonnative species, which are often tropical in origin and adaptable to warmer water temperatures. The effects of the water withdrawals may be exacerbated by the current, long-term drought facing the arid southwestern United States.

Recovery

Delisting Criteria:
Not developed.

Recovery Actions:
- Not developed.

Conservation Measures and Best Management Practices:
- Not developed.

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SPECIES ACCOUNT: *Thamnophis gigas* (Giant garter snake)

Species Taxonomic and Listing Information

Listing Status: Threatened; October 20, 1993 (58 FR 54053).

Physical Description

The giant garter snake (Thamnophis gigas) is one of the largest garter snakes, reaching an average total length of at least 162 centimeters (63.7 inches). They are olive to brown with a cream, yellow, or orange dorsal stripe and two light colored lateral stripes. They can also have a checkered pattern of black spots between the dorsal and lateral stripes. Individuals in the northern Sacramento Valley tend to be darker, with more pronounced mid-dorsal and lateral stripes. The ventral coloration is variable from cream to orange to olive brown to pale blue, with or without ventral markings. As giant garter snakes near skin shedding, all patterns and coloration may be obscured (USFWS 1999; USFWS 2012).

Taxonomy

The giant garter snake was first described as a subspecies of the northwestern garter snake (T. ordinoides). Since it was first listed, the taxonomic status of the giant garter snake has undergone several revisions, including its placements as a subspecies of the western terrestrial garter snake (T. elegans) and then the western aquatic garter snake (T. couchii). In 1987, the giant garter snake was accorded the status of a full species, T. gigas; since then, the taxonomy has not changed (58 FR 54053). The giant garter snake can be distinguished from the common garter snake (T. sirtalis) and the western terrestrial garter snake (T. elegans) by its color pattern, scale numbers, and head shape. Further biochemical, molecular, and morphological studies have demonstrated the giant garter snake’s distinction from other species in the western garter snake group (USFWS 1999).

Historical Range

Historically, giant garter snakes were found in boundaries of large flood basins, freshwater marshes, and tributary streams of the Central Valley (including Sacramento and San Joaquin valleys) of California. The giant garter snake’s historical range extends from the vicinity of Sacramento and Contra Costa counties southward to Buena Vista Lake near Bakersfield in Kern Country. The giant garter snake probably occurred from Butte County in the north and southward to Kern County. They historically inhabit natural wetlands and now occupy a variety of agricultural, managed, and natural wetlands (USFWS 1999; USFWS 2012).

Current Range

Currently, populations of the giant garter snake are found in the Sacramento Valley and isolated portions of the San Joaquin Valley; however, the species is extirpated from most of the San Joaquin Valley. Extant populations are distributed in portions of rice production zones of Sacramento, Sutter, Butte, Colusa, and Glenn counties, along with the western border of the Yolo Bypass in Yolo County, and along the eastern fringes of the Sacramento-San Joaquin Delta from the Laguna Creek-Elk Grove region of central Sacramento County southward to the Stockton area of San Joaquin County. As of 1992, there were 13 known populations, found at: (1) Butte Basin; (2) Colusa Basin; (3) Sutter Basin; (4) American Basin; (5) Yolo Basin-Willow Slough; (6) Yolo Basin-Liberty Farms; (7) Sacramento Basin; (8) Badger Creek-Willow Creek; (9) Caldoni Marsh; (10) East Stockton-Diverting Canal and Duck Creek; (11) North and South

Grasslands (probably extirpated); (12) Mendota (probably extirpated); and (13) Burrell-Lanare (probably extirpated). These population largely coincide with historical riverine flood basins and tributary streams. Populations 1 through 4 are associated with rice production zones; populations 5 through 13 mainly are in small, isolated patches of valley floor habitat (NatureServe 2015).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes;

Life History

Feeding Narrative

Adult: Giant garter snakes are carnivores, invertivores, and piscivores; they feed primarily on aquatic prey such as small fish, tadpoles, and frogs, which are distributed widely throughout their environments. Giant garter snakes can sometimes take advantage of small pools of water that may trap and concentrate prey items. It has been suggested the giant garter snake specializes in ambushing prey underwater, because it has been observed dragging its prey out of the water to be consumed. Giant garter snakes face some competition for resources from nonnative species. Giant garter snakes are mostly active during daylight hours; they are dormant or have low-activity from November to mid-March. They are fast growers; young giant garter snakes typically more than double in size in their first year. At birth, neonates immediately scatter into dense cover and absorb their yolk sacs, after which they begin foraging on their own (NatureServe 2015; USFWS 1999; USFWS 2015).

Reproduction Narrative

Adult: Male giant garter snakes are sexually mature at 3 years of age, and females are sexually mature at 5 years. The breeding season for giant garter snakes begins soon after emergence from overwintering sites. Males immediately begin searching for females after emerging from burrows. Breeding season is March through April, and females give birth from mid-July to early September. Giant garter snakes are viviparous; females brood internally and give birth to 10 to 46 young snakes, with an average litter size of 23. The sex ratio of giant garter snakes is 1:1.5 (females: males); however, sex ratios may differ with habitat quality and the neonate sex ratio has been observed as 1:1 (NatureServe 2015; USFWS 1999; USFWS 2012).

Geographic or Habitat Restraints or Barriers

Adult: Habitat loss throughout the range of the giant garter snake has resulted in fragmented and isolated habitat remnants (USFWS 2012).

Spatial Arrangements of the Population

Adult: Clumped according to resources.

Environmental Specificity

Adult: Community with all key requirements.

Tolerance Ranges/Thresholds

Adult: High

Site Fidelity

Adult: Moderate

Habitat Narrative

Adult: Giant garter snakes inhabit marshes, sloughs, ponds, small lakes, low-gradient streams, and other waterways and agricultural wetlands such as irrigation canals. Giant garter snakes appear to be most numerous in rice-growing regions. The diverse habitat elements of rice-lands contribute structure and complexity to this man-made ecosystem. Spring and summer flooding and the fall drying of rice fields coincide fairly closely with the biological needs of the species (USFWS 1999). In the summer, giant garter snakes are mostly likely found in aquatic habitats, typically in active rice fields and most often under aquatic vegetation cover (USFWS 2012). Giant garter snakes are absent from larger rivers and other water bodies that support introduced populations of large, predatory fish, and from wetlands with sand, gravel, or rock substrates (58 FR 54053). Giant garter snakes need enough water to provide food and cover during the active season from early spring through mid-fall. They also need emergent wetland plants such as cattails (Typha sp.) for coverage and foraging, and grassy banks and openings in vegetation for sunning. During the winter, when they are largely inactive, giant garter snakes need small mammal burrows and other crevices above flood elevations (USFWS 1999; USFWS 2012).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Moderate

Immigration/Emigration

Adult: Unlikely

Dispersal/Migration Narrative

Adult: Giant garter snakes are nonmigratory. Habitat destruction and fragmentation have isolated populations, and limited dispersal. Gene flow appears to be restricted in the 13 isolated populations, which lends support for naming these basins as separate populations. In addition, the breeding of closely related individuals can cause a genetic reduction in fitness, inbreeding depression, and a loss of genetic diversity (USFWS 2012). There are some researchers, however, who believe that reports of small home ranges for giant garter snakes did not employ methods (e.g., radio telemetry) suitable for detecting full annual or multi-annual home range size, dispersal, or other long-distance movements, so these may have yielded underestimates of home ranges or activity areas (NatureServe 2015). During the breeding season, male giant garter snakes begin searching for females immediately after emerging from burrows (USFWS 2012).

Additional Life History Information

Adult: Habitat destruction and fragmentation has isolated populations, and limited dispersal (USFWS 2012).

Population Information and Trends

Population Trends:

Declining; the short-term population-level trend is a decline of 10 to 30 percent. The long-term population-level trend is a decline of 30 to 50 percent (NatureServe 2015).

Species Trends:

Declining

Resiliency:

Low

Representation:

Moderate

Redundancy:

Moderate

Population Growth Rate:

Slow decline

Number of Populations:

6 to 20 populations (NatureServe 2015). Of the 13 populations identified in the listing and the draft recovery plan (published in 1999), two are presumed extirpated and three have been combined into a single population, leaving nine extant populations identified by surveys conducted in 2011 (USFWS 2012).

Population Size:

2,500 to 100,000 individuals (NatureServe 2015).

Resistance to Disease:

Moderate

Adaptability:

Moderate

Population Narrative:

Giant garter snakes have a population of 2,500 to 100,000 snakes throughout 13 known populations; however, two are presumed extirpated and three have been combined into a single population, leaving nine extant populations identified by surveys conducted in 2011. The populations are genetically different from each other, leading to a push to have distinct population segments. The short-term population-level trend of this species is a decline of 10 to 30 percent. The long-term population-level trend is a decline of 30 to 50 percent (NatureServe 2015; USFWS 2012).

Threats and Stressors

Stressor: Habitat destruction and urbanization
Exposure: Building of roads, expanding cities, water diversion, mosquito abatement.
Response: Mortality, reduced habitat.
Consequence: Reduction in population numbers.
Narrative: Urbanization and habitat destruction are the greatest threats to the giant garter snake throughout much of its range. Environmental impacts associated with urbanization are loss of habitat, reduction of wetland habitat, alteration of natural fire regimes, water diversion, fragmentation of habitat due to road construction, and degradation of habitat due to pollutants. Urbanization increasingly threatens the viability of giant garter snake populations as urban landscapes encroach on ever-diminishing habitats. Habitat loss throughout the range of the giant garter snake has resulted in fragmented and isolated habitat remnants, compounded by the elimination of some rice agricultural land that serves as an alternative habitat for the species. Much of the remaining giant garter snake habitat is subject to flood control and canal maintenance activities, subjecting the snake to ongoing risks of mortality and injury. Maintenance activities may include weed eradication, which destroys surface cover; and rodent eradication, which indirectly eliminates the occurrence and abundance of underground burrows and retreats for giant garter snakes (58 FR 54053; USFWS 1999; USFWS 2012).

Stressor: Nonnative species
Exposure: Introduction of nonnative species.
Response: Mortality, competition, illness.
Consequence: Reduction in population numbers.
Narrative: Introduced nonnative plants may adversely affect the giant garter snake. For example, water primrose (Ludwigia peploides ssp. montevidensis) may concentrate giant garter snake prey in select pockets, and constrains movements of giant garter snakes. Any efforts to reduce the invasion of nonnative terrestrial plants may disturb or injure the giant garter snake if herbicides or mechanical removal is not compatible with giant garter snake requirements and behavior. Mechanical removal, mowing, or burning, for example, may result in direct injury or death to giant garter snakes if not conducted according to best management practices. Herbicides are suspected to reduce the prey base for the giant garter snake. Additionally, herbicides eliminate wetland plants, whose surfaces are colonized by algae, protozoa, rotifers, and other small organisms that serve as a food supply for amphibian larvae.Habitat degradation or alteration that benefits nonnative species may increase the vulnerability of giant garter snakes to predation. Introduced game and predatory fish such as largemouth bass (Micropterus salmoides) and catfish (Siluriformes) eat giant garter snakes. Adult bullfrogs (Lithobates catesbeianus), signal crayfish (Pacifastacus leniusculus), and the Louisiana crayfish (Procambarus clarkia) were also found to eat neonate giant garter snakes (58 FR 54053; USFWS 1999; USFWS 2012).

Stressor: Flooding and drought
Exposure: Floods or droughts.
Response: Mortality, reduced habitat.
Consequence: Reduction in population numbers.
Narrative: Although the giant garter snake is an aquatic species, it is subject to the detrimental effects of floods. Giant garter snakes may be displaced during a flood, buried by debris, exposed to predators, or subject to drowning when burrows and owerwintering sites become inundated with water. Drought is also a threat to giant garter snakes because of the species' dependence on

permanent wetlands. Water availability will play a significant role in its survival and recovery. Emergent drought and higher temperature conditions are likely to result in high rates of mortality in the short term, with the effects of low fecundity and survivorship persisting after the drought has ceased (58 FR 54053; USFWS 1999; USFWS 2012).

Recovery

Reclassification Criteria:
Reclassification criteria are not identified in the Recovery Plan.

Delisting Criteria:
The sizes and densities at which giant garter snake populations occur are not well known. Population structure; population dynamics; and the strength, frequency, and direction of environmental fluctuation and effects are also largely unknown for giant garter snakes. Until uncertainties about these and other small population effects and their interactions are resolved, it is not possible to establish population numbers as a delisting criterion for the giant garter snakes. As an alternative, the first delisting criterion below for each recovery unit requires that subpopulations contain both adults and young. The U.S. Fish and Wildlife Service believes that if monitoring detects both adults and young in a given subpopulation, this suggests that the subpopulation is viable. To assist in establishing recovery criteria, the Central Valley is divided into four recovery units (USFWS 1999).

Sacramento Valley Recovery Unit: a. Monitoring shows that in 17 out of 20 years, 90 percent of the subpopulations in the recovery unit contain both adults and young, b. The three existing populations in the recovery unit are protected from threats that limit populations. c. Supporting habitat in the recovery unit is adaptively managed and monitored (USFWS 1999).

Mid-Valley Recovery unit a. Monitoring shows that in 17 out of 20 years, 90 percent of the subpopulations in the Recovery Unit (with the exception of the East Stockton-Diversifying Canal and Duck Creek population) contain both adults and young. b. The six existing populations in the recovery unit are protected from threats that limit these populations. c. Supporting habitat in the recovery unit is adaptively managed and monitored. d. Subpopulations are well connected by corridors or suitable habitat. e. Repatriation has been successful at all suitable sites that had recently (within last 10 years) extirpated populations (USFWS 1999).

San Joaquin Valley Recovery unit a. Monitoring shows that in 17 out of 20 years, 90 percent of the subpopulations in the recovery unit contain both adults and young, b. The six existing populations in the recovery unit are protected from threats that limit these populations. c. Supporting habitat in the recovery unit is adaptively managed and monitored. d. Subpopulations are well connected by corridors or suitable habitat. e. Recovery or repatriation has been successful at a total of five sites in the recovery unit. f. Giant garter snakes are broadly distributed in the North and South Grasslands and Mendota areas (USFWS 1999).

South Valley Unit a. Monitoring shows that in 17 out of 20 years, 90 percent of the subpopulations in the Tulare and Kern Basins contain both adults and young. b. Existing or reestablished populations in the recovery unit are protected from threats that limit populations c. Supporting habitat in the recovery unit is adaptively managed and monitored. d. Subpopulations are well connected by corridors of suitable habitat. e. Surveys for giant garter snakes are negative, and repatriation has been successful at four sites—two in the Kern (including Goose Lakes) Basin, and two in Tulare Basin (USFWS 1999).

The objective of this recovery plan is to reduce threats to and improve the population status of the giant garter snake sufficiently to warrant delisting. To achieve this goal we have defined the following objectives: 1. Establish and protect self-sustaining populations of the giant garter snake throughout the full ecological, geographical, and genetic range of the species. 2. Restore and conserve healthy Central Valley wetland ecosystems that function to support the giant garter snake and associated species and communities of conservation concern such as Central Valley waterfowl and shorebird populations. 3. Ameliorate or eliminate, to the extent possible, the threats that caused the species to be listed or are otherwise of concern, and any foreseeable future threats (USFWS, 2017).

Recovery Actions:

- Recovery criteria for the giant garter snake are defined for four recovery units in the Central Valley: the Sacramento Valley, Mid-Valley, San Joaquin Valley, and South Valley units. Recovery actions include:
- Protect known populations of the giant garter snake (USFWS 1999).
- Survey for new populations of giant garter snakes (USFWS 1999).
- Reestablish populations of giant garter snakes to suitable habitat within former range (USFWS 1999).
- Conduct necessary research on the giant garter snake (USFWS 1999).
- Develop and implement an outreach and education program (USFWS 1999).
- Develop and implement economic and other incentives for conservation and recovery on private lands (USFWS 1999).
- Actions Needed: 1. Protect existing habitat, areas identified for restoration or creation, and areas that will provide connectivity between preserved areas of habitat. 2. Develop and implement appropriate management of habitat on public and private wetlands and conservation lands. 3. Improve water quality in areas occupied by the giant garter snake and affected by poor water quality conditions. 4. Ensure summer water is available for wetland habitats used by the snake. 5. Establish an incentive or easement program(s) to encourage private landowners and local agencies to provide or maintain giant garter snake habitat. 6. Monitor populations and habitat to assess the success or failure of management activities and habitat protection efforts. 7. Conduct surveys and research to identify areas requiring protection and management. 8. Conduct research focused on the management needs of the species, and on identifying and removing threats. 9. Establish and implement outreach and education, which includes the participation of landowners; interested public and stakeholders; and other Federal, State, and local agencies. 10. Reestablish populations within the giant garter snake's historical range (USFWS, 2017).

Conservation Measures and Best Management Practices:

- No grading, excavating, or filling may take place in or within 30 feet of giant garter snake habitat between October 1 and May 1 unless authorized by the California Department of Fish and Wildlife (CDFW) (previously California Department of Fish and Game) (USFWS 1999, Appendix C).
- Construction of replacement habitat may take place at any time of the year, but summer is preferred (USFWS 1999, Appendix C).

- Water may be diverted as soon as the new habitat is completed, but placement of dirt dams or other diversion structures in the existing habitat will require onsite approval by the CDFW (USFWS 1999, Appendix C).
- The new habitat will be revegetated with suitable plant species as directed by CDFW or as stipulated in the environmental documents (USFWS 1999, Appendix C).
- Dewatering of the existing habitat may begin any time after November 1, but must begin by April 1 (USFWS 1999, Appendix C).
- Any giant garter snake surveys required by the CDFW will be completed to the satisfaction of the CDFW prior to dewatering (USFWS 1999, Appendix C).
- All water must be removed from the existing habitat by April 15, or as soon as weather permits; the habitat must remain dry (no standing water) for 15 consecutive days after April 15 and prior to excavating or filling the dewatered habitat (USFWS 1999, Appendix C).
- CDFW will be notified when dewatering begins and when it is completed. CDFW will inspect the area to determine when the 15-day dry period may start (USFWS 1999, Appendix C).

Additional Threshold Information:

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SPECIES ACCOUNT: *Thamnophis rufipunctatus* (Narrow-headed garter snake)

Species Taxonomic and Listing Information

Listing Status: Threatened; 7/8/2014; Southwest Region (R2)

Physical Description

The narrow-headed gartersnake is a small to medium-sized gartersnake with a maximum total length of 44 in (112 cm mm) (Painter and Hibbitts 1996, p. 147). Its eyes are set high on its unusually elongated head, which narrows to the snout, and it lacks striping on the dorsum (top) and sides, which distinguishes its appearance from other gartersnake species with which it could co-occur (Rosen and Schwalbe 1988, p. 7). The base color is usually tan or greybrown (but may darken) with conspicuous brown, black, or reddish spots that become indistinct towards the tail (Rosen and Schwalbe 1988, p. 7; Boundy 1994, p. 126). The scales are keeled. Degenhardt et al. (1996, p. 327), Rossman et al. (1996, pp. 242–244), and Ernst and Ernst (2003, p. 416) further describe the species.

Taxonomy

Family Colubridae (Colubrids). Due to the narrow-headed gartersnake’s morphology and feeding habits, there has been considerable deliberation among taxonomists about the correct association of this species within seven various genera over time (Rosen and Schwalbe 1988, pp. 5–6); chiefly, between the genera Thamnophis (the ‘‘gartersnakes’’) and Nerodia (the ‘‘watersnakes’’) (Pierce 2007, p. 5). Using mitochondrial DNA (mtDNA) genetic analyses (De Querioz and Lawson 1994, p. 217), inclusion of the narrow-headed gartersnake in the genus Nerodia has been refuted and the species is maintained within the genus Thamnophis.

Historical Range

The historical distribution of the narrow-headed gartersnake ranged across the Mogollon Rim and along its associated perennial drainages from central and eastern Arizona, southeast to southwestern New Mexico at elevations ranging from 2,300 to 8,000 ft (700 to 2,430 m) (Rosen and Schwalbe 1988, p. 34; Rossman et al. 1996, p. 242; Holycross et al. 2006, p. 3). The species was historically distributed in headwater streams of the Gila River subbasin that drain the Mogollon Rim and White Mountains in Arizona, and the Gila Wilderness in New Mexico; major subbasins in its historical distribution included the Salt and Verde River subbasins in Arizona, and the San Francisco and Gila River subbasins in New Mexico (Holycross et al. 2006, p. 3). Holycross et al. (2006, p. 3) suspect the species was likely not historically present in the lowest reaches of the Salt, Verde, and Gila rivers, even where perennial flow persists. Numerous records for the narrow-headed gartersnake (through 1996) in Arizona are maintained in the AGFD’s Heritage Database (1996b). The narrow-headed gartersnake as currently recognized does not occur in Mexico.

Current Range

As of 2011, the only remaining narrow-headed gartersnake populations where the species could reliably be found were located at: (1) Whitewater Creek (New Mexico), (2) Tularosa River (New Mexico), (3) Diamond Creek (New Mexico), (4) Middle Fork Gila River (New Mexico), and (5) Oak CreekCanyon (Arizona). However, populations found in Whitewater Creek and the Middle Fork

Gila River were likely significantly affected by New Mexico's largest wildfire in State history, the Whitewater-Baldy Complex Fire, which occurred in June 2012.

Distinct Population Segments Defined

No.

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: The diet of the narrow-headed gartersnake is comprised almost entirely of fish (Fleharty 1967 p. 223, Rosen and Schwalbe 1988 p. 38, Pierce 2007 p. 8, USFWS 2013a p. 41506). The narrow-headed gartersnake relies on native fish species as its primary food resource (USFWS 2013a p. 41511). The most common native fish species taken by the narrow-headed gartersnake includes Sonora sucker, desert sucker, speckled dace, roundtail chub, gila chub, and headwater chub (Rosen and Schwalbe 1988 p. 39, USFWS 2013a p. 41507). This species will also consume nonnative trout, such as brown and rainbow, as well as other soft-rayed fish species as part of their diet in the absence of native species (Rosen and Schwalbe 1988 p. 39, USFWS 2013a p. 41507, 41510). While narrow-headed gartersnakes will eat nonnative species, the gartersnakes are only found in abundance in areas with abundant resources of native fish (Rosen and Schwalbe 1988 p. 44, USFWS 2013a p. 41511). Therefore, habitat-based attributes are important for the survival of fish prey species and are equally important for the survival of narrow-headed gartersnakes. The narrow-headed gartersnake uses the interstitial spaces between partially submerged rocks and boulders to ambush prey and shelter from predators (Rosen and Schwalbe 1988 p. 35, Pierce 2007 p. 7). The species may also use the surfaces of partially submerged rock and boulders to thermoregulate by basking (Rosen and Schwalbe 1988 p. 35). When hunting, the narrow-headed gartersnake uses its tail to anchor itself to rocks to hold its position in the current and ambush its prey (Hibbitts and Fitzgerald 2005 p. 364, Pierce 2007 p. 8).

Reproduction Narrative

Adult: Sexual maturity in narrow-headed gartersnakes occurs at 2.5 years of age in males and at 2 years of age in females (Deganhardt et al. 1996, p. 328). Narrow headed gartersnakes are viviparous. The reproductive cycle for narrow-headed gartersnakes appears to be longer than other gartersnake species; females begin the development of follicles in early March, and gestation takes longer (Rosen and Schwalbe 1988, pp. 36–37). Female narrow-headed gartersnakes breed annually and give birth to 4 to 17 offspring from late July into early August, perhaps earlier at lower elevations (Rosen and Schwalbe 1988, pp. 35–37). Sex ratios in narrowheaded gartersnake populations can be skewed in favor of females (Fleharty 1967, p. 212).

Geographic or Habitat Restraints or Barriers

Adult: Busy highway or highway with obstructions such that snakes rarely if ever cross successfully; major river, lake, pond, or deep marsh (this barrier pertains only to upland species and does not apply to aquatic or wetland snakes); densely urbanized area dominated by buildings and pavement. (NatureServe 2015)

Environmental Specificity

Adult: High

Tolerance Ranges/Thresholds

Adult: Found to be active in air temperatures ranging from 52 to 89 °F (11 to 32 °C) and water temperatures ranging from 54 to 72 °F (12 to 22 °C) (Nowak, 2006, Appendix 1). Narrow-headed gartersnakes have a lower preferred temperature for activity as compared to other species of gartersnakes (Fleharty 1967, p. 228), which may facilitate their highly aquatic nature in cold streams.

Habitat Narrative

Adult: Narrow-headed gartersnakes are widely considered to be one of the most aquatic gartersnake species (Rossman et al. 1996, p. 246), and are strongly associated with clear, rocky streams, using predominantly pool and riffle habitat that includes cobbles and boulders (Rosen and Schwalbe 1988, pp. 33–34; Degenhardt et al. 1996, p. 327; Rossman et al. 1996, p. 246). Narrow-headed gartersnakes occur at elevations from approximately 2,300–8,200 ft (700 m–2,500 m), inhabiting Petran Montane Conifer Forest, Great Basin Conifer Woodland, Interior Chaparral, and the Arizona Upland subdivision of Sonoran Desertscrub communities (Rosen and Schwalbe 1988, p. 33; Brennan and Holycross 2006, p. 122; Burger 2008). In addition to aquatic habitat, narrow-headed gartersnakes rely on terrestrial habitat for thermoregulation, gestation, shelter, protection from predators, immigration, emigration, and brumation (cold-season dormancy). Important terrestrial habitat components for the narrow-headed gartersnake include cobbles, boulders, and bankside shrub vegetation for basking and foraging (Fleharty 1967, pp. 215–216; Rosen and Schwalbe 1988, p. 48; Ernst and Ernst 2003, p. 418). Bankline vegetation is an essential component of suitable narrow-headed gartersnake habitat in the presence of harmful nonnative species (USFWS 2013a p. 41506). The species uses Petran Montane Conifer Forest, Great Basin Conifer Woodland, Interior Chapparral, and the Arizona Upland subdivision of Sonoran Desertscrub communities (Rosen and Schwalbe 1988 p. 33, USFWS 2013a p. 41506). The species thermoregulates by basking on vegetation close to the water, preferebly shrub and sapling sized plants (USFWS 2013a p. 41506) or other suitable surfaces. Willows that overhang the stream channel may be of particular importance to the species (Holycross et al. 2006 p. 51). Vegatation in close proximity to water affords the species an avenue of quick escape (Fleharty 1967 p. 216, USFWS 2013a p. 41506).

Dispersal/Migration

Motility/Mobility

Adult: Low

Migratory vs Non-migratory vs Seasonal Movements

Adult: Non-migrant

Dispersal/Migration Narrative

Adult: At least some snakes of the colubrid family (Colubridae), including medium-sized species such as gartersnakes, not uncommonly move between areas up to a few kilometers apart, and several species make extensive movements of up to several kilometers, so separation distances of 1-2 km for suitable habitat are too small for medium-sized and large colubrids.

Population Information and Trends

Population Trends:

Declining

Species Trends:

Declining

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Population Growth Rate:

Low

Number of Populations:

In 2011, 38 known localities, of which 29 (76%) are considered to be non-viable. As of 2012, populations are considered likely viable in 3 localities (8 percent) where individuals are reliable detected.

Population Size:

Unknown

Minimum Viable Population Size:

Unknown

Resistance to Disease:

Unknown

Adaptability:

Uknown

Population Narrative:

The narrow-headed gartersnake has experienced significant declines in population density and distribution along streams and rivers where it was formerly well-documented and reliably detected. Many areas where the species may occur likely rely on emigration of individuals from occupied habitat into those areas to maintain the species, provided there are no barriers to movement. Narrow-headed gartersnakes have been detected in only 5 of 16 historical localities in Arizona and New Mexico surveyed by Holycross et al. (2006) in 2004 and 2005. Population densities have noticeably declined in many populations, as compared to previous survey efforts (Holycross et al. 2006, p. 66). As of 2011, the only remaining narrow-headed gartersnake populations where the species could reliably be found were located at: (1) Whitewater Creek (New Mexico), (2) Tularosa River (New Mexico), (3) Diamond Creek (New Mexico), (4) Middle

Fork Gila River (New Mexico), and (5) Oak Creek Canyon (Arizona). It has been concluded that in as many as 29 of 38 known localities (76 percent), the narrow-headed gartersnake population is likely not viable and may exist at low population densities that could be threatened with extirpation or may already be extirpated but survey data are lacking in areas where access is restricted. In most localities where the species may occur at low population densities, existing survey data are insufficient to conclude extirpation. As of 2012, narrow-headed gartersnake populations are considered likely viable in 3 localities (8 percent) where individuals are reliable detected.

Threats and Stressors

Stressor: Predation and competion by harmful non-native species
Exposure: See narrative.
Response: See narrative.
Consequence: See narrative.
Narrative: Harmful nonnative species (e.g., bullfrogs, crayfish, and spiny-rayed fish) are the single most important threat to narrowheaded gartersnakes and their prey bases, and therefore have had a profound role in their decline. Harmful nonnative species have been intentionally introduced or have naturally moved into virtually every subbasin throughout the distribution of narrow-headed gartersnakes in the United States and Mexico. Native fish are important prey for narrow-headed gartersnakes. Predation by and competition with primarily nonnative, spiny-rayed fish species, and secondarily with crayfish, are widely considered to be the primary reason for major declines in native fish communities throughout the range of this gartersnake.

Stressor: Habitat and population fragmentation as a result of harmful nonnative species
Exposure:
Response:
Consequence:
Narrative: Unnatural levels of predation and competition associated with harmful nonnative species weakens resistance of the gartersnake to other threats, including those that affect the physical suitability of their habitat. This ultimately renders populations much less resilient to stochastic, natural, or anthropogenic stressors that could otherwise be withstood. Over time and space, subsequent population declines have threatened the genetic representation of each species because many populations have become disconnected and isolated from neighboring populations. Expanding distances between extant populations coupled with increasing populations of harmful nonnative species prevents normal colonizing mechanisms that would otherwise reestablish populations where they have become extirpated. This subsequently leads to a reduction in species redundancy when isolated, small populations are at increased vulnerability to the effects of stochastic events, without a means for natural recolonization. Ultimately, the effect of scattered, small, and disjunct populations, without the means to naturally recolonize, is weakened species resiliency as a whole, which ultimately enhances the risk of either or both species becoming endangered.

Stressor: Fisheries management
Exposure:
Response:
Consequence:

Narrative: Fisheries management activities can have significant negative effects on resident gartersnake populations when gartersnakes are not considered in project planning and implementation. While the continued use of rotenone and other fisheries management techniques in the conservation and recovery of native fish is supported, the potential and significant threat rotenone use may pose to these gartersnakes if their habitat is left with a fish community that is dangerously depleted or entirely removed for extended periods of time.

Stressor: Historic and current human-caused loss and degradation of habitat
Exposure:
Response:
Consequence:
Narrative: The period from 1850 to 1940 marked the greatest loss and degradation of riparian and aquatic communities in Arizona, many of which were caused by anthropogenic (human-caused) land uses and the primary and secondary effects of those uses (Stromberg et al. 1996, p. 114; Webb and Leake 2005, pp. 305–310). An estimated one-third of Arizona's pre-settlement wetlands has dried or been rendered ecologically dysfunctional (Yuhas 1996, entire).

Stressor: Altering or dewatering aquatic habitat
Exposure:
Response:
Consequence:
Narrative: Of all the activities that may threaten their physical habitat, none are more serious than those that reduce flows or dewater habitat, such as dams, diversions, flood-control projects, and groundwater pumping. Such activities are widespread in Arizona. For example, municipal water use in central Arizona increased by 39 percent from 1998 to 2006 (American Rivers 2006), and at least 35 percent of Arizona's perennial rivers have been dewatered, assisted by approximately 95 dams that are in operation in Arizona today (Turner and List 2007, pp. 3, 9). Larger dams may prevent movement of fish between populations (which affects prey availability for narrow-headed gartersnakes) and dramatically alter the flow regime of streams through the impoundment of water (Ligon et al. 1995, pp. 184–189). These diversions also require periodic maintenance and reconstruction, resulting in potential habitat damages and inputs of sediment into the active stream. In addition to affecting the natural behavior of streams and rivers through changes in timing, intensity, and duration of flood events, dams create reservoirs that alter resident fish communities. Water level fluctuation can affect the degree of benefit to harmful nonnative fish species. Reservoirs that experience limited or slow fluctuations in water levels are especially beneficial to harmful nonnative species whereas reservoirs that experience greater fluctuations in water levels provide less benefit for harmful nonnative species. The timing of fluctuating water levels contributes to their effect; a precipitous drop in water levels during harmful nonnative fish reproduction is most deleterious to their recruitment. A drop in water levels outside of the reproductive season of harmful nonnative species has less effect on overall population dynamics.

Stressor: Climate change and drought
Exposure:
Response:
Consequence:
Narrative: The narrow-headed gartersnake is the most aquatic of the southwestern gartersnakes and is a specialized predator on native and nonnative, softrayed fish found primarily in clear,

rocky, higher elevation streams. Because of their aquatic nature, Wood et al. (2011, p. 3) predict they may be uniquely susceptible to environmental change, especially factors associated with climate change. Together, these factors are likely to make narrow-headed gartersnakes vulnerable to effects of climate change and drought, including reductions of suitable aquatic habitat, prey species, and the potential increase in harmful nonnative species.

Stressor: High-intensity wildfires and sedimentation of aquatic habitat
Exposure:
Response:
Consequence:
Narrative: Existing wildfire suppression policies intended to protect the expanding number of human structures on forested public lands have altered the fuel loads in these ecosystems and increased the probability of high-intensity wildfires. The effects of these high-intensity wildfires include the removal of vegetation, the degradation of subbasin condition, altered stream behavior, and increased sedimentation of streams. These effects can harm fish communities, as observed in the 1990 Dude Fire, when corresponding ash flows resulted in fish kills in Dude Creek and the East Verde River (Voeltz 2002, p. 77). Fish kills can drastically affect the suitability of habitat for narrow-headed gartersnakes due to the removal of a portion or the entire prey base.

Recovery

Conservation Measures and Best Management Practices:

- Not developed.

References

USFWS 2013. Endangered and threatened wildlife and plants

threatened status for the northern Mexican gartersnake and narrow-headed gartersnake. Proposed Rule. Federal Register 78(132):41500-41547.

USFWS. 2013. Endangered and threatened wildlife and plants

SPECIES ACCOUNT: *Thamnophis sirtalis tetrataenia* (San Francisco garter snake)

Species Taxonomic and Listing Information

Commonly-used Acronym: SFGS

Listing Status: Endangered; March 11, 1967 (32 FR 4001).

Physical Description

The genus Thamophis (family Colubridae) includes the slender serpents commonly known as garter snakes. The San Francisco garter snake (Thamnophis sirtalis tetrataenia; SFGS) has a wide dorsal stripe of greenish-yellow edged with black, bordered on each side by a broad red stripe which may be broken or divided, followed by a black stripe. The belly is greenish-blue in color and the top of the head is red to orange. The eyes are relatively large, and usually seven upper and ten lower labial scales are present. The body scales are in 19 rows and the dorsal scales are weakly to strongly keeled. Young range from 12.5 to 20 centimeters (cm) (5 to 8 inches [in.]) at birth (Stanford University 2013) and grow to a maximum length of 130 cm (51 in.) in adulthood (USFWS 1985), but most individuals are generally less than 91 cm (36 in.) (Stanford University 2013).

Taxonomy

The San Francisco garter snake is one of eleven recognized subspecies of the common garter snake (Thamnophis sirtalis) (USFWS 1985). Although most garter snakes have a conspicuous pale yellow or orange vertebral stripe and a pale stripe low on each side, the San Francisco garter snake can be distinguished by its wide greenish-yellow dorsal stripe bordered by a broad red stripe (USFWS 1985). Individuals in the West Bayshore population have a less distinctive, more "muddied" coloration, which could either indicate a loss of genetic diversity in the population or a broader expression of the species' natural phenotype (USFWS 2006). Some San Francisco garter snakes exhibit color patterns similar to that of a neighboring species, the California red-sided garter snake (T. s. infernalis) (USFWS 1985). In T. s. infernalis, the lower black stripe is absent and a series of regularly spaced black blotches are contiguous with the upper black stripe (USFWS 1985). There is an intergrade zone between the San Francisco garter snake and the red-sided garter snake that occurs on the San Francisco Peninsula and consists of at least six populations (Stanford University 2013; USFWS 2006). The intergrade zone extends approximately 19 kilometers (km) (12 miles [mi.]) on the eastern flank of the Santa Cruz Mountains from the vicinity of Boronda Lake in Palo Alto to Upper Crystal Springs Reservoir (Stanford University 2013).

Historical Range

The San Francisco garter snake is endemic to the San Francisco Peninsula and is known only from San Mateo County, California. Historically, San Francisco garter snakes were found on the San Francisco Peninsula from approximately the San Francisco County line, south along the eastern and western bases of the Santa Cruz Mountains at least to the Upper Crystal Springs Reservoir, and along the coast south to Año Nuevo Point, San Mateo County, California (USFWS 1985; USFWS 2006).

Current Range

Current range is assumed to be equivalent to historic range. Recent surveys suggest that there has likely been very little decrease in the overall range of the San Francisco garter snake compared to its historic distribution; however, they have likely been extirpated from individual localities within what is considered to be the historic range/distribution (USFWS 2006).

Distinct Population Segments Defined

No

Critical Habitat Designated

No;

Life History

Feeding Narrative

Adult: San Francisco garter snakes are opportunistic carnivores that primarily feed on ranid frogs, including Pacific tree frogs (Pseudacris regilla) and California red-legged frogs (Rana draytonii) (USFWS 2006). Immature California newts (Taricha torosa), recently metamorphosed western toads (Anaxyrus boreas), bullfrogs, (Rana catesbeiana), threespine stickleback (Gasterosteus aculeatus), and mosquitofish (Gambusia affinis) have also been recorded in the diets of San Francisco garter snakes (USFWS 1985). Individuals on the Stanford University property have been documented to feed on invertebrates and possibly small rodents and birds in addition to amphibians and fish (Stanford University 2013). During the spring and early summer, feeding occurs near or in ephemeral ponds inhabited by Pacific tree frogs, the primary food source for San Francisco garter snakes during this time. Although juvenile San Francisco garter snakes may initially capture and consume Pacific tree frog metamorphs (tadpoles that have recently gained adult frog features) in upland habitat, they have principally been observed moving back to aquatic sites to feed on the young-of-year frogs once these wetter areas begin to dry up and the tree frogs begin to disperse. Mature individuals prey on Pacific tree frogs as well, although they also eat California red-legged frogs during the late summer months. The late emergence of California red-legged frogs allows for a necessary second cycle of feeding by adult San Francisco garter snakes after the Pacific tree frogs have retreated from the drying wetlands to upland aestivation areas (USFWS 2006). Young are born ranging from 13 to 20 cm (5 to 8 in.) in length, and adults can reach a maximum of 130 cm (51 in.) (Stanford University 2013).Prey items are usually captured in wetlands, either in emergent vegetation or in areas of shallow open water (Stanford University 2013; USFWS 2006). Bullfrogs, largemouth bass, and sunfish compete with San Francisco garter snakes for California red-legged frog and Pacific tree frog tadpoles (USFWS 2006).

Reproduction Narrative

Adult: San Francisco garter snakes mate in the spring or fall, and mating is concentrated in the first few warm days of March. Males actively search for females, which are presumably found by scent. Many males may simultaneously court a single female. The augmented frequency in spring mating is thought to be due to the increased likelihood of encountering a mate as individuals emerge from hibernacula and concentrate near aquatic hunting grounds. Mating occurs on open grassy slopes, typically in the morning. Ovulation generally occurs in late spring, pregnancy in early summer, and live birth of young sometime in July or August. Like many members of the genus Thamnophis, females can store sperm throughout the winter. Mating aggregations of San Francisco garter snake have been observed in late October and early November (USFWS 1985). Females are ovoviviparous (internal fertilization and young are born live, but no placental connection) and typically bear young in secluded areas, either hidden in dense vegetation or under some type of cover (Stanford University 2013).Litter sizes range from 3 to 85 young and average between 12 to 24 young (USFWS 1985), which are 12.5 to 20 cm (5 to 8 in.) in length at birth (Stanford University 2013). The lifespan of San Francisco garter snakes is unknown, but likely does not exceed 10 years (Stanford University 2013). The sex ratio of San Francisco garter snakes is also unknown, but in other garter snakes (T. sirtalis) subspecies, males outnumber females (USFWS 2006).

Geographic or Habitat Restraints or Barriers

Adult: Lack of habitat connectivity, potentially highways and wide roads (USFWS 2006).

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Narrow/specialist.

Site Fidelity

Adult: Moderate

Dependency on Other Individuals or Species for Habitat

Adult: Shallow water near shore is essential from May to July to ensure the successful hatching and metamorphosis of amphibian prey items, particularly Pacific tree frogs and California red-legged frogs (USFWS 2006). San Francisco garter snakes may depend on ground-burrowing rodents to create burrows, which snakes occupy during winter months (USFWS 2006).

Habitat Narrative

Adult: San Francisco garter snakes are habitat specialists with several strict habitat requirements. Necessary habitat for San Francisco garter snakes includes densely vegetated standing freshwater habitats with some open water areas, open grassy uplands and shallow marshlands for breeding, and rodent burrows for hibernacula (shelters where they spend dormant winter months) and refugia (USFWS 2006). San Francisco garter snakes occur in the vicinity of standing water—chiefly ponds, lakes, marshes, and sloughs (USFWS 1985). However, temporary ponds and other seasonal water bodies are also used. Emergent and bankside vegetation such as cattails (Typha sp.), bulrushes (Scirpus sp.), spike rushes (Juncus sp.), and water plantain (Alisma sp.) apparently are preferred and used for cover (USFWS 1985; USFWS 2006). The interface between stream and pond habitats is used for basking, while nearby dense vegetation or water often provides escape cover. If floating algal mats or rush mats are available, snakes will use these, because they are apparently more secure basking sites (USFWS 1985). Shallow water near shore is essential from May to July to ensure the successful hatching and metamorphosis of amphibian prey items, particularly Pacific tree frogs and California red-legged frogs (USFWS 2006).San Francisco garter snakes also require open grassy uplands and shallow marshlands with adequate emergent vegetation for breeding (USFWS 2006). Flora composition in the upland habitat sites includes, but is not limited to, coyote bush (Bacharis pillularis), wild oat (Avena fatua), wild barley (Hordeum sp.), and various brome species (Bromus sp.). San Francisco garter snakes may prefer an "early successional" grassland/shrub matrix with brush densities ranging from one average-sized bush per 30 m2 (323 sq. ft.) to one large bush per 20 m2 (215 sq. ft.) . By maintaining these ratios, there is sufficient cover from predators, while allowing for exposed surfaces to facilitate thermoregulation. The San Francisco garter snake also depends on ground-burrowing rodents to create burrows for snakes to use as hibernacula and refugia during the winter (USFWS 2006). The connectivity between aquatic and upland habitat is important and is currently threatened by development and infrastructure, including roads and highways (USFWS 2006).

Dispersal/Migration

Motility/Mobility

Adult: Moderate

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Moderate; may disperse to new areas in pursuit of prey (USFWS 2006).

Immigration/Emigration

Adult: Immigrates/emigrates.

Dependency on Other Individuals or Species for Dispersal

Adult: No

Dispersal/Migration Narrative

Adult: San Francisco garter snakes are nonmigratory, but move between pond foraging habitats and upland wintering sites seasonally. Peak activity occurs between March and July, which may correspond with dispersal patterns of their prey. Radio tracking studies indicate that most individuals remain within 100 to 200 m (328 to 656 ft.) of pond foraging habitats and wintering upland sites. San Francisco garter snakes do not appear to move distances greater than 1 km (0.6 mi.), but they may disperse to new areas in pursuit of prey. Roads and highways may adversely affect dispersal and movement of the San Francisco garter snakes (USFWS 2006).

Additional Life History Information

Adult: Peak activity occurs between March and July, which may correspond with dispersal patterns of their prey. Radio tracking studies indicate that most individuals remain within 100 to 200 meters (m) (328 to 656 feet [ft.]) of pond foraging habitats and wintering upland sites. San Francisco garter snakes do not appear to move distances greater than 1 km (0.6 mi.) (USFWS 2006).

Population Information and Trends

Population Trends:

Varied: three of the six known populations appear to be declining, one is likely stable or increasing, and two are unknown (USFWS 2006).

Species Trends:

Short-term decline of 10 to 30 percent (NatureServe 2015).

Resiliency:
Low

Representation:
Low

Redundancy:
Low

Number of Populations:
Six: West of Bayshore, Laguna Salada, San Francisco State Fish and Game Refuge, Pescadero Marsh, Año Nuevo State Reserve, and Cascade Ranch (USFWS 2006).

Population Size:
Unknown (USFWS 2006)

Resistance to Disease:
Low

Additional Population-level Information:
In the absence of reliable data regarding trends in the number of individuals in any given population, trends are often inferred from changes in habitat quality and quantity (USFWS 2006).

Population Narrative:
There are six known populations of San Francisco garter snake: West of Bayshore, Laguna Salada, San Francisco State Fish and Game Refuge, Pescadero Marsh, Año Nuevo State Reserve, and Cascade Ranch. Little data exist regarding population trends, demographic features, and demographic trends for San Francisco garter snake. In the absence of reliable data regarding trends in the number of individuals in any given population, trends have been inferred from changes in habitat quality and quantity (USFWS 2006). The West of Bayshore population, near the San Francisco International Airport, appears to have declined between 1983 and the mid-1990s, possibly due to drought (USFWS 2006). The Laguna Salada population is declining due to saltwater intrusion, and the Pescadero Marsh population is likely declining due to saltwater intrusion (USFWS 2006). The population statuses are unknown for the San Francisco Fish and Game Refuge and Cascade Ranch populations (USFWS 2006). The population at Año Nuevo State Reserve is likely stable or increasing (USFWS 2006). Overall, the species has experienced a short-term decline of 10 to 30 percent (NatureServe 2015).

Threats and Stressors

Stressor: Habitat loss and degradation
Exposure: Commercial and residential development, habitat management practices, hydrological changes, and agriculture activities.
Response: Degradation and loss of habitat, decreased ability to disperse/move, increase in predator abundance, and vehicle strikes.

Consequence: Decline in abundance due to lack of habitat; mortality.
Narrative: Habitat loss and degradation of remaining habitat are the primary threats to the recovery of San Francisco garter snake. The degradation of habitat is primarily due to fragmentation resulting from expansion of infrastructure to support increasing residential and commercial developments, including new roads, improved utilities matrices, and recreational facilities. Secondarily, habitat is degraded by management practices conflicting with the needs of the San Francisco garter snake, including the allowance of serial succession, the increased use of perch ponds (shallow artificial water impoundments often used in San Mateo for irrigation) with decreasing use of stock ponds, the dredging of waterways, and recreational use of off-highway vehicles. Finally, fluctuations in water levels at reservoirs, flood control and channelization, and saline inundation events can result in further habitat degradation (USFWS 2006).

Stressor: Illegal collection
Exposure: Unauthorized take.
Response:
Consequence: Direct loss of individuals.
Narrative: The amount of illegal collection of the San Francisco garter snake and its effects on the species is not clear. The San Francisco garter snake has been illegally collected by amateur herpetologists, and some amount of illegal collection likely still occurs. It is unclear what the impact of unauthorized take is on wild San Francisco garter snake populations, or what can be done to reduce this impact (USFWS 2006).

Stressor: Chytrid fungus
Exposure: Chytrid fungus outbreaks.
Response: Reduction in prey availability.
Consequence: Decline in abundance due to lack of prey.
Narrative: The epidemic of chytrid fungus (Batrachochytrium dendrobatidis), a potentially deadly parasite, poses a threat to most of the San Francisco garter snake's natural prey base. Outbreaks of chytrid fungus are increasing in size and severity throughout the world, perhaps due to recent climate changes that have resulted from abnormal weather patterns. Because of the rapid pace at which chytrid fungus can spread, a lethal outbreak on the Peninsula could be capable of extirpating entire cohorts of amphibians. In the absence of an adequate food source, such an event could lead to catastrophic declines in all garter snake populations range-wide (USFWS 2006).

Stressor: Predation
Exposure: Presence of native and nonnative predators.
Response: Increased predation.
Consequence: Decline in abundance.
Narrative: Probable San Francisco garter snake predators include bullfrog (Rana catesbeieana), American crow (Corvus brachyrhynchos), red-tailed hawk (Buteo jamaicensis), red-shouldered hawk (Buteo lineatus), great egret (Ardea alba), snowy egret (Egretta thula), black crowned night heron (Nycticorax nycticorax), northern harrier (Circus cyaneus), great blue heron (Ardea herodias), long tailed weasels (Mustela frenata), and largemouth bass. In all cases, the extent that these predators influence San Francisco garter snake populations is not known (USFWS 2006).

Stressor: Mosquitofish

Exposure: High densities of mosquitofish.
Response: Decline in California red-legged frog tadpoles.
Consequence: Decline in prey abundance for San Francisco garter snakes.
Narrative: Introduced high densities of mosquitofish have been observed attacking California red-legged frog tadpoles. The stress produced from these attacks was shown to slow develop of the tadpoles, limiting the viability of individuals. With a reduction in the population of California red-legged frogs at a location with mosquitofish, San Francisco garter snakes could experience a similar decline in numbers (USFWS 2006).

Stressor: Parasites
Exposure: Presence of parasites.
Response:
Consequence: Direct mortality.
Narrative: Parasites may have been responsible for several mortalities of juvenile San Francisco garter snakes captured at the West of Bayshore location. Parasitic species encountered include a tapeworm, several flagellate protists, and eight different occurrences of nematode worms. Mosquitofish throughout the northern San Francisco Bay Area may serve as hosts for parasitic tapeworms and thorny-headed worms. These parasites could possibly be transmitted to animals that prey on mosquitofish, which include various ranid species and potentially San Francisco garter snakes (USFWS 2006).

Stressor: Fire suppression
Exposure: Fire suppression.
Response: Shift toward seral ecosystems.
Consequence: Reduction in habitat.
Narrative: One of the greatest threats to the San Francisco garter snake is the reduction of habitat quality resulting from the elimination of disturbance events throughout the Peninsula. Primarily, this is based on changes in management that encourage seral ecosystems. Dynamic grass-dominated uplands provide for, and are potentially maintained by, burrowing rodents that create tunnel systems used by San Francisco garter snakes for hibernacula during the winter months. The loss in recent years of ecological disturbance throughout the majority of San Mateo County has made it possibly for brush species to dominate former grasslands, potentially precluding burrowing animals. Fire suppression has allowed for the domination of these woody species across the coastal landscape, limiting the extent of grasslands that were likely important movement corridors between aquatic habitats. Augmented production levels of cattails also contribute to the loss of open water in aquatic systems. Additionally, the loss of traditional grazing practices on public lands has allowed for the accumulation of dense brush-dominated canopies across the remaining grasslands, which may decrease habitat suitability for the San Francisco garter snake. Reintroducing domestic grazing to grasslands could improve and restore habitat conditions for the San Francisco garter snakes (USFWS 2006).The perpetuation of seral conditions also has negatively impacted suitable aquatic habitat. Cattails (Typha sp.) and other emergent aquatic vegetation species may increase siltation rates in freshwater marshes due to the high water demands of these species, as well as their ability to trap overland runoff. The augmented production level of cattails contributes to the loss of the open-water component in aquatic systems. Open water, combined with emergent vegetation, creates a matrix of habitat elements thought to be necessary for Pacific tree frog and California red-legged frog populations—which are crucial for San Francisco garter snake aquatic habitat—already threated by salinization events—and the presence of bullfrogs (USFWS 2006.)

Stressor: Invasive species
Exposure: Presence of invasive species.
Response: Competition and predation.
Consequence: Direct mortality and reduction in prey availability.
Narrative: Increased presence of invasive species can compete for resources with the San Francisco garter snake or hunt individual San Francisco garter snakes directly. Bullfrogs, largemouth bass (Micropterus salmoides), and sunfish (Centrarchidae) consume California red-legged frog and Pacific tree frog tadpoles, and bullfrogs may prey directly on San Francisco garter snakes (USFWS 2006).

Stressor: Habitat degradation due to artificial water impoundments
Exposure: Steep banks, earthen dams, and artificial water impoundments.
Response: Fewer basking opportunities, and lack of vegetation.
Consequence: Reduction in habitat.
Narrative: Steep banks and earthen dams associated with artificial water impoundment reduce the suitability of an area for San Francisco garter snakes. High grade slopes may reduce basking opportunities because of the absence of level areas in close proximity to dense vegetation. Reservoirs are often absent of adequate vegetation, exposing both the snake and its prey to additional predators (USFWS 2006).

Stressor: Roads
Exposure: Presence of roads and highways.
Response: Increase in vehicular strikes, reduction in dispersal.
Consequence: Direct mortality and decreased dispersal.
Narrative: Roads and highways may adversely affect dispersal and movement of San Francisco garter snakes. Reptiles often use roads for thermoregulation, which can lead to mortality due to vehicular strikes. Highways may also adversely affect dispersal and movement of amphibian prey species (USFWS 2006).

Recovery

Reclassification Criteria:
A primary objective of the 1985 Recovery Plan is to protect and maintain a minimum of six San Francisco garter snake populations, each containing 200 adult snakes (1:1 sex ratio). If this goal is obtained and maintained for 5 consecutive years for six of the ten populations, consideration for threatened status would be appropriate. The six significant populations include the West of Bayshore property (San Francisco International Airport), San Francisco State Fish and Game Refuge property (San Francisco Public Utilities Commission), Laguna Salada/Mori Point property (City of San Francisco/National Park Service), Pescadero Marsh and Año Nuevo State Reserve properties (California State Parks), and Cascade Ranch property (private land owner) (USFWS 1985; USFWS 2006).

Delisting Criteria:
Protect and maintain a minimum of ten San Francisco garter snake populations with approximately 200 adults (1:1 sex ratio) at each site within the snake's historic range for 15 consecutive years; delisting can then be considered. The recovery criteria include the six

significant populations and the creation of four populations at undefined sites (USFWS 1985; USFWS 2006).

The recovery plan proposed that conservation agreements be signed with each of the land owners controlling the lands containing the six significant populations identified in the plan. However, no agreements have been completed to date and the additional four populations proposed in the recovery plan have not been identified. Additionally, although the precise population ratios of San Francisco garter snakes are unknown, studies of the eastern garter snake (Thamnophis sirtalis sirtalis) and the red-sided garter snake (T.s. infernalis) indicate that those sub-species do not exhibit 1:1 sex ratios, with males outnumbering females in the wild. If the sex ratios of San Francisco garter snakes are similar to the eastern and red-sided garter snakes, then a sex ratio of 1:1 may not be the appropriate criterion (USFWS 2006). In response to the issues described above, an updated recovery outline was prepared by the U.S. Fish and Wildlife Service (USFWS) in July 1995. In 2004, the Sacramento Fish and Wildlife Office established a San Francisco garter snake working group comprising USFWS employees familiar with current issues facing the species. The group's purpose is to design and implement specific conservation actions that could be performed prior to, and concurrent with, updating the recovery plan. The group is preparing an interim recovery implementation document consistent with the 1995 recovery outline to assist in guiding recovery actions until a revised recovery plan can be developed (USFWS 2006).

Recovery Actions:

- Use legal authorities to protect San Francisco garter snake and its habitat by enforcing laws and regulations to promote the conservation of the San Francisco garter snake and its habitat, evaluating success of law enforcement, and proposing appropriate new regulations or revisions (USFWS 1985).
- Protect the six known San Francisco garter snake colonies through appropriate management. These colonies include Pescadero Marsh Natural Preserve, Año Nuevo State Reserve, San Francisco State Fish and Game Refuge, the San Francisco Airport Millbrae site, and at least four additional populations (USFWS 1985).
- Assess population trends and make modifications in management plans if necessary. This includes developing population estimation techniques and conducting population surveys as necessary at Pescadero Marsh Natural Preserve, Año Nuevo State Reserve, San Francisco State Fish and Game Refuge, the Millbrae/Airport site, the Laguna Salada site, Cascade Ranch, and any additional sites discovered (USFWS 1985).
- Identify additional recovery needs for the San Francisco garter snake and modify prime objective/management plans accordingly. This includes obtaining life history data necessary to manage and eventually delist the San Francisco garter snake, determining habitat relationships, reevaluating introgression between the red-sided garter snake and the San Francisco garter snake, and identifying essential habitat (USFWS 1985).
- Provide for public information and awareness by providing onsite interpretive programs on public lands, preparing a small brochure on the San Francisco garter snake and the recovery program, and developing a slide-tape program for public presentations (USFWS 1985).
- Develop an updated recovery plan and an expanded San Francisco garter snake working group (USFWS 2006).
- Encourage conservation among private landowners (USFWS 2006).
- Continue ongoing habitat restoration and enhancement for wild populations (USFWS 2006).

- Complete captive holding facilities for use in head starting programs, in the restoration of worldwide zoo populations, and as temporary lodging during habitat maintenance (USFWS 2006).
- Increase research of population trends, demography, and phylogenetics (USFWS 2006).
- Increase law enforcement at vulnerable locations (USFWS 2006).

Conservation Measures and Best Management Practices:

-

Additional Threshold Information:

-
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SPECIES ACCOUNT: *Uma inornata* (Coachella Valley fringe-toed lizard)

Species Taxonomic and Listing Information

Commonly-used Acronym: CVFTL

Listing Status: Threatened; September 25, 1980 (45 FR 63812).

Physical Description

The Coachella Valley fringe-toed lizard (Uma inornata; CVFTL) is a medium-sized, highly specialized endemic lizard that inhabits windblown desert ecosystems of the Coachella Valley in Riverside County, California. This species averages 15 to 23 centimeters (cm) (6 to 9 inches [in.]) in total length, with the tail comprising between 49 to 64 percent of the total length of adult lizards. Coachella Valley fringe-toed lizard have a white or sandy-colored belly and back and light eye-like patterns that form shoulder stripes. Coachella Valley fringe-toed lizard have several specialized adaptations: elongated scales on their hind feet ("fringes") for added traction in loose sand, a shovel-shaped head and lower jaw adapted to aid diving into and moving short distances beneath the sand, elongated scales covering their ears to keep sand out, and unique morphology (form or structure) of internal nostrils that allows them to breathe below the sand without inhaling sand particles (45 FR 63812; USFWS 2010).

Taxonomy

The Coachella Valley fringe-toed lizard is closely related to the Colorado Desert fringe-toed lizard (Uma notata) and the Mojave fringe-toed lizard (Uma scoparia); however, the species can be separated by coloration and morphology. Dorsal color of the Coachella Valley fringe-toed lizard is whitish to pale gray, with a pattern of ocelli (eyelike markings) formed by dark markings on the pale background. The ocelli form a pattern of longitudinal strips over the shoulders. The ventral surface is white. One or several black dots may be present on side of the abdomen, and dusky lines are present on the throat. The Coachella Valley fringe-toed lizard usually has three internasal scales and fewer than 29 femoral pores. In contrast, the Colorado Desert fringe-toed lizard has a buffy dorsal ground color; a single large, black, ventrolateral blotch on each side of the abdomen; an orange color surrounding the black blotches on the ventrolateral surface; and generally bolder throat markings. The Mojave fringe-toed lizard has a buffy dorsal ground color, scattered dorsal ocelli, larger black ventrolateral blotches, an overall greenish-yellow ventral coloration, black gular crescents, usually five internasals, and usually more than 29 femoral pores (USFWS 1984).

Historical Range

At the time the species was listed in 1980, an estimated 255 square kilometers (km2) (98 square miles [sq. mi.]) of extant blowsand habitat was recorded. The Recovery Plan estimated that approximately (500 km2) (193 sq. mi.) of Coachella Valley fringe-toed lizard habitat existed in the Coachella Valley prior to human settlement of the area, and that approximately 328 km2 (126 sq. mi.) of “occupiable habitat” was extant as of 1984 (45 FR 63812; USFWS 1984).

Current Range

There are currently seven Coachella Valley fringe-toed lizard conservation areas throughout Coachella Valley: Snow Creek/Windy Point, White-Water Floodplain, Willow Hole, Edom Hill, Thousand Palms, East Indio Hills, and Santa Rosa and San Jacinto mountains. These conservation areas total 55 km2 (21 sq. mi.) of habitat. There are currently 59 known occurrences of Coachella Valley fringe-toed lizard in the Coachella Valley that are presumed extant, and another 18 extant occurrences of Coachella Valley fringe-toed lizard outside of conservation areas (USFWS 2010).

Distinct Population Segments Defined

No

Critical Habitat Designated

Yes; 9/25/1980.

Legal Description

On September 25, 1980, the U.S. Fish and Wildlife Service designated critical habitat for Uma inornata pursuant to the Endangered Species Act of 1973, as amended (45 FR 63812 - 63820).

Critical Habitat Designation

Critical habitat for the Coachella Valley fringe-toed lizard is desingated in Riverside County, California.

Primary Constituent Elements/Physical or Biological Features

Not available

Special Management Considerations or Protections

Three general types of blow-sand deposits occur in a mosaic pattern across the Coachella Valley: sandy plains, sand hummocks, and mesquite dunes. The Coachella Valley fringe-toed lizard is restricted to these habitats. Sand hummocks (small and deposits two to five feet high), which form on the leeward side of bushes, are the most common type of blow-sand deposits in the Coachella Valley comprising about 60 percent of the fringe-toed lizard habitat (England and Nelson 1976). Army Corps of Engineers proposals for flood control structures in the U.S. Whitewater River also would facilitate urban expansion in the valley. With or without these developments, however, agriculture and urbanization are continuing to eliminate more fringe-toed lizard habitat each year and there are no reasons to believe that these processes will stop until all private land is the Coachella Valley has been developed. The Service therefore believes that the physical and biological features of this habitat are such as to require special management considerations and protection.

Life History

Feeding Narrative

Adult: The Coachella Valley fringe-toed lizard is both opportunistic and omnivorous, feeding on several different plants and plant-dwelling arthropods. The species is diurnal; however, individuals are crepuscular for feeding (active at dusk and dawn). As is seen in many reptiles that live in arid environments, these lizards obtain most of their water from the insects and plants that they ingest. The species requires open blowsands with minimal vegetation cover for feeding.Surface activity of Coachella Valley fringe-toed lizard is limited by ambient temperatures. They are active when the air temperature 1 meter (m) (3.3 feet [ft.]) above ground surface is between 22 and 39 degrees Celsius (°C) (71.6 and 102.2 degrees Fahrenheit [°F]), and ground surface temperatures are between 37 and 58 °C (98.6 and 136.4 °F). The species is inactive and hibernates during the winter (NatureServe 2015; USFWS 2010; USFWS 1984).

Reproduction Narrative

Adult: Coachella Valley fringe-toed lizards reach sexual maturity when individuals reach 65 to 70 mm (2.5 to 2.75 in.) in snout-vent length, usually two summers after hatching. They are oviparous, and breed from spring (April/May) to summer (July/August), having one reproductive event with clutches of two to four eggs. After very wet winters they may lay more than one clutch, and in drought years they may not reproduce at all. Parental care is thought to be low, with Coachella Valley fringe-toed lizard leaving young to fend for themselves. Little is known about the location and timing of egg laying; however, hatchlings begin to appear from late June to early September and hibernate over winter, burrowing in November and emerging in February. More young are produced in years with a significant amount of rainfall (USFWS 1984; USFWS 2010).

Geographic or Habitat Restraints or Barriers

Adult: Low vegetation cover with low sand compaction; from sea level up to elevations of about 490 m (1,600 ft.) (USFWS 2010).

Spatial Arrangements of the Population

Adult: Clumped

Environmental Specificity

Adult: Narrow/specialist.

Tolerance Ranges/Thresholds

Adult: Low

Site Fidelity

Adult: Moderate

Habitat Narrative

Adult: Coachella Valley fringe-toed lizard is specialized to occupy a specific habitat type, consisting of accumulations of windblown (aeolian) sand from sea level up to elevations of about 490 m (1,600 ft.). Deeper sand deposits with more topographic relief are preferred by the species over flatter sand sheets. Low sand compaction is an important preferred habitat characteristic, because it is easier for Coachella Valley fringe-toed lizards to burrow in less compact sand. The presence of four-winged saltbush (Atriplex canescens), Russian thistle (Salsola tragus), and twinbugs (Dicoria) were confirmed as features in high use areas. These lizards prefer fine sand grains from 0.1 to 0.5 mm (0.004 to 0.02 in.) in size, and very low vegetation cover. There are four main sand transport systems that maintain the ecosystems on which this species depends. These systems are composed of sand source areas, fluvial transport zones, fluvial deposition/aeolian erosion areas, wind transport corridors, and aeolian sand deposition areas. Fine sand in Coachella Valley fringe-toed lizard habitat comes from windblown sand source areas (USFWS 2010).

Dispersal/Migration

Motility/Mobility

Adult: High

Migratory vs Non-migratory vs Seasonal Movements

Adult: Nonmigratory

Dispersal

Adult: Dispersal is unlikely in the absence of nearby areas of windblown sands. In areas of active sand transport, sand dunes are highly dynamic and continually moving; in some cases, moving several m (tens of ft.) per year. Movement between populations is poorly studied, although it is likely limited by the natural movement of sands (USFWS 1984).

Dispersal/Migration Narrative

Adult: Coachella Valley fringe-toed lizards are very mobile, but nonmigratory. The home range size of male Coachella Valley fringe-toed lizards (845 to 1,295 m2 [9,095 to 13,940 sq. ft.]) is approximately twice that of female Coachella Valley fringe-toed lizards (269 to 605 m2 [2,895 to 6,512 sq. ft.]). Deeper sand deposits with more topographic relief and low vegetation cover are needed for movement. Dispersal of fringe-toed lizards is unlikely in the absence of nearby areas of windblown sands. In areas of active sand transport, sand dunes are highly dynamic and continually moving; in some cases, moving several m per year. Movement between populations is poorly studied, although it is likely limited by the natural movement of sands (USFWS 2010)

Additional Life History Information

Adult: The home range size of male Coachella Valley fringe-toed lizards (845 to 1,295 square meters [m2] [9,095 to 13,940 square feet (sq. ft.)]) is approximately twice that of female Coachella Valley fringe-toed lizards (269 to 605 m2 [2,895 to 6,512 sq. ft.]) (USFWS 2010).

Population Information and Trends

Population Trends:

Short-term: stable; long-term: decline of 50 to 70 percent (NatureServe 2015).

Species Trends:

Short-term: stable; long-term: decline of 50 to 70 percent (NatureServe 2015).

Resiliency:

Low

Representation:

Low

Redundancy:

Low

Number of Populations:

Seven populations from 59 known occurrences; Snow Creek/Windy Point, White-Water Floodplain, Willow Hole, Edom Hill, Thousand Palms, East Indio Hills, and Santa Rosa and San Jacinto mountains (USFWS 2010).

Population Size:

2,500 to 100,000 individuals (NatureServe 2015).

Minimum Viable Population Size:

Unknown; further study is required (USFWS 2010).

Resistance to Disease:

Possibly low due to very homogeneous populations (USFWS 2010).

Adaptability:

Possibly low due to very homogeneous populations (USFWS 2010).

Additional Population-level Information:

There are currently 59 presumed extant occurrences in the Coachella Valley, with 41 occurring or partially occurring within the boundaries of six CVMSHCP conservation areas (USFWS 2010).

Population Narrative:

There are currently seven conservation areas for Coachella Valley fringe-toed lizard with species believed to be stable overall: Snow Creek/Windy Point, White-Water Floodplain, Willow Hole, Edom Hill, Thousand Palms, East Indio Hills, and Santa Rosa and San Jacinto mountains. Due to their cryptic nature, it is very difficult to accurately measure current populations; current estimates range from 2,500 to 100,000 individuals. The species' populations are currently viewed as stable; however, populations are thought to have declined from 50 to 70 percent since the 1980s and 1990s. There are currently 59 presumed extant occurrences in the Coachella Valley, with 41 occurring or partially occurring within the boundaries of six CVMSHCP conservation areas. Due to very homogenous populations, it is speculated that the species may have a low adaptability and disease resistance (NatureServe 2015; USFWS 2010).

Threats and Stressors

Stressor: Urbanization
Exposure: Direct loss of habitat, fragmentation of habitat, and modification of habitat in the existing conservation areas.
Response: Habitat degradation and loss.
Consequence: Populations are fragmented and possibly extirpated.
Narrative: Impacts from urbanization resulted in direct loss of habitat, fragmentation of habitat, and modification of habitat in the existing conservation areas, all of which affect essential ecosystem processes outside the conservation areas. Ecological processes needed to generate blowsand habitat are affected by continued development throughout the Coachella Valley, through alteration of hydrological systems and through fencing and housing development that blocks winds that move sands along the ground. Since listing, 52 occurrences were extirpated by urban development. Development contributed to range-wide habitat loss, and fragmentation has resulted in the isolation of Coachella Valley fringe-toed lizard into several likely small remnant or peripheral populations (USFWS 2010).

Stressor: Nonnative invasive plants
Exposure: Invasive plants outcompeting native plants.

Response: Coachella Valley fringe-toed lizard will not occupy areas under a thick canopy; habitat degradation and loss.
Consequence: Additional research needed.
Narrative: Saharan mustard (Brassica tournefortii), has relatively recently covered large areas of Coachella Valley fringe-toed lizard habitat and sand source areas in high rainfall years. Coachella Valley fringe-toed lizards will not occupy areas under a thick canopy, because the strong sunlight they require for thermoregulation cannot penetrate and the open spaces they prefer become compromised by thick vegetation. The portions of the Thousand Palms Conservation Area dunes where blowsands were most active (greater aeolian sand movement, less perennial vegetation) had substantially less Saharan mustard cover and were the areas where the highest densities of Coachella Valley fringe-toed lizards were predictably found. Saharan mustard dominated the habitat areas with less active blowsands, thereby restricting useable habitat for Coachella Valley fringe-toed lizards during the period of invasion/expansion. Saharan mustard may be a significant threat to Coachella Valley fringe-toed lizard and its ecosystem, though additional research is needed (USFWS 2010).

Stressor: Obstruction of sand transport systems
Exposure: Shrubs, topographic features, wind breaks, and fencing limiting movement of blow sand.
Response: Degradation and loss of habitat.
Consequence: Reduced population and possible population extirpation.
Narrative: Blowsands are moved by the wind close to the ground surface, compared to smaller particles (e.g., dust) which billow high in the air. One scientist observed that 50 percent of the sediment grains (by weight) in the Valley traveled on the wind within 13 cm (5 in.) of the ground, and 90 percent moved within 64 cm (25 in.) of the ground. Shrubs, topographic features, and structures slow the wind near the ground surface, causing sand to drop out and accumulate, and dunes and hummocks to form near these features. Sand accumulations increase and decrease over time, depending on the amount of entrained sand (in the aeolian transport supply from upwind) and wind speeds. When upwind sand supply is substantial, temporary accumulations of blowsand build up, creating dunes often lasting for years or decades. Without the supply of additional blowsand transported from areas upwind (similar to the dwindling of fluvial sediment deposits during extended droughts/periods without stormflows), wind erodes blowsands from these temporary aeolian accumulations faster than it is replaced. The result is depleted or eliminated dunes or hummocks, and thus degraded Coachella Valley fringe-toed lizard habitat. Areas without input of sand become “armored” (surface capped by larger materials) as the larger sediments that are not typically carried by the wind remain and the finer sands blow away. These areas of depleted blowsands (finer sand particles) do not provide suitable habitat for Coachella Valley fringe-toed lizards (USFWS 2010).

Stressor: Changes in hydrology
Exposure: Alterations in hydrology.
Response: Degradation and loss of dune habitat.
Consequence:
Narrative: At listing, hydrological changes were not identified as a threat concerning Coachella Valley fringe-toed lizard populations or its habitat. However, changes in hydrology, specifically due to groundwater pumping and creation of percolation ponds, have affected the habitat of Coachella Valley fringe-toed lizard and constitute new threats. Impacts from this threat are more likely to affect the following areas: Thousand Palms Conservation Area, Whitewater Floodplain

Conservation Area, Willow Hole Conservation Area, and the Edom Hill Conservation Area. In the Thousand Palms Conservation Area, large areas of mesquite hummocks have disappeared that were clearly visible in historical photographs. Mesquite hummocks, present historically in the conservation area, likely played an important role in dune formation on the Thousand Palms Conservation Area. Groundwater well data for the region indicate that water levels have dropped considerably in the aquifer under the conservation area over the last couple decades. Groundwater pumping of the aquifer has likely caused substantial drops in the groundwater level under the conservation area. Current groundwater levels are likely beyond the reach of mesquite, resulting in the potential loss of the mesquite stands that formerly helped the dunes/hummocks of the Thousand Palms Conservation Area. Because of the falling water table, mesquite hummocks may never be restored naturally to the conservation area, though recent revegetation efforts have demonstrated that mesquite can be established in the Sonoran Desert of California. The lack of mesquite would expedite the loss of blowsand and Coachella Valley fringe-toed lizard habitat from this conservation area (USFWS 2010).

Stressor: Off-highway vehicle (OHV) activity
Exposure: OHV activity.
Response: Loss and degradation of habitat, increased water and wind erosion, and increased soil compaction.
Consequence: Loss of individuals; additional research is needed to assess this threat.
Narrative: OHV activity has been shown to impact dune habitats by altering vegetation communities, increasing levels of water and wind erosion, and increasing soil compaction. Illegal OHV recreation regularly occurs on most of the remaining habitat areas for the species, primarily in the Whitewater Floodplain Conservation Area and surrounding areas, the Willow Hole Conservation Area, the Edom Hill Conservation Area, and the Snow Creek/Windy Point Conservation Area. The County of Riverside has recently increased enforcement related to OHV use; the Bureau of Land Management has fenced large portions of their lands with Coachella Valley fringe-toed lizard habitat, and will conduct inspections at least every 2 weeks to determine compliance/effectiveness and document OHV management measures. OHV use in Coachella Valley remains a current threat impacting Coachella Valley fringe-toed lizard habitat; additional research is needed to assess this threat (USFWS 2010).

Stressor: Regulatory mechanisms
Exposure: Inadequacy of existing regulatory mechanisms.
Response: Loss of habitat or habitat degradation.
Consequence: Reduction in population; extirpation.
Narrative: The state's authority to conserve rare wildlife and plants comprises three major statutes: the California Endangered Species Act, California Environmental Quality Act, and the Natural Community Conservation Planning Act. The species is also protected under the federal endangered species act, and under the FTLHCP. The CVMSHCP affords protection to 42 Coachella Valley fringe-toed lizard occurrences and the sand transport systems, through adaptive management of Coachella Valley fringe-toed lizard habitat. Protections afforded by the plan have helped to preserve Coachella Valley fringe-toed lizard habitat and minimize further impacts of habitat loss and fragmentation. Protection is also afforded to Coachella Valley fringe-toed lizard habitat by restricting use of nonnative plant species into landscapes on or adjacent to the conservation areas. Though impacts from development and other threats have been reduced, existing regulatory mechanisms remain inadequate to ameliorate impacts from current threats to Coachella Valley fringe-toed lizard and their habitat throughout their range (USFWS 2010).

Stressor: Small population size
Exposure: Small population size.
Response: Genetically bottlenecked populations typically experience substantially lowered reproductive fitness, and are more susceptible to extirpation.
Consequence: Population loss and extirpation, and decreased genetic variation.
Narrative: Coachella Valley fringe-toed lizard population sizes are unknown in conservation areas, though average census population numbers, based on variable density data and the amount of potential habitat, were estimated for the Whitewater Floodplain Conservation Area and Thousand Palms Conservation Area. Since 1985, studies revealed that this species is subject to large fluctuations in population size. A population that fluctuates widely is more likely to decline to a level from which it cannot recover than is a population that remains relatively stable. These fluctuations are a threat to the Coachella Valley fringe-toed lizard, due to extremely low numbers reached during declining fluctuation periods. Managing for specific population targets for Coachella Valley fringe-toed lizards may be inappropriate, because it is difficult to “distinguish natural population fluctuations from a downward trajectory of a species at risk of extinction.” During extended droughts, Coachella Valley fringe-toed lizard population numbers were often near zero, but the populations quickly rebounded during periods of average rainfall, indicating that these extreme population dips were acceptable for considering these isolated populations viable. The degree of homogeneity in Coachella Valley fringe-toed lizards likely reflects a genetic bottleneck, and continued loss of gene variability is expected due to ongoing destruction and degradation of Coachella Valley fringe-toed lizard dune habitat. The loss of genetic variability in Coachella Valley fringe-toed lizards decreases the likelihood that genetic variations that would likely aid the species’ persistence in the future remain in the population. The evolutionary potential (potential for a species to adapt to change over time) of a species is reduced by genetic drift and inbreeding in small populations. This makes a population more prone to extinction or extirpation from new diseases or other environmental changes (USFWS 2010).

Stressor: Climate change
Exposure: Global and regional changes in climate.
Response: Reduction and/or loss of habitat, change in behavior, changes in competition, nonnative species, low water supply, and disease.
Consequence: Reduction in population, and population extirpation.
Narrative: Current climate change predictions for terrestrial areas in the Northern Hemisphere indicate intense precipitation events, warmer air temperatures, and increased summer continental winds. Climate modeling for California indicates similar outcomes in temperature and precipitation. Results from a 2007 International Panel on Climate Change assessment indicated a 1 to 3 °C (1.8 to 5.4 °F) increase in average temperature by the year 2050. Over the same time span, a 12 to 35 percent decrease in precipitation is indicated. The Desert Research Institute of the Western Regional Climate Center (WRCC) documented in Palm Springs, in the northern portion of the Coachella Valley, a 2 °C (4 °F) increase in average temperature since 1950. Since 1950, the WRCC has shown a steady increase in temperatures throughout the Coachella Valley. A biological model, validated with observed extirpations of 12 local spiny (Sceloporus) lizard populations in Mexico, predicted the extinction of nearly 40 percent of all lizard species worldwide by 2080 due to global warming processes. These extinctions were correlated with the warming of sites in spring when reproductive energy demands are highest. As daily temperatures become greater, lizard species spend greater amounts of time burrowing or in refuges and less time foraging. Significant temperature increases create a stressor for endemic species, which

may enhance pressures from competitors, nonnative species, habitat change, low water supply, and disease. Species must adapt to these pressures in situ (in place) or shift their geographic range. Such a shift in range for narrow endemic species such as Coachella Valley fringe-toed lizard could exceed the tolerance of the species. Additionally, very little available habitat in the Coachella Valley exists to assist this species with a range shift. Though we know little of the adaptive ability of Coachella Valley fringe-toed lizard, climate change could potentially pose a significant range-wide threat to the species (USFWS 2010).

Recovery

Reclassification Criteria:
Reclassification or uplisting criteria have not been established for this threatened species.

Delisting Criteria:
The recovery plan indicates that the primary objective is to minimize further decline of Coachella Valley fringe-toed lizard and degradation of its habitat, by securing and protecting suitable habitat in two or more large-scale protected areas (one consisting of designated critical habitat) in historical habitats that maintain viable, self-sustaining populations, thus permitting consideration for delisting. The size of the areas to be preserved and the size of Coachella Valley fringe-toed lizard populations essential to recovery need to be determined (USFWS 1984; USFWS 2010). The 2010 5-Year Review identifies the recovery actions from the 1984 Recovery Plan as criteria to accomplish the objective, and recover/delist the species. The 5-Year Review identifies all of the recovery/delisting criteria or recovery actions as applicable; however, some of the criteria are not up to date, and one does not pertain to any threat factors (USFWS 2010).

To protect, manage, and enhance existing habitat for CVFTL in the Coachella Valley by determining appropriate method(s) to protect habitat; protect critical habitat; protect other areas as needed; monitor existing habitat conditions and distribution of habitat and modify management actions accordingly (habitat surveys); and develop and implement habitat management plan(s) for protected areas (restoration of habitat, evaluation of CVFTL success in restored habitat) (USFWS 2010).

Maintain and enhance CVFTL populations by determining biological requirements (population densities in various habitats, population dynamics, minimum sustainable population size, predator-prey and competitive relationships, key variables of high, medium, and low quality habitats) and utilizing results in management decisions; determine population status regularly (experimental design for sampling plots, establishment of permanent study plots, regular survey of selected plots) and utilize data in management decisions; develop and implement recommendations to maintain CVFTL genetic diversity; determining effects of human-related modifications on CVFTL populations (windbreaks, OHV use, pesticides, and nonnative invasive plants) and utilize data in management decisions; and implement programs to reestablish and evaluate CVFTL in rehabilitated areas under management control (probability of success, site selection, development of habitat management plans, restore sites for testing, reintroduction of CVFTL into restored areas as necessary, monitoring of CVFTL population numbers within restored areas).

Foster public awareness and support for the conservation of CVFTL and its ecosystem through an education and public awareness program by establishing an interpretive kiosk with selfguided nature trail at reserve sites; prepare periodic press releases on the ecology and status of CVFTL; prepare programs on CVFTL recovery and management and present to schools, clubs, and other organizations; developing and distributing posters on CVFTL for local businesses; and develop and distribute short films on conservation of CVFTL (USFWS 2010).

Utilize existing laws and regulations protecting CVFTL and its habitat by enforcing State and Federal laws; evaluating success of law enforcement; and proposing appropriate new regulations or revisions (USFWS 2010).

Recovery Actions:

- The recovery plan identifies a number of recovery actions needed to minimize the further decline of the Coachella Valley fringe-toed lizard and degradation of its habitat (USFWS 1984). The 2010 5-Year Review identifies the same recovery actions as criteria to accomplish the objective, and to recover/delist the species. The 5-Year Review identifies all of the recovery/delisting criteria or recovery actions as applicable; however, some of the criteria are not up to date, and one does not pertain to any threat factors (USFWS 2010).
- To protect, manage, and enhance existing habitat (USFWS 1984).
- Maintain and enhance Coachella Valley fringe-toed lizard populations (USFWS 1984).
- Foster public awareness and support for the conservation of Coachella Valley fringe-toed lizard and its ecosystem through an education and public awareness program (USFWS 1984).
- Use existing laws and regulations protecting Coachella Valley fringe-toed lizard and its habitat (USFWS 1984).
- Permanently protect Coachella Valley fringe-toed lizard dune habitat and the essential fluvial and aeolian ecological processes that sustain this habitat in the six conservation areas (Snow Creek/Windy Point Conservation Area, Whitewater Floodplain Conservation Area, Willow Hole Conservation Area, Edom Hill Conservation Area, Thousand Palms Conservation Area, and East Indio Hills Conservation Area) where presumed extant occurrences of Coachella Valley fringe-toed lizard currently exist. Acquire/protect from development the parcels of suitable habitat throughout Coachella Valley fringe-toed lizards range that occur in essential sand transport corridors (USFWS 2010).
- Through planting and irrigation, restore mesquite hummocks in the Willow Hole Conservation Area and Thousand Palms Conservation Area, thus allowing for the rejuvenation of Coachella Valley fringe-toed lizard dune habitat (USFWS 2010).
- Establish a minimum effective population size to ensure the genetic diversity of this species, and create additional research opportunities and modeling to determine the necessary habitat required to maintain genetic diversity (USFWS 2010).
- Conduct annual monitoring surveys for Coachella Valley fringe-toed lizard on each of the six conservation areas where presumed extant occurrences are located (USFWS 2010).
- Revise the recovery plan to include newly found threats (alterations in hydrology, climate change, and small population size) as they pertain to Coachella Valley fringe-toed lizard and its habitat (USFWS 2010).

Conservation Measures and Best Management Practices:

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Additional Threshold Information:

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