APPENDIX B

Status of Species Under National Marine Fisheries Service's Jurisdiction

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Section 7(a)(2) of the Endangered Species Act (ESA) (16 U.S.C. 1531 et seq.) requires that each federal agency ensure any action authorized, funded, or carried out by such agency is not likely to jeopardize the continued existence of any endangered or threatened species or result in the destruction or adverse modification of critical habitat of such species. The following species are under the jurisdiction of NOAA's National Marine Fisheries Service (NMFS) and may be affected by the EPA's issuance of regulations pursuant to section 316(b) of the Clean Water Act (Table 1).

Table 1. National Marine Fisheries Service species listed under the Endangered Species Act that may be affected by the issuance of regulations pursuant to section 3016(b) of the Clean Water Act. Designated critical habitat is denoted by an asterisk (*); proposed critical habitat is denoted by a double asterisk (**).

Common name (Distinct population segment, evolutionarily significant unit, or subspecies)	Scientific name	Status
Cetaceans		
Blue whale	*Balaenoptera musculus*	Endangered
Bowhead whale	*Balaena mysticetes*	Endangered
Fin whale	*Balaenoptera physalus*	Endangered
Humpback whale	*Megaptera novaeangliae*	Endangered
Killer whale (Southern Resident*)	*Orcinus orca*	Endangered
North Atlantic right whale*	*Eubalaena glacialis*	Endangered
Sei whale	*Balaenoptera borealis*	Endangered
Sperm whale	*Physeter macrocephalus*	Endangered
Beluga whale (Cook Inlet)*	*Delphinapterus leucas*	Endangered
False killer whale (Hawaiian insular)	*Pseudorca crassidens*	Endangered
Pinnipeds		
Guadalupe fur seal	*Arctocephalus townsendi*	Threatened
Hawaiian monk seal*,**	*Monachus schauinslandi*	Endangered
Steller sea lion (Western*)	*Eumetopias jubatus*	Endangered
Bearded seal (Beringia)	*Erignathus barbatus nauticus*	Threatened
Ringed seal (Arctic)	*Phoca hispida hispida*	Threatened
Sea turtles		
Green sea turtle (Florida & Mexico's Pacific coast colonies)	*Chelonia mydas*	Endangered
Green sea turtle (all other areas*)		Threatened
Hawksbill sea turtle*	*Eretmochelys imbricate*	Endangered
Kemp's ridley sea turtle	*Lepidochelys kempii*	Endangered
Leatherback sea turtle*	*Dermochelys coriacea*	Endangered
Loggerhead sea turtle (North Pacific Ocean)	*Caretta caretta*	Endangered
Loggerhead sea turtle (Northwest Atlantic Ocean**)		Threatened
Olive ridley sea turtle (Mexico's Pacific coast breeding colonies)	*Lepidochelys olivacea*	Endangered
Olive ridley sea turtle (all other areas)		Threatened
Sturgeons		
Shortnose sturgeon	*Acipenser brevirostrum*	Endangered
Green sturgeon (southern*)	*Acipenser medirostris*	Threatened
Gulf sturgeon*	*Acipenser oxyrhynchus desotoi*	Threatened
Atlantic sturgeon (Gulf of Maine)	*Acipenser oxyrhynchus*	Threatened
Atlantic sturgeon (New York Bight)		Endangered
Atlantic sturgeon (Chesapeake Bay)		Endangered

Common name (Distinct population segment, evolutionarily significant unit, or subspecies)	Scientific name	Status
Atlantic sturgeon (Carolina)		Endangered
Atlantic sturgeon (South Atlantic)		Endangered
Salmonids		
Atlantic salmon (Gulf of Maine*)	*Salmo salar*	Endangered
Chinook salmon (CA Coastal*)	*Oncorhynchus tschawytscha*	Threatened
Chinook salmon (Central Valley Spring-run*)		Threatened
Chinook salmon (Lower Columbia River*)		Threatened
Chinook salmon (Upper Columbia River Spring-run*)		Endangered
Chinook salmon (Puget Sound*)		Threatened
Chinook salmon (Sacramento River Winter-run*)		Endangered
Chinook salmon (Snake River Fall-run*)		Threatened
Chinook salmon (Snake River Spring/Summer-run*)		Threatened
Chinook salmon (Upper Willamette River*)		Threatened
Chum salmon (Columbia River*)	*Oncorhynchus keta*	Threatened
Chum salmon (Hood Canal Summer-run*)		Threatened
Coho salmon (Central CA Coast*)	*Oncorhynchus kisutch*	Endangered
Coho salmon (Lower Columbia River**)		Threatened
Coho salmon (Southern Oregon & Northern California Coast*)		Threatened
Coho salmon (Oregon Coast*)		
Sockeye salmon (Ozette Lake*)	*Oncorhynchus nerka*	Threatened
Sockeye salmon (Snake River*)		Endangered
Steelhead (Central California Coast*)	*Oncorhynchus mykiss*	Threatened
Steelhead (California Central Valley*)		Threatened
Steelhead (Lower Columbia River*)		Threatened
Steelhead (Middle Columbia River*)		Threatened
Steelhead (Northern California*)		Threatened
Steelhead (Puget Sound)		Threatened
Steelhead (Snake River*)		Threatened
Steelhead (South-Central California Coast*)		Threatened
Steelhead (Southern California*)		Threatened
Steelhead (Upper Columbia River*)		Threatened
Steelhead (Upper Willamette River*)		Threatened
Other fishes		
Pacific eulachon*	*Thaleichthys pacificus*	Threatened
Bocaccio (Georgia Basin**)	*Sebastes paucispinis*	Endangered
Yelloweye rockfish (Georgia Basin**)	*Sebastes pinniger*	Threatened
Canary rockfish (Georgia Basin**)	*Sebastes ruberrimus*	Threatened
Smalltooth sawfish*	*Pristis pectinata*	Endangered
Marine invertebrates		
Elkhorn coral*	*Acropora palmata*	Threatened[1]
Staghorn coral*	*Acropora cervicornis*	Threatened[1]
White abalone	*Haliotis sorenseni*	Endangered
Black abalone*	*Haliotis cracherodii*	Endangered
Marine plants		
Johnson's seagrass*	*Halophilia johnsonii*	Threatened

[1] Proposed endangered

1 Cetaceans

There are about 90 species of cetaceans; all are found in marine environments except for four species of freshwater dolphins. The order contains two suborders; mysticeti (baleen whales) and odontoceti (toothed whales, which includes dolphins and porpoises). Ten ESA-listed cetacean species may be affected by the proposed action and are described below.

1.1 Cook Inlet Beluga Whale

The beluga whale (*Delphinapterus leucas*) is a small, toothed, white whale. The DPS resides year-round within Cook Inlet, in the Gulf of Alaska. It was listed as endangered under the ESA, effective December 22, 2008 (73 FR 62919). We used information available in the final rule, the 2008 Status Reviews (Hobbs and Shelden 2008, Hobbs et al. 2008), and recent stock assessment reports (Allen and Angliss 2011) to summarize the status of the DPS, as follows.

1.1.1 Life History

The Cook Inlet DPS is reproductively, genetically, and physically discrete from the four other known beluga populations in Alaska (i.e., those north of the Alaska Peninsula). Its unique habitat experiences large tidal exchanges, with salinities varying from freshwater to marine at either end of the estuary. Belugas occur in mid-Inlet waters in the winter. During spring, summer, and fall, they concentrate in the upper Inlet (a contraction of its range), which offers the most abundant prey, most favorable feeding topography, best calving areas, and best protection from predation. Cook Inlet belugas focus on specific prey species when they are seasonally abundant. During the spring, they focus on eulachon; in the summer, as the eulachon runs diminish, their focus shifts to salmonids. These fatty, energy-rich prey are critical to pregnant and lactating belugas. Calves are born in the summer and remain with their mothers for about 24 months. The calving interval ranges from 2 – 4 years. Females reach sexual maturity at 4 to 10 years, and males mature at 8 to 15 years. Life expectancy exceeds 60 years.

1.1.2 Population Dynamics

The most recent abundance estimate for the Cook Inlet DPS is 345 (CV = 0.13) belugas, based on an average of population estimates from 2008 to 2010 (Allen and Angliss 2011). There were an estimated 1,300 whales in 1979. Subsistence removals led to a 47 percent decline from 1994 to 1998 (from 653 to 347 whales). From 1999 to 2008, the population has declined an average of 1.5 percent per year, despite restriction on subsistence harvest since 1999 (0 – 2 whales harvested annually; 5 total).

1.1.3 Status

The Cook Inlet beluga whale DPS is endangered as a result of over-exploitation. A brief commercial whaling operation in the 1920s harvested 151 Cook Inlet belugas in 5 years. Cook Inlet belugas were harvested by Alaska Natives and for sport prior to the enactment of the Marine Mammal Protection Act (MMPA) in 1972. Annual subsistence take by Alaska Natives during 1995 - 1998 averaged 77 whales, with 20 percent of the population harvested in 1996. Subsistence removals through the 1990s are sufficient to account for past declines in abundance, but are now restricted. The current decline is attributed to other factors. Since the early 1990s, over 200 belugas have stranded along the mudflats in upper Cook Inlet, often resulting in death; the cause is uncertain but may be linked with the extreme tidal fluctuations, predator avoidance, or pursuit of prey. Additional threats include: coastal development, oil and gas development, seismic exploration, point and non- point source discharge of contaminants, contaminated waste disposal, water quality standards, activities that involve the release of chemical contaminant and/or noise, vessel operations, and research (73 FR 62919). Its resilience to future perturbation is low because of the following factors: the population is small (N = 345) and has not grown as expected with the cessation of harvest; as a result of the range contraction, the population is more vulnerable to catastrophic events; and if the current DPS is extirpated, it is unlikely other belugas would repopulate Cook Inlet (Hobbs et al. 2008).

1.1.4 Critical Habitat

On April 11, 2011, NMFS designated critical habitat for the Cook Inlet beluga whale that includes two areas. Area 1 encompasses the upper Inlet, a 1,909 km2 area bounded by the Municipality of Anchorage, the Matanuska-Susitna Borough, and the Kenai Peninsula borough. This area hosts a high concentration of belugas from spring through fall. It provides shallow tidal flats and river mouths or estuarine areas, important to foraging and calving. Mudflats and shallow areas adjacent may allow for molting and escape from predators. Area 2 consists of 5,891 km2 south of Area 1 including: Tuxedni, Chinitna, and Kamishak Bays on the west coast, a portion of Kachemak Bay on the east coast, and south of Kalgin Island. During the fall and winter, Belugas typically occur in smaller densities or deeper waters of this feeding and transit area. Areas 1 and 2 contain the following physical or biological features essential to the conservation of this DPS (76 FR 20180):

> (1) Intertidal and subtidal waters of Cook Inlet with depths less than 30 feet (9.1 m) and within 5 miles (8 km) of high and medium flow anadromous fish streams.
>
> (2) Primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole.
>
> (3) Waters free of toxins or other agents of a type and amount harmful to Cook Inlet beluga whales.
>
> (4) Unrestricted passage within or between the critical habitat areas.
>
> (5) Waters with in-water noise below levels resulting in the abandonment of critical habitat areas by Cook Inlet beluga whales.

1.2 Southern Resident Killer Whale

Killer whales (or orcas) are distributed worldwide, but populations are isolated by region and ecotype (i.e., different morphology, ecology, and behavior). Southern Resident killer whales occur in the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait during the spring, summer and fall. During the winter, they move to coastal waters primarily off Oregon, Washington, California, and British Columbia. The DPS was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). We used information available in the final rule, the 2011 Status Review (NMFS 2011p) and the 2011 Stock Assessment Report (http://www.nmfs.noaa.gov/pr/pdfs/sars/po2011whki-pensr.pdf) to summarize the status of this species, as follows.

1.2.1 Life History

Southern Resident killer whales are geographically, matrilineally, and behaviorally distinct from other killer whale populations (70 FR 69903). The DPS includes three large, stable pods (J, K, and L), which occasionally interact (Parsons et al. 2009). Most mating occurs outside natal pods, during temporary associations of pods, or as a result of the temporary dispersal of males (Pilot et al. 2010). Males become sexually mature at 10 – 17 years of age. Females reach maturity at 12 – 16 years of age and produce an average of 5.4 surviving calves during a reproductive life span of approximately 25 years. Mothers and offspring maintain highly stable, life-long social bonds, and this natal relationship is the basis for a matrilineal social structure. They prey upon salmonids, especially Chinook salmon (Hanson et al. 2010).

1.2.2 Population Dynamics

The most recent abundance estimate for the Southern Resident DPS is 87 whales in 2012. This represents an average increase of 0.4 percent annually since 1982 when there were 78 whales. Population abundance has fluctuated during this time with a maximum of approximately 100 whales in 1995 (http://www.nmfs.noaa.gov/pr/pdfs/sars/po2011whki-pensr.pdf). As compared to stable or growing populations, the DPS reflects a smaller percentage of juveniles and lower fecundity (NMFS 2011p) and has demonstrated weak growth in recent decades.

1.2.3 Status

The Southern Resident killer whale DPS was listed as endangered in 2005 in response to the population decline from 1996 – 2001, small population size, and reproductive limitations (i.e., few reproductive males and delayed calving). Current threats to its survival and recovery include: contaminants, vessel traffic, and reduction in prey availability. Chinook salmon populations have declined due to degradation of habitat, hydrology issues, harvest, and hatchery introgression; such reductions may require an increase in foraging effort. In addition, these prey contain environmental pollutants (e.g., flame retardants; PCBs; and DDT). These contaminants become concentrated at higher trophic levels and may lead to immune suppression or reproductive impairment (70 FR 69903). The inland waters of Washington and British Columbia support a large whale watch industry, commercial shipping, and recreational boating; these activities generate underwater noise, which may mask whales' communication or interrupt foraging. The factors that originally endangered the species persist throughout its habitat: contaminants, vessel traffic, and reduced prey. The DPS's resilience to future perturbation is reduced as a result of its small population size (N = 86); however, it has demonstrated the ability to recover from smaller population sizes in the past and has shown an increasing trend over the last several years. NOAA Fisheries is currently conducting a status review prompted by a petition to delist the DPS based on new information, which indicates that there may be more paternal gene flow among populations than originally detected (Pilot et al. 2010).

1.2.4 Critical Habitat

On November 29, 2006, NMFS designated critical habitat for the Southern Resident killer whale (71 FR 69054). The critical habitat consists of approximately 6,630 km^2 in three areas: the Summer Core Area in Haro Strait and waters around the San Juan Islands; Puget Sound; and the Strait of Juan de Fuca. It provides the following physical and biological features: water quality to support growth and development; prey species of sufficient quantity, quality and availability to support individual growth, reproduction and development, as well as overall population growth; and inter-area passage conditions to allow for migration, resting, and foraging.

1.3 Main Hawaiian Islands Insular False Killer Whale

NMFS currently recognizes three stocks of false killer whale in Hawaiian waters: the Main Hawaiian Islands insular, Hawaii pelagic, and the Northwestern Hawaiian Islands (Carretta et al.

2011, Bradford et al. 2012) (77 FR 70915). NMFS considers all false killer whales found within 40 km (22 nm) of the Main Hawaiian Islands as belonging to the insular stock and all false killer whales beyond 140 km (76 nm) as belonging to the Pelagic Stock (77 FR 70915). The animals belonging to the Northwest Hawaiian Islands stock are insular to the Northwest Hawaiian Islands (Bradford et al. 2012), however, this stock was identified by animals encountered off Kaua‘i. It has been previously recognized that the ranges for the two stocks (pelagic and insular) overlap by 100 km, but there is also overlap among all three stocks in these presently identified ranges (Carretta et al. 2011, Bradford et al. 2012).

The Main Hawaiian Islands insular false killer whale DPS is considered resident to the Main Hawaiian Islands and is genetically and behaviorally distinct compared to other stocks (77 FR 70915). Genetic data suggest little immigration into the Main Hawaiian Islands insular false killer whale population (Baird et al. 2012). However, because data on ecological relationships among false killer whale groups in the region are uncertain,additional data are being collected to identify whether other false killer whale groups in the Hawaiian Islands should also be considered part of the Main Hawaiian Islands insular false killer whale DPS (77 FR 70915).

1.3.1 Life History

Main Hawaiian Islands insular false killer whales are large members of the dolphin family. False killer whales have dark coloration except for some lighter patches near the throat and middle chest. Their body shape is more slender than other large delphinids.

1.3.2 Population Dynamics

The minimum population estimate for the Main Hawaiian Islands insular stock of false killer whales is the number of distinct individuals identified during the 2008-2011 photo-identification studies, which is 129 false killer whales (Baird, Hawaii insular false killer whale catalog; (Carretta et al. 2012). No data are available on current or maximum net productivity rate for this stock.

1.3.3 Status

NMFS listed the Main Hawaiian Island insular population of false killer whales as an endangered distinct population segment (DPS) on November 28, 2012 (77 FR 70915). Reeves et al. (2009) summarized information on false killer whale sightings near Hawaii between 1989 and 2007, based on various survey methods, and suggested that the Main Hawaiian Islands insular stock of false killer whales may have declined during the last two decades. More recently, Baird (Baird 2009) reviewed trends in sighting rates of false killer whales from aerial surveys conducted using consistent methodology around the Main Hawaiian Islands between 1994 and 2003 (Mobley Jr 2001, Mobley Jr. 2003, 2004, 2005). Sighting rates during these surveys exhibited a statistically significant decline that could not be attributed to any weather or methodological changes. Reanalysis of previously published abundance estimates for the insular stock has led to them generally being discounted (77 FR 70915).

The recent Status Review of Main Hawaiian Islands insular false killer whales (Oleson et al. 2010) presented a quantitative analysis of extinction risk using a Population Viability Analysis (PVA). The modeling exercise was conducted to evaluate the probability of actual or near extinction, defined as fewer than 20 animals, given measured, estimated, or inferred information on population size and trends, and varying impacts of catastrophes, environmental stochasticity and Allee effects. A variety of alternative scenarios were evaluated, with all plausible models indicating the probability of decline to fewer than 20 animals within 75 years as greater than 20 percent. Though causation was not evaluated, all models indicated current declines at an average rate of -9 percent since 1989 (95 percent probability intervals -5 to -12.5 percent) (Oleson et al. 2010).

1.3.4 Critical Habitat

No critical habitat has been designated for the Main Hawaiian Islands insular false killer whale.

1.4 Blue Whale

The blue whale is the largest animal on earth. Three subspecies comprise the species, which occurs in coastal and pelagic waters in all oceans. Though often found in coastal waters, blue whales generally occur in offshore waters, from subpolar to subtropical latitudes. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the recovery plan (NMFS 1998b) and recent stock assessments (Waring et al. 2010, Carretta et al. 2013), and the status report (COSEWIC 2002) to summarize the status of the species, as follows.

1.4.1 Life History

The gestation period of blue whales is approximately 10 – 12 months, and calves are nursed for 6 – 7 months. The average calving interval is 2 – 3 years. Blue whales reach sexual maturity at 5 – 15 years of age. Parturition and mating occurs in lower latitudes during the winter season, and weaning probably occurs in or en route to summer feeding areas in higher, more productive latitudes. Blue whales forage almost exclusively on krill (i.e., relatively large euphausiid crustaceans) and can eat approximately 3,600 kg daily. Feeding aggregations are often found at the continental shelf edge, where upwelling produces concentrations of krill at depths of 90 – 120 m.

1.4.2 Population Dynamics

There are an estimated 5,000 – 12,000 blue whales worldwide. Three stocks occur in U.S. waters: the eastern North Pacific, the western North Atlantic, and Hawaii. For the eastern North Pacific stock, the best estimate of abundance is 2,497 whales, with an estimated annual growth rate of approximately three percent annually. The western North Atlantic stock has a minimum population size of 440 individuals, and abundance appears to be increasing, though there are insufficient data to provide reliable population trends. Blue whale sightings are rare in Hawaii, and no data are available from which to estimate abundance or trends.

1.4.3 Status

The blue whale is endangered as a result of past commercial whaling. In the North Atlantic, at least 11,000 blue whales were taken from the late 19th to mid-20th centuries. In the North Pacific, at least 9,500 whales were killed between 1910 and 1965. Commercial whaling no longer occurs, but blue whales are threatened by ship strikes, entanglement in fishing gear, pollution, and noise. Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, it has not recovered to pre-exploitation levels.

1.4.4 Critical Habitat

No critical habitat has been designated for the blue whale.

1.5 Fin Whale

The fin whale is a large, widely distributed baleen whale, comprised of two (or possibly three) subspecies. Fin whales are found in deep, offshore waters of all major oceans, primarily in temperate to polar latitudes. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the recovery plan (NMFS 2010b), the five-year review (NMFS 2011o), and recent stock assessment reports (Allen and Angliss 2012, Waring et al. 2012, Carretta et al. 2013)to summarize the status of the species, as follows.

1.5.1 Life History

The gestation period of fin whales is less than one year, and calves are nursed for 6 – 7 months. The average calving interval is 2 – 3 years. Fin whales reach sexual maturity at 6 – 10 years of age. Parturition and mating occurs in lower latitudes during the winter season. Intense foraging occurs at high latitudes during the summer. Fin whales eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lance. The availability of sand lance, in particular, is thought to have had a strong influence on the distribution and movements of fin whales along the east coast of the United States.

1.5.2 Population Dynamics

There are over 100,000 fin whales worldwide. Though only two subspecies are recognized (Northern Hemisphere and Southern Hemisphere), North Atlantic, North Pacific, and Southern Hemisphere fin whales appear to be reproductively isolated. Of the 3 – 7 stocks in the North Atlantic (N ~ 50,000), one occurs in U.S. waters, where the best estimate of abundance is 3,985 whales. There are three stocks in U.S. Pacific waters: Alaska (Nmin =5,700), Hawaii (Nmin = 101), and California/Oregon/Washington (Nmin = 3,269). Abundance appears to be increasing in Alaska (4.8 percent annually) and possibly California. Trends are not available for other stocks due to insufficient data. Abundance data for the Southern Hemisphere stock are limited; however, there were an estimated 85,200 whales in 1970.

1.5.3 Status

The fin whale is endangered as a result of past commercial whaling. In the North Atlantic, at least 55,000 fin whales were killed between 1910 and 1989. In the North Pacific, at least 74,000 whales were killed between 1910 and 1975. Approximately 704,000 whales were killed in the Southern Hemisphere from 1904 to 1975. Fin whales are still killed under the International Whaling Commission's "aboriginal subsistence whaling" in Greenland, under Japan's scientific whaling program, and via Iceland's formal objection to the Commission's ban on commercial whaling. Additional threats include: ship strikes, reduced prey availability due to overfishing or climate change, and noise. Though the original cause of endangerment remains, whaling has been significantly reduced. Its large population size may provide some resilience to current threats, but trends are largely unknown.

1.5.4 Critical Habitat

No critical habitat has been designated for the fin whale.

1.6 Sei Whale

The sei whale is a widely distributed baleen whale. Sei whales prefer subtropical to subpolar waters on the continental shelf edge and slope worldwide. They are usually observed in deeper waters of oceanic areas far from the coastline. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the recovery plan (NMFS

2011q), the five-year review (NMFS 2012e), and recent stock assessment reports (Waring et al. 2012, Carretta et al. 2013)to summarize the status of the species, as follows.

1.6.1 Life History
The gestation period of sei whales is 10 – 12 months, and calves are nursed for 6 – 9 months. The average calving interval is 2 – 3 years. Sei whales reach sexual maturity at 6 – 12 years of age. They winter at relatively low latitudes and summer at relatively higher latitudes. Throughout their range, sei whales occur predominantly in deep water; they are most common over the continental slope. Sei whales in the North Atlantic reportedly feed primarily on calanoid copepods, with a secondary preference for euphausiids. In the Pacific, they also feed on fish (e.g., anchovies, saury, whiting, lamprey, and herring).

1.6.2 Population Dynamics
There are ~80,000 sei whales worldwide, in the North Atlantic, North Pacific, and Southern Hemispere. Three stocks occur in U.S. waters: Nova Scotia (N = 357), Hawaii (Nmin = 37), and Eastern North Pacific (Nmin = 83). Population trends are not available due to insufficient data. It is unknown whether the population size is stable or fluctuating.

1.6.3 Status
The sei whale is endangered as a result of past commercial whaling. There are no estimates of pre-exploitation abundance for the North Atlantic. Models indicate that total abundance declined from 42,000 to 8,600 individuals between 1963 and 1974, in the North Pacific. In the Southern Hemisphere, pre-exploitation abundance is estimated at 65,000 whales, with recent abundance estimated at 9,700 whales. Now, only a few individuals are taken each year by Japan; however, Iceland has expressed an interest in targeting sei whales. Current threats include ship strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and noise. Its large population size may provide some resilience to current threats, but trends are largely unknown.

1.6.4 Critical Habitat
No critical habitat has been designated for the sei whale.

1.7 Humpback Whale
The humpback whale is a widely distributed baleen whale, distinguishable by its long flippers. The species inhabits all major oceans from the equator to sub-polar latitudes and generally prefers coastal waters. The humpback whale was originally listed as endangered on December 2, 1970 (35 FR 18319). On August 29, 2013, NMFS initiated a status review of the North Pacific population to determine whether to identify the population as DPS and to delist it. We used information available in the recovery plan (NMFS 1991) and recent stock assessment reports (Allen and Angliss 2013, Carretta et al. 2013, Waring et al. 2013)to summarize the status of the species, as follows.

1.7.1 Life History
The gestation period of humpback whales is 11 months, and calves are nursed for 12 months. The average calving interval is 2 – 3 years and sexual maturity is reached at 5 – 11 years of age. Humpback whales inhabit waters over or along the continental shelf and oceanic islands. They winter at low latitudes, where they calf and nurse, and summer at high latitudes, where they feed.

Humpbacks exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton.

1.7.2 Population Dynamics

There are over 60,000 humpback whales worldwide, occurring primarily in the North Atlantic, North Pacific, and Southern Hemisphere. Current estimates indicate approximately 20,000 humpback whales in the North Pacific, with an annual growth rate of 4.9 percent (Calambokidis 2010). Stocks in U.S. waters include: American Samoa, California/Oregon/Washington, and Central North Pacific. As of 1993, there was an estimated 11,570 humpback whales in the North Atlantic, growing at a rate of three percent annually (Stevick et al. 2003). The Southern Hemisphere supports more than 36,000 humpback whales and is growing at a minimum annual rate of 4.6 percent (Reilly et al. 2008).

1.7.3 Status

The humpback whale is endangered as a result of past commercial whaling. Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (Reilly et al. 2008). Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling” provisions of the International Whaling Commission. Additional threats include ship strikes and fisheries interactions (including entanglement), and noise. The species’ large population size and increasing trends indicate that it is resilient to current threats, and one population (North Pacific) is currently being considered for delisting.

1.7.4 Critical Habitat

No critical habitat has been designated for the humpback whale.

1.8 North Atlantic Right Whale

The North Atlantic right whale is a narrowly distributed baleen whale, distinguished by its stocky body and lack of a dorsal fin. North Atlantic right whales inhabit coastal waters of the Atlantic Ocean, particularly between 20° and 60° latitude. For much of the year, their distribution is strongly correlated to the distribution of their prey. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the 5-year review (NMFS 2012a) and the recent stock assessment report (Waring et al. 2013)to summarize the status of the species, as follows.

1.8.1 Life History

The gestation period of North Atlantic right whales is 12 – 13 months, and calves are nursed for 8 – 17 months. The average calving interval is 3 – 5 years. Right whales reach sexual maturity at 9 years of age. They migrate to low latitudes during the winter to give birth in shallow, coastal waters. In the summer, they feed on large concentrations of copepods in the high latitudes.

1.8.2 Population Dynamics

Right whales occur in the eastern and western North Atlantic; however, less than 20 individuals exist in the eastern North Atlantic, and the population may be functionally extinct. There are at least 396 individuals in the western North Atlantic population. Despite two periods of increased mortality, the species has demonstrated overall growth rates of two percent over 17 years (1990 – 2007). This variability may indicate loss of resilience and susceptibility to population collapse (Dai et al. 2012, Scheffer et al. 2012).

1.8.3 Status

The North Atlantic right whale is endangered as a result of past commercial whaling. Pre-exploitation abundance has been estimated at more than 1,000 individuals, distributed throughout temperate, subarctic, coastal and continental shelf waters of the North Atlantic Ocean. Commercial whaling reduced the population size to ~50 individuals and truncated the range of the species; however, whaling is now prohibited. The two major threats to the survival of the species are ship strike and fisheries interactions (including entanglement). While population trends are positive, the species' resilience to future perturbations is low due to its small population size and continued threats of ship strike and entanglement.

1.8.4 Critical Habitat

On June 3, 1994, NMFS designated critical habitat for the North Atlantic right whale (59 FR 28805). Northern designated areas (Great South Channel, Massachusetts Bay, Cape Cod Bay, and Stellwagen Bank) include complex oceanographic features that drive prey density and distribution. Southern areas (waters from the coast out 15 nautical miles between the latitudes of 31°15' N and 30°15' N and from the coast out five nautical miles between 30°15' N and 28°00' N) were designated to protected calving and breeding grounds.

1.9 North Pacific Right Whale

The North Pacific right whale is a baleen whale, distinguished by its stocky body and lack of a dorsal fin. It inhabits the Pacific Ocean, particularly between 20° and 60° latitude. The species was originally listed with the North Atlantic right whale (i.e., "Northern" right whale) as endangered on December 2, 1970 (35 FR 18319). It was listed separately as endangered on March 6, 2008 (73 FR 12024). We used information available in the 5-year review (NMFS 2012c) and the recent stock assessment report (Allen and Angliss 2013) to summarize the status of the species, as follows.

1.9.1 Life History

The gestation period of North Pacific right whales is approximately 1 year, and calves are nursed for approximately 1 year. Right whales reach sexual maturity at 9 – 10 years of age. Little is known about migrating patterns, but whales have been observed in lower latitudes in the winter (Japan, California, and Mexico). In the summer, they feed on large concentrations of copepods in the Alaskan waters.

1.9.2 Population Dynamics

The North Pacific right whale remains one of the most endangered whale species in the world, likely numbering fewer than 1,000 individuals. There are no reliable estimates of current abundance or trends for right whales in the North Pacific, and we do not know whether the population size is stable or fluctuating.

1.9.3 Status

The North Pacific right whale is endangered as a result of past commercial whaling. Pre-exploitation abundance has been estimated at more than 11,000 individuals. Current threats to the survival include poaching, ship strike, fisheries interactions (including entanglement). The species' resilience to future perturbations is low due to its small population size and continued threats of poaching, ship strike, and entanglement.

1.9.4 Critical Habitat

In 2008, NMFS designated critical habitat for the North Pacific right whale, which includes an area in the Southeast Bering Sea and an area south of Kodiak Island in the Gulf of Alaska (73 FR 19000). These areas are influenced by large eddies, submarine canyons, or frontal zones which enhance nutrient exchange and act to concentrate prey. These areas are adjacent to major ocean currents and are characterized by relatively low circulation and water movement. Both critical habitat areas support feeding by North Pacific right whales because they contain the designated primary constituent elements, which include: nutrients, physical oceanographic processes, certain species of zooplankton, and a long photoperiod due to the high latitude (73 FR 19000). Consistent North Pacific right whale sights are a proxy for locating these elements.

2 Pinnipeds

Pinnipedia is the group of semi-aquatic mammals that includes the families: Phocidae (earless or true seals); Otaridae (eared seals); and Odobenidae (walrus). Over thirty species of pinniped occur worldwide in a variety of aquatic habitats, though they most commonly occur in coastal, marine areas. Two ESA-listed pinniped species under NMFS's jurisdiction (walrus are under the jurisdiction of the USFWS) may be affected by the proposed action and are described below.

2.1 Steller Sea Lion (Western DPS)

The Steller sea lion ranges from Japan, through the Okhotsk and Bering Seas, to central California. It consists of two morphologically, ecologically, and behaviorally distinct DPSs: the Eastern DPS, which includes sea lions in Southeast Alaska, British Columbia, Washington, Oregon and California; and the Western DPS, which includes sea lions in all other regions of Alaska, as well as Russia and Japan. On May 5, 1997, NMFS issued a final determination to list the western DPS as endangered under the ESA (62 FR 24345). We used information available in the final listing (62 FR 24345) and the 2012 stock assessment report (Allen and Angliss 2012) to summarize the status of the western DPS, as follows.

2.1.1 Life History

Within the western DPS, pupping and breeding occurs at numerous major rookeries from late May to early July. Male Steller sea lions become sexually mature at 3 – 7 years of age. They are polygynous, competing for territories and females by age 10 or 11. Female Steller sea lion become sexually mature at 3 – 6 years of age and reproduce into their early 20s. Most females breed annually, giving birth to a single pup, but nutritional stress may result in reproductive failure. About 90% of pups within a given rookery are born within a 25-day period, as such they are highly vulnerable to fluctuations in prey availability. Most pups are weaned in 1 – 2 years.

Females and their pups disperse from rookeries by August – October. Juveniles and adults disperse widely, especially males. Their large aquatic ranges are used for foraging, resting, and traveling. Steller sea lions forage on a wide variety of demersal, semi-demersal, and pelagic prey, including fish and cephalopods. Some prey species form large seasonal aggregations, including endangered salmon and eulachon species. Others are available year round.

2.1.2 Population Dynamics

As of 2011, the best estimate of abundance of the western Steller sea lion DPS in Alaska was 52,209 (Nmin = 45, 916). This represents a large decline since counts in the 1950s (N = 140,000) and 1970s (N = 110,000). The potential biological removal is estimated at 275 animals.

2.1.3 Status

Steller sea lion western DPS site counts decreased 40 percent from 1991 to 2000, an average annual decline of 5.4 percent; however, counts increased 11 percent from 2000 to 2004 and three percent between 2004 and 2008, an average annual increase of 1.5 percent. The species was listed as threatened in 1990 because of significant declines in population sizes (55 FR 49204). At the time, the major threat to the species was thought to be reduction in prey availability. To protect and recovery the species, NMFS established the following measures: prohibition of shooting at or near sea lions; prohibition of vessel approach to within 3 nautical miles of specific rookeries, within 0.5 miles on land, and within sight of other listed rookeries; and restriction of incidental fisheries take to 675 sea lions annually in Alaskan waters. In 1997, the western DPS was reclassified as endangered because it had continued to decline since its initial listing in 1990 (62 FR 24345). Despite the added protection (and an annual incidental fisheries take of approximately 26 individuals), the DPS is likely still in decline (though the decline has slowed or stopped in some portions of the range). The reasons for the continued decline are unknown but may be associated with nutritional stress as a result of environmental change and competition with commercial fisheries. The DPS appears to have little resilience to future perturbations.

2.1.4 Critical Habitat

In 1997, NMFS designated critical habitat for the Steller sea lion (58 FR 45269). The critical habitat includes specific rookeries, haulouts, and associated areas, as well as three foraging areas that are considered to be essential for the health, continued survival, and recovery of the species.

In Alaska, areas include major Steller sea lion rookeries, haulouts and associated terrestrial, air, and aquatic zones. Critical habitat includes a terrestrial zone extending 3,000 feet (0.9 km) landward from each major rookery and haulout; it also includes air zones extending 3,000 feet (0.9 kin) above these terrestrial zones and aquatic zones. Aquatic zones extend 3,000 feet (0.9 km) seaward from the major rookeries and haulouts east of 144°W. In California and Oregon, major Steller sea lion rookeries and associated air and aquatic zones are designated as critical habitat. Critical habitat includes an air zone extending 3,000 feet (0.9 km) above rookery areas historically occupied by sea lions. Critical habitat also includes an aquatic zone extending 3,000 feet (0.9 kin) seaward.

In addition, NMFS designated special aquatic foraging areas as critical habitat for the Steller sea lion. These areas include the Shelikof Strait (in the Gulf of Alaska), Bogoslof Island, and Seguam Pass (the latter two are in the Aleutians). These sites are located near Steller sea lion abundance centers and include important foraging areas, large concentrations of prey, and host large commercial fisheries that often interact with the species.

2.2 Hawaiian Monk Seal

The Hawaiian monk seal is a large phocid that inhabits the Northwestern Hawaiian Islands (NWHI) and main Hawaiian Islands (MHI). It was listed as endangered under the ESA in 1976 (41 FR 51611). We used information available in the 2007 5-year review (NMFS 2007d), the 2012 stock assessment report (Carretta et al. 2013), and unpublished NMFS data to summarize the status of this species, as follows.

2.2.1 Life History

Monk seals are generally born between February and August. They nurse for 5 – 6 weeks, during which time the mother does not forage. Upon weaning, the mothers return to sea, and the pups are left unattended on the beaches. Females spend approximately 8 – 10weeks foraging at sea before returning to beaches to molt. They mature at 5 – 10 years of age. Males likely mature at the same age but may not gain access to females until they are older. Males compete in a dominance hierarchy to gain access to females (i.e., guarding them on shore). Mating occurs at sea, however, providing opportunity for female mate choice. Though some females mate every year after first parturition, most do not. Overall reproductive rates are low, especially in the NWHI. For example, the pooled birth rate at Laysan and Lisianski was 0.54 pups per adult female per year (Johanos et al. 1994). The low birth rates may reflect low prey availability. Monk seals are considered foraging generalists that feed primarily on benthic and demersal prey. They forage in subphotic zones either because these areas host favorable prey items or because these areas are less accessible by competitors (Parrish 2009). Juvenile seals may not have the experience, endurance, or diving capacity to make such deep dives, leaving them more susceptible to starvation.

2.2.2 Population Dynamics

As of 2012, ~1,212 Hawaiian monk seals remained in the wild. As of 2011, a total of 152 seals were documented in the MHI, where the subpopulation is growing at a rate of seven percent annually (Baker et al. 2011). The majority of seals (N = 893) still reside in the NWHI. Hawaiian monk seals are found predominantly throughout the NWHI with six of the population's reproductive sites being located at Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, and the French Frigate Shoals (NMFS 2014 citing Antonelis et al. 2006; Reeves et al. 2002).

Hawaiian monk seals occur on lands (islands, atolls, emergent reefs) throughout the Hawaiian Archipelago, from Kure Atoll to Hawaiʿi Island, a distance of over 2,500 km (approximately 1,553 miles). Seals forage (search for food) in and transit the waters surrounding and between all land areas. Additionally, intermittent sightings of Hawaiian monk seals have occurred at remote Johnston Atoll approximately 800 km (about 500 miles) south of the Hawaiian Archipelago. Although seals are perhaps not continuously present at this site, they do occur there naturally so Johnston Atoll is considered part of the species range. Historically, most Hawaiian monk seals have been located in the remote NWHI, with subpopulations at Kure Atoll, Midway Atoll, Pearl and Hermes Reef, Lisianski Island, Laysan Island, French Frigate Shoals, Necker Island and Nihoa Island. Seals are also seen at Gardner Pinnacles and Maro Reef in the NWHI; however, these sites have limited areas where seals can haul out. A historically small, but currently growing portion of the seals occur in the MHI, including the islands of Niʿihau, Kauaʿi, Oʿahu, Molokaiʿi, Lānaʿi, Kahoʿolawe, Maui, and Hawaiʿi. Seals also land on smaller islands (for example, Kaula Rock, Lehua Rock) and offshore islets that occur throughout the MHI (NMFS 2014).

2.2.3 Status

The Hawaiian monk seal is a endangered species that continues to decline in abundance at a rate of four percent annually, presumably as a result in changes to their foraging base. The species has declined in abundance by over 68% since 1958. Birth rates in the NWHI declined dramatically in the 1990s, possibly reflecting unfavorable environmental conditions. Concurrently, there was a rapid increase in the number of monk seal sightings and births in the MHI. Hawaiian monk seals were once harvested for their meat, oil and skins, leading to extirpation in the MHI and near-extinction of the species by the 20th century (Hiruki and Ragen 1992, Ragen 1999). The species experienced a partial recovery by 1960, when hundreds of seals were counted on NWHI beaches. Since then, however, the species has declined in abundance. Though the ultimate cause(s) for the decline remain unknown, threats include: starvation; predation by sharks; competition with fish and fisheries; entanglement in marine debris; male aggression; beach erosion; and environmental changes that reduce prey availability. In the MHI, additional threats include disturbance of nursing pups and illegal killing, which likely reflects conflict over actual or perceived fisheries interactions (Kehaulani Watson et al. 2011, McAvoy 2012). With only ~1,212 individuals remaining the species' resilience to further perturbation is low. Other species in the same genus have gone extinct (i.e., Caribbean monk seal) or have been extirpated from the majority of their previous range (i.e., Mediterranean monk seal). We conclude that the Hawaiian monk seal's resilience to further perturbation is low, and its status is precarious.

2.2.4 Critical Habitat

Hawaiian monk seal critical habitat was originally designated on April 30, 1986 (51 FR 16047) and was extended on May 26, 1988 (53 FR 18988). It includes all beach areas, sand spits and islets (including all beach crest vegetation to its deepest extent inland), lagoon waters, inner reef waters, and ocean waters out to a depth of 20 fathoms (37 m) around the NWHI breeding atolls and islands. The marine component of this habitat serves as foraging areas, while terrestrial habitat provides resting, pupping and nursing habitat.

On June 2, 2011, NMFS published a proposed rule to revise critical habitat for Hawaiian monk seals (76 FR 32026), extending the current designation in the NWHI out to the 500 m depth contour (including Sand Island at Midway Atoll) and designating six new areas in the MHI (i.e., terrestrial and marine habitat from 5 m inland from the shoreline extending seaward to the 500 m depth contour around Kaula, Niihau, Kauai, Oahu, Maui Nui, and Hawaii Islands). A final rule has not yet been published.

3 Sea Turtles

Sea turtles are air-breathing reptiles with streamlined bodies and large flippers. They inhabit tropical and subtropical ocean waters throughout the world. Of the seven species of sea turtles found worldwide, the six species described below are found in U.S. waters and may be affected by the proposed action.

3.1 Leatherback Sea Turtle

The 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. The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973. We used information available in the 5-year review (NMFS and USFWS 2007c) and the critical habitat designation (77 FR 61573) to summarize the status of the species, as follows.

3.1.1 Life History

Age at maturity remains elusive, with estimates ranging from 5 to 29 years (Spotila et al. 1996, Avens et al. 2009). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing >80 g (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) in approximately 50% worldwide (Eckert et al. 2012). Females nest every 1 – 7 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 ~33 percent 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 (Rivalan et al. 2005, Sherrill-Mix and James 2008, Casey et al. 2010). Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000, Price et al. 2004).

3.1.2 Population Dynamics

The global population of adult females has declined over 70 percent in less than one generation, from an estimated 115,000 adult females in 1980 to 34,500 adult females in 1995 (Pritchard 1982, Spotila et al. 1996). There may be as many as 34,000 – 94,000 adult leather backs in the North Atlantic, alone (Turtle Expert Working Group 2007), but dramatic reductions (> 80 percent) have occurred in several populations in the Pacific, which was once considered the stronghold of the species (Sarti Martinez 2000).

3.1.3 Status

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. As a result 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, as a result of sea-level rise. The species' resilience to additional perturbation is low.

3.1.4 Critical Habitat

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 m 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; however, studies do not support significant critical habitat deterioration.

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 km2 stretching along the California coast from Point Arena to Point Arguello east of the 3000 m depth contour; and 64,760 km2 stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 m depth contour. The designated areas comprise approximately 108558 km2 of marine habitat and include waters from the ocean surface down to a maximum depth of 80 m. 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.

3.2 Hawksbill Sea Turtle

The hawksbill sea turtle has a sharp, curved, beak-like mouth. It has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans. The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973. We used information available in the 5-year reviews (NMFS and USFWS 2007b, NMFS 2013e, NMFS and USFWS 2013) to summarize the status of the species, as follows.

3.2.1 Life History

Hawksbill sea turtles reach sexual maturity at 20 – 40 years of age. Females return to their natal beaches every 2 – 5 years to nest (an average of 3 – 5 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 22 – 25 cm 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.

3.2.2 Population Dynamics

Surveys at 88 nesting sites worldwide indicate that 22,004 – 29,035 females nest annually(NMFS 2013e, NMFS and USFWS 2013). 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.

3.2.3 Status

Long-term data on the hawksbill sea turtle indicate that 63 sites have declined over the past 20 to 100 years (historic trends are unknown for the remaining 25 sites). Recently, 28 sites (68 percent) 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 percent 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.

3.2.4 Critical Habitat

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.

3.3 Kemp's Ridley Sea Turtle

The Kemp's ridley is the smallest of all sea turtle species and considered to be the most endangered sea turtle, internationally (Zwinenberg 1977, Groombridge 1982, TEWG 2000). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas. The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and listed as endangered under the ESA since 1973. We used information available in the revised recovery plan (NMFS et al. 2011) to summarize the status of the species, as follows.

3.3.1 Life History

Adult Kemp's ridley sea turtles have an average straight carapace length of 2.1 ft (65 cm). Females mature at 12 years of age. The average remigration is 2 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 97 – 100 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 2 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 ft (37 m) 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.

3.3.2 Population Dynamics

Of the seven species of sea turtles 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. From 1980 to 2003, the number of nests increased 15 percent annually. In 2009, an estimated 8,000 nesting females produced over 20,000 nests. In addition, a total of 911 nests were recorded on the Texas coast from 2002 – 2010.

3.3.3 Status

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.

3.3.4 Critical Habitat

On February 17, 2010, WildEarth Guardians, Santa Fe, New Mexico, submitted to USFWS and NMFS a petition to designate critical habitat for the Kemp's ridley sea turtle (available online at: http://www.nmfs.noaa.gov/pr/pdfs/petitions/kempsridley_criticalhabitat_feb2010.pdf). Critical habitat has not been designated for the species.

3.4 Olive Ridley Sea Turtle (Mexico's Pacific Coast Breeding Colonies)

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution. 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 on the Pacific coast of Mexico, and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range). We used information available in the 5-year review (NMFS and USFWS 2007d) to summarize the status of the endangered listing, as follows.

3.4.1 Life History

Olive ridley females mature at 10 – 18 years of age. They lay an average of two clutches per season (3-6 months in duration). The annual average clutch size is 100 – 110 eggs per nest. Olive ridleys commonly nest in successive years. Females nest in solitary or in arribadas, large aggregations coming ashore at the same time and location. As adults, Olive ridleys forage on crustaceans, fish, mollusks, and tunicates, primarily in pelagic habitats.

3.4.2 Population Dynamics

The eastern Pacific lineage is genetically and geographically isolated from other olive ridley lineages.

3.4.3 Status

Prior to 1950, abundance was conservatively estimated to be 10 million adults. Years of adult harvest reduced the population to just over one million adults by 1969. Shipboard transects along the Mexico and Central American coasts between 1992 and 2006 indicate an estimated 1.39 million adults. Based on the number of olive ridleys nesting in Mexico, populations appear to be increasing in one location (La Escobilla: from 50,000 nests in 1988 to more than one million in 2000) and stable at all others. Harvest prohibitions and the closure of a nearshore turtle fishery resulted in a partial recovery; however, remaining threats include Current bycatch in longline and trawl fisheries and the illegal harvest of eggs and turtles. Given its large population size, it is somewhat resilient to future perturbation.

3.4.4 Critical Habitat

No critical habitat has been designated for the olive ridley sea turtle.

3.5 Olive Ridley Sea Turtle (All Other Areas)

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution. 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 on the Pacific coast of Mexico, and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range). We used information available in the 5-year review (NMFS and USFWS 2007d) to summarize the status of the threatened listing, as follows.

3.5.1 Life History

See above (Olive ridley sea turtle, Mexico's Pacific coast breeding colonies).

3.5.2 Population Dynamics

Threatened olive ridley sea turtles nest in arribadas at a few beaches in the eastern Pacific, western Atlantic, and northern Indian Oceans. Solitary nesting is observed on many tropical beaches throughout the Atlantic, Pacific, and Indian Oceans. Arribadas now range in size from

335 to 2,000 nests in the western Atlantic, from 1,300 to 200,000 turtles in the eastern Pacific, and from 1,000 to 200,000 in the Indian Ocean.

3.5.3 Status

It is likely that solitary nesting locations once hosted large arribadas; since the 1960s, populations have experienced declines in abundance of 50 – 80 %. Many populations continue to decline. Olive ridley sea turtles continue to be harvested as eggs and adults, legally in some areas, and illegally in others. Incidental capture in fisheries is also a major threat. The olive ridley sea turtle is the most abundant sea turtle in the world; however, several populations are declining as a result of continued harvest and fisheries bycatch. Its large population size, however, allows some resilience to future perturbation.

3.5.4 Critical Habitat

No critical habitat has been designated for the olive ridley sea turtle.

3.6 Loggerhead Sea Turtle (North Pacific Ocean)

The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws. The North Pacific Ocean DPS ranges throughout tropical to temperate waters in the North Pacific. The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800). In 2011, the North Pacific Ocean DPS was listed as endangered under the ESA (76 FR 58868). We used information available in the 2009 Status Review (Conant et al. 2009) and the final listing rule (76 FR 58868) to summarize the status of the species, as follows.

3.6.1 Life History

Mean age at first reproduction for female loggerhead sea turtles is 30 years (SD = 5). 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 primarily on Japanese 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 (Kuroshio Extension Bifurcation Region) and later in the neritic zone (i.e., coastal waters) in the eastern and central Pacific. Coastal waters in the eastern and western North Pacific provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads.

3.6.2 Population Dynamics

There are nine loggerhead DPSs, which are geographically separated and genetically isolated, as indicated by genetic, tagging, and telemetry data. The North Pacific DPS has a small nesting population. An 18-year time series of nesting data in Japan indicates a decline in the North Pacific population from 6,638 nests in 1990 to 2,064 nests in 1997. Since then, nesting has gradually increased to 7,000 – 8,000 nests, based on estimates taken in 2009).

3.6.3 Status

In the loggerhead sea turtle North Pacific Ocean DPS, historical evidence from Kamouda Beach indicates a substantial overall decline (50 – 90 percent) since 1950. Furthermore, population modeling in 2009 indicated that the North Pacific Ocean DPS appears to be declining, is at risk, and is thus likely to decline in the foreseeable future (Conant et al. 2009). The decline is a result of incidental capture in fishing gear, directed harvest, coastal development, increased human use of nesting beaches, and pollution. Coastal fisheries in Japan, the South China Sea, and Baja

California, Mexico are the biggest threat to the species. Drift gillnet fisheries in California and Oregon and the Hawaii-based longline fishery once took large numbers of loggerheads; however, seasonal and take-based closures have minimized the impact of these fisheries. The DPS remains at risk for extinction and its resilience to future perturbations is low.

3.6.4 Critical Habitat

No critical habitat has been designated for the North Pacific Ocean loggerhead sea turtle DPS.

3.7 Loggerhead Sea Turtle (Northwest Atlantic Ocean)

The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws. The Northwest Atlantic Ocean DPS inhabits continental shelf and estuarine environments throughout tropical and temperate waters in the North Atlantic to 40˚ W. The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800). In 2011, the Northwest Atlantic Ocean DPS was listed as threatened under the ESA (76 FR 58868). We used information available in the 2009 Status Review (Conant et al. 2009) and the final listing rule (76 FR 58868) to summarize the status of the species, as follows.

3.7.1 Life History

Adult loggerhead sea turtles have a mean straight carapace length of 3 ft (92 cm). Mean age at first reproduction for female loggerhead sea turtles is 30 years (SD = 5). Mating occurs in the spring, and eggs are laid throughout the summer. Northwest Atlantic females lay an average of five clutches per season. The annual average clutch size is 115 eggs per nest. The average remigration interval is 3.7 years (Tucker 2010). Nesting occurs primarily on beaches along the southeastern coast of the United States, from southern Virginia to Alabama. Additional nesting occurs on beaches throughout the Gulf of Mexico and Caribbean Sea. Temperature determines the sex of the turtle during the middle of the incubation period. Post- hatchling loggerheads from southeast U.S. nesting beaches may linger for months in waters just off the nesting beach or become transported by ocean currents within the Gulf of Mexico and North Atlantic, where they become associated with Sargassum habitats, driftlines, and other convergence zones. The juvenile stage is spent first in the oceanic zone (e.g., waters around the Azores, Madeira, Morocco, and the Grand Banks off Newfoundland) and later in the neritic zone (i.e., continental shelf waters) from Cape Cod Bay, Massachusetts, south through Florida, the Caribbean, and the Gulf of Mexico. Neritic stage juveniles often inhabit relatively enclosed, shallow water estuarine habitats with limited ocean access. Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd 1988). Adults inhabit shallow water habitats with large expanses of open ocean access, as well as continental shelf waters. Sub-adult and adult loggerheads prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom, coastal habitats.

3.7.2 Population Dynamics

There are nine loggerhead DPSs, which are geographically separated and genetically isolated, as indicated by genetic, tagging, and telemetry data. The Northwest Atlantic Ocean DPS is further divided into five recovery units or nesting subpopulations: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean. Using a stage/age demographic model, the adult female population size of the DPS is estimated at 20,000 – 40,000 females (NMFS 2009a). Peninsular Florida hosts more than 10,000 females nesting annually, which constitutes 87 percent of all nesting effort in the DPS. A 23 percent increase in nest counts from

1989 until 1998 was followed by a sharp decline in the subsequent decade (http://myfwc.com/research/wildlife/sea-turtles/nesting/loggerhead-trends/); large fluctuations in population size often indicate the loss of resilience and susceptibility to population collapse (Dai et al. 2012, Scheffer et al. 2012). Nesting aggregations from Georgia to North Carolina host 1,000 to 9,999 females nesting annually. The other recovery units are much smaller but are still considered essential to the continued existence of the species.

3.7.3 Status

The loggerhead sea turtle Northwest Atlantic Ocean DPS was listed as threatened under the ESA as a result of bycatch mortality, resulting from domestic and international commercial fishing, particularly in gillnet, longline, and trawl fisheries. Turtle excluder devices on shrimp trawlers and the use of circle hooks in the longline fishery have reduced bycatch significantly; however bycatch remains the most significant threat to the DPS. The rangewide nesting trend of the DPS from 1989 until 2010 is slightly negative but not significantly different from zero. We conclude that, as a result of its relatively large abundance (20,000 – 40,000 females), the DPS is not currently at risk of extinction; however, its large fluctuations in population size indicates loss of resilience, such that it is likely to become endangered within the foreseeable future.

3.7.4 Critical Habitat

On July 18, 2013, NMFS proposed critical habitat for the Northwest Atlantic Ocean loggerhead DPS within the Atlantic Ocean and the Gulf of Mexico. Specific areas proposed for designation include 36 occupied marine areas within the range of the Northwest Atlantic Ocean DPS. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors. They also asked for comments on whether to include as critical habitat in the final rule some areas that contain foraging habitat and two large areas that contain Sargassum habitat.

3.8 Green Sea Turtle (All Other Areas)

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 lb (159 kg) and a straight carapace length of greater than 3.3 ft (1 m). It has a circumglobal distribution, occurring throughout nearshore tropical, subtropical, and, to a lesser extent, temperate waters. 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 August 1, 2012, NMFS found that a petition to identify the Hawaiian population of green turtle as a DPS, and to delist the DPS, may be warranted (77 FR 45571). We used information available in the 2007 5-Year Review (NMFS and USFWS 2007a) to summarize the status of the species, as follows.

3.8.1 Life History

Age at first reproduction for females is 20 - 40 years. They lay an average of three nests per season with an average of 100 eggs per nest. The remigration interval (i.e., return to natal beaches) is 2 – 5 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.

3.8.2 Population Dynamics
Nesting data at 46 sites from 1990-2006 indicate that 108,761 to 150,521 females nest each year. At the 23 sites for which nesting trend data are available, ten are increasing, nine are stable, and four are decreasing. Where long term data (≥ 20 years) are available (nine sites), nesting populations are stable or increasing in abundance. Nesting populations are doing relatively well in the Pacific, Western Atlantic, and Central Atlantic Ocean; whereas, populations are doing poorly in Southeast Asia, Eastern Indian Ocean, and Mediterranean.

3.8.3 Status
Once abundant in tropical and subtropical waters, globally, green sea turtles exist at a fraction of their historical abundance, as a result of over-exploitation. Egg harvest, the harvest of females on nesting beaches, and directed hunting of turtles in foraging areas remain the three greatest threats to their recovery. In addition, bycatch in drift-net, long-line, set-net, pound-net, and trawl fisheries kill thousands of green sea turtles annually. Increasing coastal development (including construction, beach erosion and renourishment, and artificial lighting) threatens nesting success and hatchling survival. Apparent increases in recent years are optimistic but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to 50 years. While the threats of harvest, coastal development, and fisheries bycatch continue, the species appears to be somewhat resilient to future perturbations.

3.8.4 Critical Habitat
On September 2, 1998, NMFS designated critical habitat for green sea turtles (63 FR 46694), which include coastal waters surrounding Culebra Island, Puerto Rico. Seagrass beds surrounding Culebra provide important foraging resources for juvenile, subadult, and adult green sea turtles. Additionally, coral reefs surrounding the island provide resting shelter and protection from predators. This area provides important developmental habitat for the species.

3.9 Green Sea Turtle (Florida and Mexico’s Pacific Coast Breeding Colonies)
As described above, the green sea turtle 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. We used information available in the 2007 5-Year Review (NMFS and USFWS 2007a) to summarize the status of the species, as follows.

3.9.1 Life History
See above, except in Florida, nests contain an average of 136 eggs and the average remigration interval is 2 years. In addition to nesting on Florida beaches, green sea turtles are found in coastal waters throughout the state. Important neritic habitats include: Mosquito and Indian River Lagoons, Port Canaveral, St. Lucie Inlet, and Biscayne Bay.

3.9.2 Population Dynamics

Along the central and southeast coast of Florida, an estimated 200 – 1,100 females nest each year (Meylan et al. 1994, Weishampel et al. 2003). According to data collected from Florida's index nesting beach survey from 1989-2012, green sea turtle nest counts across Florida have increased approximately ten-fold from a low of 267 in the early 1990s to a high of 10,701 in 2011. In the Pacific Mexico, surveys from 2000 to 2006 indicate an average of 6,050 nests, and a 25-year dataset reveals an increasing trend for the largest nesting site (Colola).

3.9.3 Status

The historic and current threats for the Florida and Mexico's Pacific coast breeding populations are the same as described above for all other areas. Recent increases in nesting on Florida beaches are likely a result of a Florida statute prohibiting the killing of green sea turtles, ESA listing, the 1994 Florida State ban on gillnets and other entangling nets, CITES Appendix I listing, and turtle protections in other nations. Recent increases in the Mexican breeding populations are likely the result of nesting beach protection (1979) and a 1990 presidential decree protecting all sea turtles. However, the threats of harvest, coastal development, and fisheries bycatch continue. The populations' resilience to future perturbations is low but increasing with population size increases.

3.9.4 Critical Habitat

No critical habitat has been designated for the green sea turtle along Florida and Mexico's Pacific Coast.

4 Salmonids

Since 1997 NMFS promulgated a total of 29 limits to the ESA section 9(a) take prohibitions for 21 threatened Pacific salmon and steelhead Evolutionarily Significant Units (ESUs) or Distinct Population Segments (DPSs) (62 FR 38479, July 18, 1997; 65 FR 42422, July 10, 2000; 65 FR 42485, July 10, 2000; 67 FR 1116, January 9, 2002; 73 FR 7816, February 11, 2008). On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160). NMFS took this action to provide appropriate flexibility to ensure that fisheries and artificial propagation programs are managed consistently with the conservation needs of threatened salmon and steelhead. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed prior to release into the wild.

4.1 Atlantic Salmon (Gulf of Maine DPS)

The three generally recognized groups of Atlantic salmon (North American, European, and Baltic) range from northeastern North America through portions of the North Atlantic Ocean to Europe and northwestern Russia in both fresh and saltwater habitats. The North American group historically ranged from northern Quebec southeast to Newfoundland and southwest to Long Island Sound. It included Canadian populations and U.S. populations, including the listed Gulf of Maine (GOM) DPS. The GOM DPS was first listed as endangered by the USFWS and NMFS on November 17, 2000 (65 FR 69459). The listing was refined by the Services on June 19, 2009 (74 FR 29344) to include all anadromous Atlantic salmon whose freshwater range occurs in the watersheds from the Androscoggin River northward along the Maine coast to the Dennys River, and wherever these fish occur in the estuarine and marine environment. We used information available in the 2006 Status Review (Fay et al. 2006) and the Final Rule to List the Expanded Gulf of Maine DPS as Endangered Under the ESA (74 FR 29344) to summarize the status of the GOM DPS, as follows.

4.1.1 Life History

Adult Atlantic salmon typically spawn in early November and juveniles spend approximately two years feeding on small invertebrates and occasionally small vertebrates in freshwater until they weigh approximately two ounces and are six inches in length. Smoltification (the physiological and behavioral changes required for the transition to salt water) usually occurs at age two for the GOM DPS. The GOM DPS migrates more than 4,000 km in the open ocean to reach feeding areas in the Davis Strait between Labrador and Greenland. Adult salmon feed opportunistically and their diet is composed primarily of other fish. The majority of GOM DPS salmon (about 90 percent) spend two winters at sea before reaching maturity and returning to their natal rivers, with the remainder spending one or three winters at sea. At maturity, GOM DPS salmon typically weigh between eight to 15 pounds and average 30 inches in length.

4.1.2 Population Dynamics

Historically, the GOM DPS population was several orders of magnitude larger than contemporary populations. Foster and Atkins (1869) estimated that roughly 100,000 adult salmon returned to the Penobscot River alone before the river was dammed, whereas estimates of abundance for the entire GOM DPS exceeded 5,000 individuals in only four years from 1967 to 2007. From 2001 to 2007, abundance has been estimated between 819 (in 2002) and 1,416 (in 2004) individuals. Abundance was estimated at 1,014 individuals in 2007, the most recent year for which abundance records are available.

4.1.3 Status

The GOM DPS of Atlantic salmon was listed as endangered in 2000 in response to population decline caused by many factors, including overexploitation, degradation of water quality, and damming of rivers, all of which remain persistent threats. Atlantic salmon in the GOM DPS currently exhibit critically low spawner abundance, poor marine survival, and are still confronted with a variety of threats, including: poor water quality, land and water use practices, habitat loss, predation, incidental capture and poaching, genetic threats from hatchery programs, and climate change. The abundance of Atlantic salmon in the GOM DPS has been low and, in general, has been in decline over the past several decades. The proportion of fish of natural origin to hatchery-reared fish is very small (approximately 10 percent) and is continuing to decline. The conservation hatchery program has assisted in slowing the decline and helping to stabilize populations at low levels, but has not contributed to an increase in the overall abundance of salmon and has not been able to halt the decline of the naturally reared component of the GOM DPS. The 2006 status review reports an estimated extinction risk of 19 to 75 percent within the next 100 years for the GOM DPS, even when current levels of hatchery supplementation are considered. Even with current conservation efforts, returns of adult Atlantic salmon to the GOM DPS rivers remain extremely low. Based on the information above, the species would likely have a low resilience to additional perturbations.

4.1.4 Critical Habitat

On June 19, 2009, NMFS and the USFWS defined critical habitat for Atlantic salmon (74 FR 29300). The critical habitat includes all anadromous Atlantic salmon streams whose freshwater range occurs in watersheds from the Androscoggin River northward along the Maine coast northeastward to the Dennys River, and wherever these fish occur in the estuarine and marine environment. PCEs were identified within freshwater and estuarine habitats of the occupied range of the GOM DPS and include sites for spawning and incubation, juvenile rearing, and migration. Critical habitat and PCEs were not designated within marine environments because of the limited knowledge of the physical and biological features that the species uses during the marine phase of its life.

4.2 Chinook Salmon (General Overview)

We discuss the distribution, life history, population dynamics, status, and critical habitats of the nine species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed Chinook salmon species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in status reviews (Good et al. 2005, Ford 2011), various salmon ESU listing documents, and biological opinions (NMFS 2012b) to summarize the status of the species.

Chinook salmon are the largest of the Pacific salmon and historically ranged from the Ventura River in California to Point Hope, Alaska in North America, and in northeastern Asia from Hokkaido, Japan to the Anadyr River in Russia in both fresh and saltwater habitats (Healey 1991). In freshwater, Chinook salmon prefer streams that are deeper and larger than those used by other Pacific salmon species.

4.2.1 Life History

Chinook salmon exhibit varied and complex life history strategies and can generally be described as one of two types: "stream-type" or "ocean type". Stream-type Chinook salmon ESUs reside in freshwater for a year or more following emergence before migrating to salt water; ocean-type Chinook salmon ESUs migrate to the ocean within their first year and typifies populations north of 56°N (Healey 1991). Stream-type ESUs usually return in late winter and early spring (spring-run) as immature adults and reside in deep pools during summer before spawning in fall. Ocean-type ESUs migrate to the ocean within their first year (sub-yearlings) and usually return as full mature adults in fall (fall-run) and spawn soon after river entry. Temperature and stream flow can significantly influence the timing of migrations and spawning, as well as the selection of spawning habitat (Geist et al. 2009, Hatten and Tiffan. 2009). All Chinook salmon are semelparous (i.e. they die after spawning).

The timing of return to fresh water, and ultimately spawning, often provides a temporal isolating mechanism for populations with different life histories. Return timing is often related to spawning location. Thus, differences in the timing of spawning migration also serve as a geographic isolating mechanism. Fall-run Chinook salmon generally spawn in the mainstem of larger rivers and are less dependent on flow, although early autumn rains and a drop in water temperature often provide cues for movements to spawning areas. Spring-run Chinook salmon take advantage of high flows from snowmelt to access the upper reaches of rivers.

Generally, Chinook salmon outmigrants (smolts) are about two to five inches long when they enter saline (often brackish) waters. The process of smoltification enables salmon to adapt to the ocean environment. Several factors can affect smoltification process, not only at the interface between fresh water and salt water, but higher in the watershed as the process of transformation begins long before fish enter salt waters. These factors include exposure to chemicals such as heavy metals and elevated water temperatures (Wedemeyer et al. 1980).

Chinook salmon feed on a variety of prey organisms depending upon life stage. In freshwater and brackish waters Chinook salmon primarily feed on small invertebrates and vertebrates. The diet of juvenile Chinook salmon in the ocean off Oregon and Washington is comprised primarily of juvenile fishes (cottids, pleuronectids, rockfishes, sandlance, smelts, anchovies, and sardines) as well as euphausiids (Emmett et al. 2006, Daly et al. 2012)). Adult Chinook salmon eat larger life stages of the same types of forage fishes during their oceanic life stage.

4.2.2 Population Dynamics

The population dynamics of each Chinook salmon ESU will be discussed separately, below.

4.2.3 Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the *Protective Regulations for Threatened Salmonid Species* section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed prior to release into the wild.

4.2.4 Critical Habitat

Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At the time of designation, primary constituent elements (PCEs) are identified and include sites necessary to support one or more Chinook salmon life stage(s). These PCEs will be identified for each ESU below, but in general they may include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. Physical or biological features that characterize these sites will also be discussed for each ESU separately, but they may include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat designation identified for each ESU contains additional details on the areas included as part of the designation, and the areas that were excluded from designation.

4.3 Chinook Salmon (California Coastal ESU)

The California Coastal Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams south of the Klamath River to the Russian River, California. Seven artificial propagation programs were included in the ESU, however on June 26, 2013, NMFS proposed to remove the artificial propagation programs from the ESU because the artificial propagation programs have been terminated (78 FR 38270). We used information available in the status review (Good et al. 2005), "An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain" (Bjorkstedt et al. 2005), "A framework for assessing the viability of Threatened and Endangered Salmon and Steelhead in the North-central California Coast Recovery Domain" (Spence et al. 2008), listing documents (64 FR 50393; 70 FR 37160), and previously issued biological opinions (NMFS 2008a, 2012b) to summarize the status of the species.

4.3.1 Life History
California Coastal Chinook salmon are a fall-run, ocean-type salmon. A spring-run (river-type) component existed historically, but is now considered extinct (Bjorkstedt et al. 2005). The different populations vary in run timing depending on latitude and hydrological differences between watersheds. Entry of California Coastal Chinook salmon into the Russian River depends on increased flow from fall storms, usually in November to January. Juveniles of this ESU migrate downstream from April through June and may reside in the estuary for an extended period before entering the ocean.

4.3.2 Population Dynamics
Historical estimates of escapement, based on professional opinion and evaluation of habitat conditions, suggest abundance was roughly 73,000 in the early 1960s with the majority of fish spawning in the Eel River. Comparison of historical and current abundance information indicates that independent populations of Chinook salmon are depressed in many basins (Bennett 2005). All spring-run populations once occupying the North Mountain Interior are considered extinct or nearly so. Redd counts in Mattole River in the northern portion of the ESU indicate a small but consistent population; the cooler northern climate likely provides for favorable conditions for these populations. The Eel River interior fall-run populations are severely depressed. Two functionally independent populations are believed to have existed along the southern coastal portion of the ESU; of these two, only the Russian River currently has a run of any significance. This is also the only population with abundance time series. The 2000 to 2007 median observed (at Mirabel Dam) Russian River Chinook salmon run size is 2,991 with a maximum of 6,103 (2003) and a minimum of 1,125 (2008) adults (Cook 2008, Sonoma County Water Agency 2008). The number of spawners has steadily decreased since its high returns in 2003 with 1,963 fish observed in 2007 and 1,125 observed by December 22, 2008.

4.3.3 Status
NMFS listed California Coastal Chinook salmon as threatened on September 16, 1999 (64 FR 50393) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). California Coastal Chinook salmon was listed due to the combined effect of dams that prevent them from reaching spawning habitat, logging, agricultural activities, urbanization, and water withdrawals in the river drainages that support them. This ESU is at considerable risk from population fragmentation and reduced spatial diversity. There is little connectivity between the southern and northern portions of their range. At the southern portion of the ESU, only the Russian River population has had a constant run that exceeded 1,000 adult spawning fish over the last 10 years. This places the ESU at risk from random catastrophic events, chronic stressors, and long-term environmental change. Life history diversity has been significantly reduced by loss of the spring-run race and reduction in coastal populations. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.3.4 Critical Habitat
NMFS designated critical habitat for California Coastal Chinook salmon on September 2, 2005 (70 FR 52488). Specific geographic areas designated include the following CALWATER hydrological units: Redwood Creek, Trinidad, Mad River, Eureka Plain, Eel River, Cape Mendocino, Mendocino Coast and the Russian River. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and

quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The spawning PCE in coastal streams is degraded by years of timber harvest that has produced large amounts of sand and silt in spawning gravel and reduced water quality by increased turbidity. Agriculture and urban areas have impacted rearing and migration PCEs in the Russian River by degrading water quality and by disconnecting the river from it floodplains by the construction of levees. Water management from dams within the Russian and Eel River watersheds maintain high flows and warm water during summer which benefits the introduced predatory Sacramento pikeminnow, which has resulted in excessive predation along migration corridors. Breaches of the sandbar at the mouth of the Russian River result in periodic mixing of salt water which degrades the estuary PCE by altering water quality and salinity conditions that support juvenile physiological transitions between fresh- and salt water. The current condition of PCEs for this ESU indicates that they are not currently functioning or are degraded; these conditions are likely to maintain low population abundances across the ESU.

4.4 Chinook Salmon (Central Valley Spring-run ESU)

The Central Valley spring-run Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Sacramento River and its tributaries in California. Central Valley spring-run Chinook salmon have been extirpated from the San Joaquin River and its tributaries and the American River due to the construction of Friant and Folsom dams, respectively. Naturally spawning populations of Central Valley spring-run Chinook salmon currently are restricted to accessible reaches of the upper Sacramento River, and its tributaries Butte, Deer, and Mill Creeks and limited spawning occurs in the basins of smaller tributaries (California Department of Fish and Game 1998). This ESU includes one artificial propagation program. We used information available in the status review (Good et al. 2005), listing documents (64 FR 50393; 70 FR 37160), the draft recovery plan (NMFS 2009c) and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.4.1 Life History

The Chinook Central Valley ESU is a spring-run, ocean-type salmon. This ESU returns to the Sacramento River between March and July and spawning occurs from late August to early October, with a peak in September. Juveniles of this ESU require cool freshwater while they mature over the summer.

4.4.2 Population Dynamics

The Central Valley drainage as a whole is estimated to have supported spring-run Chinook salmon runs as large as 700,000 fish between the late 1880s and the 1940s (Fisher 1994), although these estimates may reflect an already declining population, in part from the commercial gillnet fishery that occurred for this ESU. Median natural production of spring-run Chinook salmon from 1970 to 1989 was 30,220 fish. In the 1990s, the population experienced a substantial production failure with an estimated natural production ranging between 3,863 and 7,806 fish (with the exception of 1995 which had a natural production of an estimated 35,640 adults) during the years between 1991 and 1997. Numbers of naturally produced fish increased significantly in 1998 to an estimated 48,755 adults and estimated natural production has remained above 10,000 fish since then (USFWS and U.S. Bureau of Reclamation 2007).

The Sacramento River trends show long- and short- term negative trend and negative population growth. Meanwhile, the median production of Sacramento River tributary populations increased from a low of 4,248 with only one year exceeding 10,000 fish before 1998 to a combined natural production of more than 10,000 spring-run Chinook in all years after 1998 (USFWS and U.S. Bureau of Reclamation 2007). Time series data for Mill, Deer, Butte, and Big Chico Creeks spring-run Chinook salmon (through 2006) indicate that all three tributary spring-run Chinook populations experienced population growth. Although the populations are small, Central Valley spring-run Chinook salmon have some of the highest population growth rates of Chinook salmon in the Central Valley.

4.4.3 Status

NMFS originally listed Central Valley spring-run Chinook salmon as threatened on September 16, 1999 (64 FR 50393), and reaffirmed their status on June 28, 2005 (70 FR 37160). This species was listed due to loss of historical spawning habitat, degradation of remaining habitat, and threats to genetic diversity from hatchery salmon. Risks persist to the spatial structure and diversity of the ESU. Only three extant independent populations exist, and they are especially vulnerable to disease or catastrophic events because they are in close proximity. In addition, until there are means to spatially separate the spring-run and fall-run populations in the lower basin of the Feather River, some level of genetic introgression of the races is expected to continue. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.4.4 Critical Habitat

NMFS designated critical habitat for Central Valley spring-run Chinook salmon on September 2, 2005 (70 FR 52488). In total, Central Valley spring-run Chinook salmon occupy 37 watersheds (freshwater and estuarine). The total area of habitat designated as critical includes about 1,100 miles of stream habitat and about 250 square miles of estuarine habitat in the San Francisco-San Pablo-Suisun Bay complex. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Spawning and rearing PCEs are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds which maintained cool and clean water throughout the summer. The rearing PCE is degraded by floodplain habitat being disconnected from the mainstem of larger rivers throughout the Sacramento River watershed, thereby reducing effective foraging. The migration PCE is degraded by lack of natural cover along the migration corridors. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta. Contaminants from agriculture and urban areas have degraded rearing and migration PCEs to the extent that they have lost their functions necessary to serve their intended role to conserve the species. Water quality impairments in the designated critical habitat of this ESU include inputs from fertilizers, insecticides, fungicides, herbicides, surfactants, heavy metals, petroleum products, animal and human sewage, sediment in the form of turbidity, and other anthropogenic pollutants. Pollutants enter the surface waters and riverine sediments as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges. The current condition of PCEs for this ESU indicates they are not currently functioning or are degraded; these conditions are likely to maintain low population abundances across the ESU.

4.5 Chinook Salmon (Lower Columbia River ESU)

This Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from the Columbia River and its tributaries from its mouth at the Pacific Ocean upstream to a transitional point between Washington and Oregon, east of the Hood River and the White Salmon River, and includes the Willamette River to Willamette Falls, Oregon, exclusive of spring-run Chinook salmon in the Clackamas River. Twenty artificial propagation programs are included in the ESU (70 FR 37160; 76 FR 50448). We used information available in status reviews (Good et al. 2005, Ford 2011, NMFS 2011d), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), the recovery plan (NMFS 2013c), listing documents (64 FR 14308; 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.5.1 Life History

Lower Columbia River Chinook salmon have three life history types: early fall run, ocean-type ("tule" salmon); late fall run, stream-type ("bright" salmon); and spring-run, stream-type. Presently, the fall-runs are the predominant life history types, though spring-run Lower Columbia River Chinook salmon were numerous historically.

Both fall-runs of Lower Columbia River Chinook salmon enter fresh water from August through October to spawn in large river mainstems; however, the bright salmon has a delayed entry to spawning grounds and resides in the river for a longer time between river entry and spawning. Tule salmon spawn from late September to November, with peak spawning activity in mid-October and brights spawn from November to January, with peak spawning in mid-November. Most tule salmon remain at sea from one to five years (more commonly three to five years) and return to spawn at two to six years of age. Brights return to fresh water predominately as three- and four-year-olds.

Spring-run Chinook salmon enter fresh water in March through June to spawn in upstream tributaries in August and September. The spring-run Chinook salmon migrates to the sea as yearlings, typically in spring, though some may over-winter in the mainstem Columbia River before outmigrating (Lower Columbia Fish Recovery Board 2010). The natural timing of Lower Columbia River spring-run Chinook salmon emigration is obscured by hatchery releases. Most remain at sea from one to five years (more commonly two to four years) and return to spawn at three to six years of age (Lower Columbia Fish Recovery Board 2010).

4.5.2 Population Dynamics

It is estimated that 31 independent Chinook salmon populations (22 fall- and late fall-runs and nine spring- runs) existed historically in the Lower Columbia River. Of those 31 populations, it is estimated that that eight to 10 historical populations have been extirpated, most of them spring-run populations. Historically, the number of spring-run Chinook salmon returning to the Lower Columbia River may have almost equaled that of fall-run Chinook salmon. However, the majority of spring-run LCR Chinook salmon populations are now extirpated and total returns are substantially lower for the fall-run component in recent years.

Historical records of Chinook salmon abundance are sparse. However, cannery records suggest a peak run of 4.6 million fish (43 million lbs) in 1883 (Lichatowich 1999). Recent trend indicators for most populations are negative. The majority of populations for which data are available have a long-term population growth trend of less than one; indicating the population is not replacing itself and is in decline (Bennett 2005). Only the late-fall run population in Lewis River has an abundance and population trend that may be considered viable. The Sandy River is the only stream system supporting measurable natural production of spring-run Chinook salmon;

however, the population is at risk from low abundance and negative to low population growth rates (productivity) (McElhany et al. 2007).

4.5.3 Status

NMFS listed Lower Columbia River Chinook salmon as threatened on March 24, 1999 (64 FR 14308) and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). This ESU was listed due to the combined effect of dams that reduce access to spawning habitat, logging, agricultural activities, urbanization, threats to genetic diversity from hatchery salmon, and overexploitation. Though the basin-wide spatial structure has remained generally intact, the loss of about 35 percent of historical habitat has affected distribution within several Columbia River subbasins. The ESU is at risk from generally low abundances in all but one population, combined with most populations having a negative or stagnant long-term population growth. Though fish from conservation hatcheries do help to sustain several LCR Chinook salmon runs in the short-term, hatchery production is unlikely to result in sustainable wild populations in the long-term. Further, the genetic diversity of all populations (except the late fall-run) has been eroded by large hatchery influences. Having only one population that may be viable puts the ESU at considerable risk from environmental stochasticity and random catastrophic events. The near-loss of the spring-run life history type limits the ESU's ability to maintain its fitness in the face of environmental change. Based on these factors, this ESU would likely have a moderate (late fall-run salmon in Lewis River) to low (all other populations) resilience to additional perturbations.

4.5.4 Critical Habitat

NMFS designated critical habitat for LCR Chinook salmon on September 2, 2005 (70 FR 52630). It includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Hood Rivers as well as specific stream reaches in a number of tributary subbasins. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Timber harvest, agriculture, and urbanization have degraded spawning and rearing PCEs by reducing floodplain connectivity and water quality, and by removing natural cover in several rivers. Hydropower development projects have reduced timing and magnitude of water flows, thereby altering the water quantity needed to form and maintain physical habitat conditions and support juvenile growth and mobility. Adult and juvenile migration PCEs are affected by several dams along the migration route.

4.6 Chinook Salmon (Upper Columbia River Spring-run ESU)

The Upper Columbia River spring-run Chinook salmon ESU includes all naturally spawned populations of Chinook salmon in all river reaches accessible to Chinook salmon in Columbia River tributaries upstream of Rock Island Dam and downstream of Chief Joseph Dam in Washington, excluding the Okanogan River. Six artificial propagation programs are part of this ESU. We used information available in status reviews (Good et al. 2005, Ford 2011, NMFS 2011m), listing documents (63 FR 11482; 64 FR 14308; 70 FR 37160), the recovery plan (Upper Columbia Salmon Recovery Board 2007), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.6.1 *Life History*

Upper Columbia River spring-run salmon are a stream-type salmon. Salmon in this ESU return to the upper Columbia tributaries from April through July, with the run peaking in mid-May. Spawning occurs in the late summer, peaking in mid- to late August. Juvenile spring-run Chinook salmon spend a year in fresh water before emigrating to salt water in the spring of their second year. Most returning adults are four- and five-year-old fish that have spent two and three years at sea, respectively.

4.6.2 *Population Dynamics*

The ESU historically consisted of four populations; of these, one is now extinct. Spawning escapements have declined within all extant populations (in Wenatchee, Entiat, and Methow rivers) since 1958. In the most recent five-year geometric mean (1997 to 2001), spawning escapement for naturally produced fish was 273 for the Wenatchee population, 65 for the Entiat population, and 282 for the Methow population, only eight to 15 percent of the minimum abundance thresholds, though escapement did increase substantially in 2000 and 2001 in all three river systems. Based on 1980 to 2004 returns, the average annual growth rate for this ESU is estimated at 0.93 (meaning the population is not replacing itself) (Fisher and Hinrichsen 2006). Assuming that population growth rates were to continue at 1980 to 2004 levels, Upper Columbia River spring-run Chinook salmon populations are projected to have very high probabilities of decline within 50 years.

4.6.3 *Status*

NMFS listed Upper Columbia River Spring-run Chinook salmon as endangered on March 24, 1999 (64 FR 14308), and reaffirmed their endangered status on June 28, 2005 (70 FR 37160). The ESU was listed due to the combined effects of dams that prevent them from reaching spawning habitat; habitat degradation from irrigation diversions, hydroelectric development, livestock grazing, and urbanization; and reduced genetic diversity from artificial propagation efforts. The Interior Columbia Basin Technical Review Team characterizes the spatial structure risk to Upper Columbia River Spring-run Chinook populations as “low” or “moderate” and the diversity risk as “high” (Interior Columbia Technical Review Team 2008a, b, c). The high risk is a result of reduced genetic diversity from homogenization of populations that occurred under the Grand Coulee Fish Maintenance Project in 1939 to 1943. Abundance data showed an increase in spawner returns in 2000 and 2001, though this increase was not sustained in subsequent years. Population viability analyses for this species (using the Dennis Model) suggest that these Chinook salmon face a significant risk of extinction: a 75 to 100 percent probability of extinction within 100 years (given return rates for 1980 to present). Based on these factors, this ESU would likely have a very low resilience to additional perturbations.

4.6.4 *Critical Habitat*

NMFS designated critical habitat for Upper Columbia River spring-run Chinook salmon on September 2, 2005 (70 FR 52630). The designation includes all Columbia River estuaries and river reaches upstream to Chief Joseph Dam and several tributary subbasins. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Spawning and rearing PCEs are somewhat degraded in tributary systems by urbanization, grazing, irrigation, and diversion. These activities have resulted in excess erosion of fine sediment and silt that smother spawning gravel and reduction in flow necessary for successful incubation, formation of physical rearing conditions, and juvenile mobility. Moreover siltation further affects critical habitat by reducing water quality through contaminated agricultural runoff; and removing natural cover. Adult and juvenile migration PCEs are heavily degraded by Columbia River Federal dam projects and a number of mid-Columbia River Public Utility District dam projects also obstruct the migration corridor.

4.7 Chinook Salmon (Puget Sound ESU)

The Puget Sound Chinook salmon ESU includes all naturally spawned populations of Chinook salmon from rivers and streams flowing into Puget Sound from the North Fork Nooksack River to the Elwha River on the Olympic Peninsula in Washington. Thirty-six hatchery populations were included as part of the ESU and five were considered essential for recovery and listed (spring-run salmon from Kendall Creek, North Fork Stillaguamish River, White River, and Dungeness River, and fall-run salmon from the Elwha River). On June 26, 2013, NMFS proposed to change the number of artificial propagation considered to be part of the ESU to 27 (78 FR 38270). We used information available in the status review (Good et al. 2005), "Independent populations of Chinook salmon in Puget Sound" (Ruckelshaus et al. 2006), listing documents (63 FR 11482; 64 FR 14308; 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.7.1 Life History

Chinook salmon in this area generally have an "ocean-type" life history. Puget Sound populations include both early-returning (August) and late-returning (mid-September to October) Chinook salmon spawners (Healey 1991). However, within these generalized life histories, significant variation occurs in residence time in fresh water and estuarine environments. For example, Hayman et al. (1996) described three juvenile Chinook salmon life histories with varying residency times in the Skagit River system in northern Puget Sound. Puget Sound Chinook salmon generally return to freshwater habitats as three- to four-year-olds.

4.7.2 Population Dynamics

This ESU has lost 16 spawning aggregations (nine from the early fall-run type) that were either independent historical populations or major components of the remaining 22 existing independent historical populations identified. The disproportionate loss of early-run life history diversity represents a significant loss of the evolutionary legacy of the historical ESU. Estimates of the historic abundance range from 1,700 to 51,000 potential Puget Sound Chinook salmon spawners per population. During the period from 1996 to 2001, the geometric mean of natural spawners in populations of Puget Sound Chinook salmon ranged from 222 to just over 9,489 fish. Long-term trends in abundance and median population growth rates for naturally spawning populations indicate that approximately half of the populations are declining and the other half are increasing in abundance over the length of available time series. However, the median overall long-term trend in abundance indicates that most of these populations are barely replacing themselves. Eight of 22 populations are declining over the short-term, compared to 11 or 12 populations that have long-term declines. Populations with the greatest long-term population growth rates are the North Fork Nooksack and White rivers.

4.7.3 Status

NMFS listed Puget Sound Chinook salmon as threatened in 1999 (64 FR 14308) and reaffirmed its status as threatened on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming, forest practices, agricultural practices, and urbanization; reduced genetic diversity from artificial propagation efforts; and overharvest. The spatial structure of the ESU is compromised by extinct and weak populations being disproportionably distributed to the mid- to southern Puget Sound and the Strait of Juan de Fuca. A large portion (at least 11) of the extant runs is sustained, in part, through artificial propagation. Of the populations with greater than 1,000 natural spawners, only two have a low fraction of hatchery fish. This places the ESU at risk from random catastrophic events, chronic stressors, and long-term environmental change. Life history diversity has been significantly reduced by the disproportionate loss of the early fall-run life history. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.7.4 Critical Habitat

NMFS designated critical habitat for Puget Sound Chinook salmon on September 2, 2005 (70 FR 52630). Specific geographic area include portions of the Nooksack River, Skagit River, Sauk River, Stillaguamish River, Skykomish River, Snoqualmie River, Lake Washington, Green River, Puyallup River, White River, Nisqually River, Hamma Hamma River and other Hood Canal watersheds, the Dungeness/Elwha Watersheds, and nearshore marine areas of the Strait of Georgia, Puget Sound, Hood Canal and the Strait of Juan de Fuca. PCEs include freshwater spawning sites, freshwater rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. Forestry practices have heavily impacted migration, spawning, and rearing PCEs in the upper watersheds of most rivers systems within critical habitat designated for the Puget Sound Chinook salmon. Degraded PCEs include reduced conditions of substrate supporting spawning, incubation and larval development caused by siltation of gravel; and degraded rearing habitat by removal of cover and reduction in channel complexity. Urbanization and agriculture in the lower alluvial valleys of mid- to southern Puget Sound and the Strait of Juan de Fuca have reduced channel function and connectivity, reduced available floodplain habitat, and affected water quality. Thus, these areas have degraded spawning, rearing, and migration PCEs. Hydroelectric development and flood control also obstruct Puget Sound Chinook salmon migration in several basins. The most functional PCEs are found in northwest Puget Sound: the Skagit River basin, parts of the Stillaguamish River basin, and the Snohomish River basin where federal land overlap with critical habitat designated for the Puget Sound Chinook salmon. However, estuary PCEs are degraded in these areas by reduction in the water quality from contaminants, altered salinity conditions, lack of natural cover, and modification and lack of access to tidal marshes and their channels.

4.8 Chinook Salmon (Sacramento River Winter-run ESU)

The Sacramento River winter-run Chinook salmon ESU includes all naturally spawned populations of winter-run Chinook salmon entering and using the Sacramento River system in the Central Valley, California. The ESU now consists of a single spawning population. Two hatchery populations were included as part of the ESU, however on June 26, 2013, NMFS proposed that one artificial propagation program be removed from the ESU, as the program has been terminated (78 FR 38270). We used information available in status reviews (Good et al.

2005, NMFS 2011h), listing documents (54 FR 32085, 55 FR 10260, 69 FR 33102, 70 FR 37160), the draft recovery plan (NMFS 2009c), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.8.1 Life History

The winter-run Chinook salmon have characteristics of both stream- and ocean-type life histories. Adults enter fresh water in winter or early spring but delay spawning until late spring (May to June). Fry emerge from the gravel in late June to early July and continue through October (Fisher 1994). Young winter-run Chinook salmon start migrating to sea as early as mid-July with a peak movement over the Red Bluff Diversion Dam in September. Some offspring move downstream as fry while other rear in the upper Sacramento River and move down as smolt. Normally fry have passed the Red Bluff Diversion Dam by October while smolts may pass over the dam until March. Juvenile winter-runs occur in the Delta primarily from November through early May. Winter-run juveniles remain in the Delta until they are from five to 10 months of age, and then begin emigrating to the ocean as early as November and continue through May (Fisher 1994). Returning adults can be between two to six years of age, but the majority return as three-year olds.

4.8.2 Population Dynamics

Construction of Shasta Dams in the 1940s eliminated access to historic spawning habitat for winter-run Chinook salmon. As a result the ESU has been reduced to a single spawning population which is entirely dependent upon the provision of suitably cool water from Shasta Reservoir during periods of spawning, incubation and rearing. Winter-runs may have been as large as 200,000 fish based upon commercial fishery records from the 1870s (Fisher 1994). During the first three years of operation of the counting facility at the Red Bluff Diversion Dam (1967 to 1969), an average of 86,500 winter-run Chinook salmon were counted (California Department of Fish and Game 2009). Critically low levels were reached during the drought of 1987 to 1992 with an absolute bottom of 191 fish counted. The three-year average run size for the period of 1989 to 1991 was 388 fish. The population grew rapidly from the early 1990s to mid-2005; mean run size increased from 1,363 adults before 2000 to 8,470 adults between 2000 and 2006 (USFWS and U.S. Bureau of Reclamation 2007). Abundance has declined in subsequent years (4,461 adults estimated for 2007 and a preliminary estimate between 2,600 to 2,950 adults for 2008), and the 10-year trend in abundance is negative.

4.8.3 Status

The SR winter-run Chinook salmon ESU was first listed as threatened on August 4, 1989 under an emergency rule (54 FR 32085). On January 4, 1994, NMFS reclassified the ESU as an endangered species due to several factors, including: (1) the continued decline and increased variability of run sizes since its listing as a threatened species in 1989; (2) the expectation of weak returns in coming years as the result of two small year classes (1991 and 1993); and (3) continuing threats to the species (59 FR 440). On June 14, 2004, NMFS proposed to reclassify the ESU as threatened (69 FR 33102), but its status as endangered was upheld in the final listing determination on June 28, 2005 (70 FR 37160). Good et al. (2005) found that the SR winter-run Chinook salmon ESU was in danger of extinction. The major concerns of the BRT were that there is only one extant population, and it is spawning outside of its historical range in artificially-maintained habitat that is vulnerable to drought and other catastrophes. Additionally, the ESU is expected to have lost some genetic diversity through bottleneck effects in the late

1980s and early 1990s and hatchery releases may also have affected population genetics. Abundance data showed an increase in spawner returns from 1990s to mid-2005, though this increase was not sustained in subsequent years. The population growth rate for this ESU is negative, indicating the population has been declining and is not self-sustaining. Based on these factors, this ESU would likely have a very low resilience to additional perturbations.

4.8.4 Critical Habitat

NMFS designated critical habitat for this species on June 16, 1993 (58 FR 33212). The designation includes: the Sacramento River from Keswick Dam, Shasta County (river mile 302) to Chipps Island (river mile 0) at the westward margin of the Sacramento-San Joaquin Delta, and other specified estuarine waters. PCEs include specific water temperature criteria, minimum instream flow criteria, and water quality standards. In addition, biological features vital for the ESU include unimpeded adult upstream migration routes, spawning habitat, egg incubation and fry emergence areas, rearing areas for juveniles, and unimpeded downstream migration routes for juveniles. As there is overlap in designated critical habitat for both the Sacramento River Winter-run Chinook salmon and the spring-run Chinook salmon, the conditions of PCEs for both ESUs are similar. Spawning and rearing PCEs are degraded by high water temperature caused by the loss of access to historic spawning areas in the upper watersheds where water maintain lower temperatures. The rearing PCE is further degraded by floodplain habitat disconnected from the mainstems of larger rivers throughout the Sacramento River watershed. The migration PCE is also degraded by the lack of natural cover along the migration corridors. Rearing and migration PCEs are further affected by pollutants entering the surface waters and riverine sediments as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges. Juvenile migration is obstructed by water diversions along Sacramento River and by two large state and federal water-export facilities in the Sacramento-San Joaquin Delta. The current condition of PCEs for the Sacramento River Winter-run Chinook salmon indicates that they are not currently functioning or are degraded. Their conditions are likely to maintain low population abundances across the ESU.

4.9 Chinook Salmon (Snake River Fall-run ESU)

The Snake River (SR) Fall-run Chinook salmon ESU includes all naturally spawned populations of fall-run Chinook salmon in the mainstem Snake River below Hells Canyon Dam; and in the Tucannon River, Grande Ronde River, Imnaha River, Salmon River, and Clearwater River subbasins. Four artificial propagation programs are included in the ESU. We used information available in status reviews (Good et al. 2005, Ford 2011, NMFS 2011i), listing documents (57 FR 14653, 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.9.1 Life History

Prior to dam construction, fall Chinook salmon were primarily ocean-type; however, today both an ocean-type and reservoir-type occur (Connor et al. 2005). Adult ocean-type salmon in the ESU enter the Columbia River in July and August and spawn from October to November. Juveniles emerge from the gravels in March and April of the following year, moving downstream from natal spawning and early rearing areas from June through early autumn. Reservoir-type juveniles overwinter in pools created by dams before migrating to sea; this response is likely due to early development in cooler temperatures which prevents rapid growth.

Phenotypic characteristics have shifted in apparent response to environmental changes from hydroelectric dams (Connor et al. 2005).

4.9.2 Population Dynamics

The SR Fall-run Chinook salmon ESU consists of one extant population that is confined to a small fraction (15 percent) of its historical range. Two populations have been extirpated. Estimated annual returns for the period 1938 to 1949 were at 72,000 fish. By the 1950s, numbers had declined to an annual average of 29,000 fish (Bjornn and Horner 1980). Numbers of SR Fall-run Chinook salmon continued to decline during the 1960s and 1970s as approximately 80 percent of their historic habitat were eliminated or severely degraded by the construction of the Hells Canyon complex (1958 to 1967) and the lower Snake River dams (1961 to 1975). The abundance of natural-origin spawners of the ESU for 2001 (2,652 adults) exceeded 1,000 fish for the first time since counts began at the Lower Granite Dam in 1975. The total spawning escapement into natural areas above Lower Granite Dam has remained relatively high since the rapid increase in the late 1990s. The current 5-year geometric mean total escapement is above 10,000, substantially greater than the 1997−2001 geometric mean reported in the previous BRT review. A relatively high proportion of the estimated spawners are of hatchery origin (78% for the most recent 5-year cycle). However natural-origin returns have also increased substantially over the geometric mean estimates for the 2005 BRT review and the cycle just prior to the 1997 listing decision.

4.9.3 Status

NMFS listed Snake River fall-run Chinook salmon as endangered in 1992 (57 FR 14653), but reclassified their status as threatened on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; forest, agricultural, mining and wastewater management practices; and overharvest. Both long- and short-term trends in natural returns are positive. Productivity is likely sustained largely by a system of small artificial rearing facilities in the lower Snake River Basin. Depending upon the assumptions made regarding the reproductive contribution of hatchery fish, long- and short-term trends in productivity are at or above replacement. Low abundances in the 1990s combined with a large proportion of hatchery derived spawners likely have reduced genetic diversity from historical levels; however, the salmon in this ESU remain genetically distinct from similar fish in other basins. The population remains at a moderate risk of becoming extinct (probability between five and 25 percent in 100 years). Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

4.9.4 Critical Habitat

NMFS designated critical habitat for Snake River fall-run Chinook salmon on December 28, 1993 (58 FR 68543). This critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams. Specific PCEs were not designated in the critical habitat final rule; instead four “essential habitat” categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The “essential features” that characterize these sites include substrate/spawning gravel; water quality, quantity, temperature, velocity; cover/shelter; food; riparian vegetation; space; and safe passage conditions. Hydropower operations and flow management practices have impacted spawning and rearing habitat and migration corridors throughout the ESU's range. The major degraded essential habitat and features include: safe passage for juvenile migration; rearing habitat water quality; and spawning areas with gravel, water quality, cover/shelter, riparian vegetation, and space to support egg incubation and larval growth and development. Water quality impairments in the designated critical habitat are common within the range of this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and riverine sediments from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary; traveling along with contaminated stormwater runoff, aerial drift and deposition, and via point source discharges.

4.10 Chinook Salmon (Snake River Spring/Summer-run ESU)

The SR Spring/Summer-run Chinook ESU includes all naturally spawned populations of spring/summer-run Chinook salmon in the mainstem Snake River and the Tucannon River, Grande Ronde River, Imnaha River, and Salmon River subbasins. Fifteen artificial propagation programs are included in the ESU, however on June 26, 2013, NMFS proposed the number of artificial propagation programs included in the ESU be changed to 11 (78 FR 38270). We used information available in status reviews (Matthews and Waples 1991, Good et al. 2005, NMFS 2011i), Interior Columbia Basin Technical Recovery Team reports (Interior Columbia Technical Review Team 2003), listing documents (57 FR 14653, 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.10.1 Life History

Snake River spring/summer-run Chinook salmon have a stream-type life history. Spring-run salmon of this ESU pass Bonneville Dam beginning in early March to mid-June and spawn from mid- to late August. Summer-run salmon return to the Columbia River from June through August and spawn approximately one month later than spring-run salmon. Summer-run salmon tend to spawn lower in the Snake River drainages than spring-run fish; however, an overlap of summer-run and spring-run spawning areas does occur. In both run types eggs incubate over the winter, and hatch in late winter and early spring of the following year. Juvenile fish mature in fresh water for one year before they migrate to the ocean in the spring of their second year of life. Depending on the tributary and the specific habitat conditions, juveniles may migrate extensively from natal reaches into alternative summer-rearing or overwintering areas. Salmon of this ESU return from the ocean to spawn primarily as four and five year-old fish, after two to three years in the ocean.

4.10.2 Population Dynamics

The Interior Columbia Basin Technical Recovery Team has identified 32 populations in five major population groups (Upper Salmon River, South Fork Salmon River, Middle Fork Salmon River, Grande Ronde/Imnaha, Lower Snake Mainstem Tributaries) for this species. Historic populations above Hells Canyon Dam are considered extinct. The status review reports that total annual salmon production of this ESU may have exceeded 1.5 million adults in the late 1800s. Total (natural plus hatchery origin) returns fell to roughly 100,000 spawners by the late 1960s (Fulton 1968). Abundance of summer run Chinook salmon have increased since low returns in the mid-1990s (lowest run size was 692 fish in 1995). The 1997 to 2008 geometric mean total return for the summer run component at Lower Granite Dam was slightly more than 8,700 fish, compared to the geometric mean of 3,076 fish for the years 1987 to 1996 (Data from the

Columbia Basin Fisheries Agencies and Tribes http://www.fpc.org/). However, over 80 percent of the 2001 return and over 60 percent of the 2002 return originated from hatcheries.

4.10.3 Status

NMFS listed Snake River spring/summer-run Chinook salmon as threatened on April 22, 1992 (57 FR 14653), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; forest, agricultural, mining, and wastewater management practices; overharvest; and artificial propagation. There is no obvious long-term positive trend, though recent trends are approaching one, indicating the population is nearly replacing itself. Risks to individual populations within the ESU may be greater than the extinction risk for the entire ESU due to low levels of annual abundance of individual populations. Multiple spawning sites are accessible and natural spawning and rearing are well distributed within the ESU. However, many spawning aggregates have also been extirpated, which has increased the spatial separation of some populations. The South Fork and Middle Fork Salmon Rivers currently support the bulk of natural production in the drainage. There is no evidence of wide-scale genetic introgression by hatchery populations. The high variability in life history traits indicates sufficient genetic variability within the ESU to maintain distinct subpopulations adapted to local environments. Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

4.10.4 Critical Habitat

NMFS designated critical habitat for Snake River spring/summer-run Chinook salmon on December 28, 1993 (58 FR 68543). This critical habitat encompasses the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to listed Snake River salmon (except reaches above impassable natural falls, and Dworshak and Hells Canyon dams). Specific PCEs were not designated in the critical habitat final rule; instead four “essential habitat” categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The “essential features” that characterize these sites include substrate/spawning gravel; water quality, quantity, temperature, velocity; cover/shelter; food; riparian vegetation; space; and safe passage conditions. Hydropower operations and flow management practices have impacted spawning and rearing habitat and migration corridors in some regions. The Interior Columbia Basin Technical Review Team reports that the Panther Creek population was extirpated because of legacy and modern mining-related pollutants that created a chemical barrier to fish passage. Water quality impairments are common in the range of the critical habitat designated for this ESU. Pollutants such as petroleum products, pesticides, fertilizers, and sediment in the form of turbidity enter the surface waters and riverine bottom substrate from the headwaters of the Snake, Salmon, and Clearwater Rivers to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges.

4.11 Chinook Salmon (Upper Willamette River ESU)

The Upper Willamette River Chinook salmon ESU includes all naturally spawned populations of spring-run Chinook salmon in the Clackamas River and in the Willamette River, and its tributaries, above Willamette Falls, Oregon. Seven artificial propagation programs are included in the ESU, however on June 26, 2013, NMFS proposed to change the number of artificial propagation programs included in the ESU to six (78 FR 38270). We used information available in status reviews (Good et al. 2005, NMFS 2011n), the recovery plan (Oregon Department of Fish and Wildlife and NMFS 2011), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), listing documents (64 FR 14308, 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.11.1 Life History

Upper Willamette River Chinook salmon are a spring-run, stream-type salmon. Adults appear in the lower Willamette River in February, but the majority of the run ascends Willamette Falls in April and May, with a peak in mid- to late May. Present-day salmon ascend the Willamette Falls via a fish ladder. The migration of spring Chinook salmon over Willamette Falls extends into July and August and overlaps with the beginning of the introduced fall-run of Chinook salmon. The adults hold in deep pools over summer and spawn between August to October, with a peak in September. Fry emerge from December to March and juvenile migration varies among three distinct emigration "runs": fry migration in late winter and early spring; sub-yearling (less than one year old) migration in fall to early winter; and yearlings (greater than one year old) migrating in late winter to spring. Sub-yearlings and yearlings rear in the mainstem Willamette River where they also use floodplain wetlands in the lower Willamette River during the winter-spring floodplain inundation period. Fall-run Chinook salmon spawn in the Upper Willamette but are not considered part of the ESU because they are not native. Salmon of this ESU return from the ocean to spawn primarily as four and five year-old fish, after two to three years in the ocean.

4.11.2 Population Dynamics

Historically, this ESU included sizable numbers of spawning salmon in the Santiam River, the middle fork of the Willamette River, and the McKenzie River, as well as smaller numbers in the Molalla River, Calapooia River, and Albiqua Creek. Most natural spring-run Chinook salmon populations of this ESU are likely extirpated or nearly so; the spring-run in the McKenzie River is the only known remaining naturally reproducing population in this ESU. The total abundance of adult spring-run Chinook salmon (hatchery-origin + natural-origin fish) passing Willamette Falls has remained relatively steady over the past 50 years (ranging from approximately 20,000 to 70,000 fish). However, the current abundance is an order of magnitude below the peak abundance levels observed in the 1920s (approximately 300,000 adults). Total number of fish increased during the period from 1996 to 2004 when it peaked at more than 96,000 adult spring-run Chinook salmon passing Willamette Falls. Since then, the run has steadily decreased with only about 14,000 fish counted in 2008, the lowest number since 1960. ESU abundance increased again to about 25,000 adult spring-run Chinook salmon in 2009. Runs consist of a high, but uncertain, fraction of hatchery-produced fish.

4.11.3 Status

NMFS listed Upper Willamette River Chinook salmon as threatened on March 24, 1999 (64 FR 14308) and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of damming; agricultural practices; urbanization; overharvest; and artificial propagation. The McKenzie River population is the only remaining self-sustaining naturally reproducing independent population. The other natural-origin populations in this ESU have very low current abundances, and long- and short-term population trends are negative. The spatial distribution of the species has been reduced by the loss of 30 to 40 percent of the total historic habitat. This loss has restricted spawning to a few areas below dams. Access of fall-run Chinook salmon to the upper Willamette River and the mixing of hatchery stocks within the ESU have threatened the genetic integrity and diversity of the species. Much of the genetic diversity that existed between populations has been homogenized. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.11.4 Critical Habitat

NMFS designated critical habitat for this species on September 2, 2005 (70 FR 52630). Designated critical habitat includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River as well as specific stream reaches in a number of subbasins. PCEs include freshwater spawning and rearing sites, freshwater migration corridors. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The migration PCE is degraded by dams altering migration timing and water management altering the water quantity necessary for mobility and survival. Migration, rearing, and estuary PCEs are also degraded by loss of riparian vegetation and in-stream cover. Pollutants such as petroleum products, fertilizers, pesticides, and fine sediment enter the stream through runoff, point source discharge, drift during application, and non-point discharge where agricultural and urban development occurs. Degraded water quality in the lower Willamette River where important floodplain rearing habitat is present affects the ability of this habitat to sustain its role to conserve the species. The current condition of PCEs identified in this critical habitat indicates that migration and rearing PCEs are not currently functioning or are degraded and impact their ability to serve their intended role for species conservation.

4.12 Chum Salmon (General Overview)

We discuss the distribution, life history, population dynamics, status, and critical habitats of the two species (here we use the word “species” to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed chum salmon species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in status reviews (Johnson et al. 1997, Good et al. 2005), various listing documents, and biological opinions (NMFS 2012b) to summarize the status of the species.

Because their range extends farther along the shores of the Arctic Ocean than other Pacific salmonid, chum salmon have the widest natural geographic and spawning distribution of the Pacific salmonids. Chum salmon have been documented to spawn from Korea and the Japanese island of Honshu, east around the rim of the North Pacific Ocean to Monterey Bay, California.

Historically, chum salmon were distributed throughout the coastal regions of western Canada and the U.S. Presently, major spawning populations occur as far south as Tillamook Bay on the northern Oregon coast.

4.12.1 Life History

In general, North American chum salmon migrate north along the coast in a narrow coastal band that broadens in southeastern Alaska. Chum salmon usually spawn in the lower reaches of rivers during summer and fall. Redds are dug in the mainstem or in side channels of rivers from just above tidal influence to nearly 100 km from the sea. The time to hatching and emergence from the gravel redds are influenced by DO, gravel size, salinity, nutritional conditions, behavior of alevins in the gravel, and incubation temperature (Bakkala 1970, Schroder 1977, Salo 1991).

Chum salmon juveniles use shallow, low flow habitats for rearing that include inundated mudflats, tidal wetlands and their channels, and sloughs. The duration of estuarine residence for chum salmon juveniles are known for only a few estuaries. Observed residence time ranged from four to 32 days, with about 24 days as the most common.

Immature salmon distribute themselves widely over the North Pacific Ocean and maturing adults return to the home streams at various ages, usually at two to five years of age, and in some cases up to seven years (Bigler 1985). This ocean-type migratory behavior contrasts with the stream-type behavior of some other species in the genus Oncorhynchus (e.g., steelhead, coho, and most types of Chinook and sockeye salmon). Stream-type salmonids usually migrate to sea at a larger size, after months or years of freshwater rearing. Thus, survival and growth for juvenile chum salmon depend less on freshwater conditions than on favorable estuarine conditions. Another behavioral difference between chum salmon and other salmonid species is that chum salmon form schools. Presumably, this behavior reduces predation (Pitcher 1986) especially if fish movements are synchronized to swamp predators (Miller and Brannon 1982). All chum salmon are semelparous (i.e., they die after spawning) and exhibit obligatory anadromy (i.e., there are no recorded landlocked or naturalized freshwater populations; they must spend portions of their lives in both salt and freshwater habitats).

Chum salmon feed on a variety of prey organisms depending upon life stage and size. In freshwater Chum salmon feed primarily on small invertebrates; in saltwater, their diet consists of copepods, tunicates, mollusks, and fish.

4.12.2 Population Dynamics
The population dynamics of each chum salmon ESU will be discussed separately, below.

4.12.3 Status
On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the *Protective Regulations for Threatened Salmonid Species* section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed prior to release into the wild.

4.12.4 Critical Habitat
Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At the time of designation, primary constituent elements (PCEs) are identified and include sites necessary to support one or more chum salmon life stage(s). For both ESUs discussed below, PCEs include freshwater spawning, rearing, and migration areas; estuarine and nearshore marine areas free of obstructions; and offshore marine areas with good water quality. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat designation identified for each ESU contains additional details on the areas included as part of the designation, and the areas that were excluded from designation.

4.13 Chum Salmon (Columbia River ESU)
The Columbia River chum salmon ESU includes all naturally spawned populations of chum salmon in the Columbia River and its tributaries in Washington and Oregon. Three artificial

propagation programs are part of the ESU. We used information available in status reviews (Good et al. 2005, Ford 2011, NMFS 2011d), listing documents (63 FR 11774, 64 FR 14508, 70 FR 37160), recovery plans (Lower Columbia Fish Recovery Board 2010, Oregon Department of Fish and Wildlife 2010, NMFS 2013c), "Historical population structure of Pacific salmonids in the Willamette River and Lower Columbia River Basins" (Myers et al. 2006), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.13.1 Life History

Salmon of this ESU return to the Columbia River from mid-October to November and spawning occurs from early November to late December. Adults generally spawn in the lower reaches of rivers, digging redds along the edges of the mainstem and in tributaries or side channels. Some spawning sites are located in areas where geothermally-warmed groundwater or mainstem flow upwells through the gravel. Chum salmon fry emigrate to estuaries from March through May shortly after emergence. Like ocean-type Chinook salmon, juvenile chum salmon rear in estuaries for an extended period (weeks to months) before beginning their long distance oceanic migration, primarily from February to June. The period of estuarine residence is a critical life history phase and plays a major role in determining the size of the subsequent adult run back to fresh water. Chum salmon remain in the North Pacific and Bering Sea for two to six years, with most adults returning to the Columbia River as four-year-olds.

4.13.2 Population Dynamics

Historically, the ESU was composed of 17 populations in Oregon and Washington between the mouth of the Columbia River and the Cascade crest. Of these populations, 15 of them (six in Oregon and nine in Washington) are so depleted that either their baseline probability of persistence is very low or they are extirpated or nearly so. An extensive 2000 survey in Oregon streams supports that chum salmon almost had been extirpated from the Oregon portion of this ESU. Over the last century, Columbia River chum salmon returns have collapsed from hundreds of thousands to just a few thousand per year. Only two populations (Grays River and the Lower Gorge) with any significant spawning remain today, both in Washington. The estimated size of the Lower Gorge population is at 400 to 500 individuals, down from a historical level of greater than 8,900. A significant increase in spawner abundance occurred in 2001 and 2002 to around 10,000 adults. However, spawner surveys indicate that the abundance again decreased to low levels during 2003 through 2008 though the spawner surveys may underestimate abundance since the proportion of tributary and mainstem spawning differ between years and the surveys do not include spawners in the Columbia River mainstem. In the 1980s, estimates of the Grays River population ranged from 331 to 812 individuals. However, the population increased in 2002 to as many as 10,000 individuals. Based on data for number of spawners per river mile, this increase continued through 2003 and 2004. However, fish abundance fell again to less than 5,000 fish during the years 2005 through 2008.

4.13.3 Status

NMFS listed Columbia River chum salmon as threatened on March 25, 1999 (64 FR 14508) and reaffirmed their status on June 28, 2005 (71 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of water withdrawal, conveyance, storage, and flood control; logging and agriculture; mining; urbanization; and overharvest. Much of the historical spatial structure has been lost on both the population and the ESU levels by extirpation (or near-extirpation) of many local stocks and the widespread loss of estuary habitats. Estimates of abundance and trends are available only for the Grays River and Lower Gorge populations, both of which have long- and short-term productivity trends at or below replacement. Limited distribution also increases risk to the ESU from local disturbances. Although hatchery production of chum salmon has been limited and hatchery effects on diversity are thought to have been relatively small, diversity has been greatly reduced at the ESU level because of presumed extirpations and the low abundance in the remaining populations (fewer than 100 spawners per year for most populations). Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.13.4 Critical Habitat

NMFS originally designated critical habitat for Columbia River chum salmon on February 16, 2000 (65 FR 7764); critical habitat was re-designated on September 2, 2005 (70 FR 52630). Designated critical habitat includes areas in the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Lower Cowlitz, and Lower Columbia subbasin and river corridor. PCEs for this ESU and physical or biological features that characterize them are described in Section 3.0.4. Limited information exists on the quality of essential habitat characteristics for this ESU; however, the migration PCE has been significantly impacted by dams obstructing adult migration and access to historic spawning locations and water quality and cover for estuary and rearing PCEs have decreased in quality to the extent that the PCEs are not likely to maintain their intended function to conserve the species.

4.14 Chum Salmon (Hood Canal Summer-run ESU)

The Hood Canal summer-run chum salmon ESU includes all naturally spawned populations in Hood Canal and its tributaries as well as populations in Olympic Peninsula rivers between Hood Canal and Dungeness Bay, Washington. Eight artificial propagation programs are included in the ESU, however on June 26, 2013, NMFS proposed to change the number of artificial propagation programs included in the ESU to four (78 FR 38270). We used information available in status reviews (Good et al. 2005, NMFS 2011g), listing documents (63 FR 11774, 64 FR 14508, 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.14.1 Life History

Salmon of this ESU enter natal rivers from late August until October (Washington Department of Fisheries et al. 1993) and spawning occurs from mid-September through mid-October. Adults generally spawn in low gradient, lower mainstem reaches of natal streams, typically in center channel areas due to the low flows encountered in the late summer and early fall and fry emerge between January and May. After hatching, fry move rapidly downstream to subestuarine habitats where they rear for an average of 23 days before entering the ocean. Summer-run chum salmon seem to have a longer incubation time than fall-run chum salmon in the same streams. Consequently, offspring of summer-run chum salmon have lower average weight and less lipid content than offspring of fall-run chum salmon. Thus, prey availability during their early life history is important for fry survival. Most adult salmon of this ESU return from the ocean to spawn as three- and four-year old fish.

4.14.2 Population Dynamics

Historically, this ESU consisted of two independent populations (the Strait of Juan de Fuca and Hood Canal populations) that, together, contained an estimated 16 stocks (Sands et al. 2007). Of the 16 historic stocks, seven are considered extirpated, primarily from the eastern side of Hood Canal. Of the extant Strait of Juan de Fuca stocks, three spawn in rivers and streams entering the eastern Strait of Juan de Fuca and Admiralty Inlet. The Hood Canal population consists of six extant stocks within the Hood Canal watershed. HC Summer-run chum salmon are part of an extensive rebuilding program developed and implemented in 1992 by state and tribal co-managers. The largest supplemental program occurs at the Big Quilcene River fish hatchery. Reintroduction programs occur in Big Beef (Hood Canal population) and Chimacum (Strait of Juan de Fuca population) creeks. Adult returns for some of the HC Summer-run chum salmon stocks showed modest improvements in 2000, with upward trends continuing in 2001 and 2002. The recent five-year mean abundance is variable among stocks, ranging from one fish to nearly 4,500 fish. Productivity in the last five-year period (2005 to 2009) has been very low, especially compared to the relatively high productivity observed during the five to 10 previous years (1994 to 2004).

4.14.3 Status
NMFS listed Hood Canal summer-run chum salmon as threatened on March 25, 1999 (64 FR 14508), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of water withdrawal, conveyance, storage, and flood control; logging and agriculture; mining; urbanization; overharvest; and artificial propagation. Much of the historical spatial structure and connectivity has been lost on both the population and the ESU levels by extirpation of many local stocks and the widespread loss of estuary and lower floodplain habitats. Long-term trends in productivity are above replacement only for the Quilcene and Union River stocks; however, most stocks remain depressed. The overall trend in spawning abundance is generally stable (meaning adults are replacing themselves) for the Hood Canal population (all natural spawners and natural-origin only spawners) and for the Strait of Juan de Fuca population (all natural spawners). Only the Strait of Juan de Fuca population’s natural-origin only spawners shows a significant positive trend. Estimates of the fraction of naturally spawning hatchery fish exceed 60 percent for some stocks, which indicates that reintroduction programs are supplementing the numbers of total fish spawning naturally in streams. There is also concern that the Quilcene hatchery stock has high rates of straying, and may represent a risk to historical population structure and diversity. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.14.4 Critical Habitat
NMFS designated critical habitat for Hood Canal summer-run chum salmon on September 2, 2005 (70 FR 52630). Designated critical habitat includes the Skokomish River, Hood Canal subbasin, which includes the Hamma Hamma and Dosewallips rivers and others, the Puget Sound subbasin, Dungeness/Elwha subbasin, and nearshore marine areas of Hood Canal and the Strait of Juan de Fuca. This includes a narrow nearshore zone within several Navy security/restricted zones and approximately eight miles of habitat that was unoccupied at the time of the designation (including Finch, Anderson and Chimacum creeks), but has been re-seeded. PCEs for this ESU and physical or biological features that characterize them are described in Section 3.0.4. The spawning PCE is degraded by excessive fine sediment in the gravel and the rearing PCE is degraded by loss of access to sloughs in the estuary and nearshore areas and excessive predation. Low flow in several rivers also adversely affects most PCEs. In estuarine areas, both migration and rearing PCEs of juveniles are impaired by loss of functional

floodplain areas necessary for growth and development of juvenile chum salmon. These degraded conditions likely maintain low population abundances across the ESU.

4.15 Coho Salmon (General Overview)

We discuss the distribution, life history, population dynamics, status, and critical habitats of the four species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed coho salmon species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in status reviews (Good et al. 2005), various listing documents, and biological opinions (NMFS 2012b) to summarize the status of the species.

The species was historically distributed throughout the North Pacific Ocean from central California to Point Hope, Alaska, through the Aleutian Islands, and from the Anadyr River, Russia, south to Hokkaido, Japan.

4.15.1 Life History

Coho salmon exhibit a stream-type life history. Most coho salmon enter rivers between September and February. In many systems, coho salmon wait to enter until fall rainstorms have provided the river with sufficiently strong flows and depth. Coho salmon spawn from November to January, and occasionally into February and March. Some spawning occurs in third-order streams, but most spawning activity occurs in fourth- and fifth-order streams with gradients of three percent or less. After fry emerge in spring, they disperse upstream and downstream to establish and defend territories weak water currents such as backwaters and shallow areas near stream banks. Juveniles rear in these areas during the spring and summer. In early fall juveniles move to river margins, backwater, and pools. During winter juveniles typically reduce feeding activity and growth rates slow down or stop. By March of their second spring, juveniles feed heavily on insects and crustaceans and grow rapidly before smoltification and outmigration (Olegario 2006). Relative to species such as chum salmon, Chinook salmon, and steelhead, coho salmon smolts usually spend a short time (one to three days) in the estuary with little feeding (Thorpe 1994, Miller and Sadro 2003). After entering the ocean, immature coho salmon initially remain in nearshore waters close to the parent stream. North American coho salmon will migrate north along the coast in a narrow coastal band that broadens in southeastern Alaska. During this migration, juvenile coho salmon tend to occur in both coastal and offshore waters.

Along the Oregon/California coast, coho salmon primarily return to rivers to spawn as three-year olds, having spent approximately 18 months rearing in fresh water and 18 months in salt water. In some streams, a smaller proportion of males may return as two-year olds. The presence of two-year old males can allow for substantial genetic exchange between brood years. The relatively fixed three-year life cycle exhibited by female coho salmon limits demographic interactions between brood years. This makes coho salmon more vulnerable to environmental perturbations than other salmonids that exhibit overlapping generations, i.e., the loss of a coho salmon brood year in a stream is less likely than for other Pacific salmon to be reestablished by females from other brood years. All coho salmon are semelparous and anadromous.

Coho salmon feed on a variety of prey organisms depending upon life stage and size. While at sea, coho salmon tend to eat fish including herring, sand lance, sticklebacks, sardines, shrimp and surf smelt. While in estuaries and in fresh water coho salmon are significant predators of Chinook, pink, and chum salmon, as well as aquatic and terrestrial insects. Smaller fish, such as fry, eat chironomids, plecoptera and other larval insects, and typically use visual cues to find their prey.

4.15.2 Population Dynamics

The population dynamics of each Chinook salmon ESU will be discussed separately, below.

4.15.3 Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the *Protective Regulations for Threatened Salmonid Species* section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed prior to release into the wild.

4.15.4 Critical Habitat

Critical habitat will be discussed for each coho salmon ESU separately, below.

4.16 Coho Salmon (Central California Coast ESU)

The Central California Coast coho salmon ESU includes all naturally spawned populations of coho salmon from Punta Gorda in northern California south to and including the San Lorenzo River in central California, as well as populations in tributaries to San Francisco Bay, excluding the Sacramento-San Joaquin River system. The ESU also includes four artificial propagation programs. We used information available in status reviews (Weitkamp et al. 1995, Good et al. 2005, NMFS 2011a, Spence and Williams 2011), “An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain” (Bjorkstedt et al. 2005), listing documents (60 FR 38011; 61 FR 56138; 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.16.1 Life History

Both run and spawn timing of coho salmon in this region are late (both peaking in January) relative to northern populations, with little time spent in fresh water between river entry and spawning. Spawning runs coincide with the brief peaks of river flow during the fall and winter. Most juveniles of this ESU undergo smoltification and start their seaward migration one year after emergence from the redd. Juveniles spending two winters in fresh water have, however, been observed in at least one coastal stream within the range of the ESU. Smolt outmigration generally peaks in April and May (Shapovalov and Taft 1954). In general, coho salmon within California exhibit a three-year life cycle. However, two-year old males commonly occur in some streams.

4.16.2 Population Dynamics

The ESU consisted historically of 11 functionally independent populations and a larger number of dependent populations. One of the two historically independent populations in the Santa Cruz mountains (*i.e.,* south of the Golden Gate Bridge) is extirpated. Coho salmon are considered effectively extirpated from the San Francisco Bay. The Russian River population, once the largest and most dominant source population in the ESU, is now at high risk of extinction because of low abundance and failed productivity. The Lost Coast to Navarro Point to the north contains the majority of coho salmon remaining in the ESU.

Limited information exists on abundance of coho salmon for this ESU. About 200,000 to 500,000 coho salmon were produced statewide in the 1940s. This escapement declined to about 99,000 by the 1960s with approximately 56,000 (56 percent) originating from streams within this ESU. The estimated number of coho salmon produced within the ESU in the late 1980s had further declined to 6,160 (46 percent of the estimated statewide production). Additionally, information on the abundance and productivity trends for the naturally spawning component of this ESU is extremely limited. There are no long-term time series of spawner abundance for individual river systems. Returns increased in 2001 in streams within the northern portion of the ESU; however, returns in 2006/07 and 2007/08 were extremely low (MacFarlane et al. 2008) and about 500 fish returned in 2010 across the entire range. Hatchery raised smolt have been released infrequently but occasionally in large numbers in rivers throughout the ESU. Releases have included transfer of stocks within California and between California and other Pacific states as well as smolt raised from eggs collected from native stocks.

4.16.3 Status

NMFS listed the central California coast coho salmon ESU as threatened on October 31, 1996 (61 FR 56138) and later reclassified their status as endangered on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging, agricultural, and mining activities; urbanization; stream channelization; damming; wetland loss; overharvest; artificial propagation; and prolonged drought and poor ocean conditions. ESU spatial structure has been substantially modified due to lack of viable source populations and loss of dependent populations. Limited information exists on abundance for central California coast coho salmon; therefore, the best data available are presence-absence surveys used as a proxy for abundance changes. At the time of the 1996 listing, coho salmon occurred in 47 percent of streams (62) and were considered extirpated from 53 percent (71) of streams that historically harbored coho salmon within the ESU (Brown et al. 1994). Later reviews have concluded that the number of occupied streams relative to historic has not changed and may actually have declined. Additionally, the low rates of return from 2006 to 2010 suggest that all three year classes are faring poorly across the species' range. Though hatchery salmon have been released, genetic studies show little homogenization of populations (i.e., transfer of stocks between basins) has had little effect on the geographic genetic structure of the ESU (Hedgecock 2002). Salmon in this ESU likely have considerable diversity in local adaptations given that the ESU spans a large latitudinal diversity in geology and ecoregions, and include both coastal and inland river basins. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.16.4 Critical Habitat

NMFS designated critical habitat for central California coast coho salmon on May 5, 1999 (64 FR 24049). Designated critical habitat includes accessible reaches of all rivers (including estuarine areas and tributaries) between Punta Gorda and the San Lorenzo River (inclusive) in California. Critical habitat for this species also includes two streams entering San Francisco Bay: Arroyo Corte Madera Del Presidio and Corte Madera Creek. Specific PCEs were not designated in the critical habitat final rule; instead five "essential habitat" categories were described: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. The "essential features" that characterize these sites include adequate 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover/shelter; 7) food; 8) riparian vegetation; 9) space; and 10) safe passage conditions. NMFS (2008a) evaluated the condition of each habitat feature in terms of its current condition relative to its role and function in the conservation of the species. The assessment of habitat showed a distinct trend of increasing degradation in quality and quantity of all essential features as the habitat progresses south through the species range, with the area from the Lost Coast to the Navarro Point supporting the most favorable habitats and the Santa Cruz Mountains supporting the least. However, all populations are generally degraded regarding spawning and incubation substrate, and juvenile rearing habitat. Elevated water temperatures occur in many streams across the entire ESU.

4.17 Coho Salmon (Lower Columbia River ESU)

The lower Columbia River coho salmon ESU includes all naturally spawned populations of coho salmon in the Columbia River and its tributaries in Oregon and Washington, from the mouth of the Columbia up to and including the Big White Salmon and Hood Rivers, Washington; and the Willamette River to Willamette Falls, Oregon. This ESU includes 25 artificial propagation programs, however on June 26, 2013, NMFS proposed the number of artificial propagation programs included in the ESU be changed to 23 (78 FR 38270). We used information available in status reviews (Johnson et al. 1991, Good et al. 2005, Ford 2011, NMFS 2011d), recovery plans (Lower Columbia Fish Recovery Board 2010, Oregon Department of Fish and Wildlife 2010, NMFS 2013c), "Viability status of Oregon salmon and steelhead populations in the Willamette and lower Columbia basins (McElhany et al. 2007), listing documents (70 FR 37160; 78 FR 2725), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.17.1 Life History

The majority of the Lower Columbia River coho salmon are of hatchery origin. Hatchery runs are currently managed for two distinct runs: early-returning and late-returning. Early-returning coho salmon return to the Columbia River in mid-August and to spawning tributaries in early September, with peak spawning from mid- October to early November. Late-returning coho salmon return from late September through December and enter spawning tributaries from October through January. Most late-returning spawning occurs from November through January. Fry emerge from redds during a three-week period between early March and late July. Juveniles rear in fresh water for a year and smolt outmigration occurs from April through June with a peak in May. Juvenile coho are present in the Columbia River estuary from March to August. In general, salmon of this ESU return to freshwater as three-year-olds.

Analysis of run timing of coho salmon suggests that the Clackamas River population is composed of one late returning population and one early returning population. The late-returning population is believed to be descended from the native Clackamas River population and the early-returning population is believed to descend from hatchery fish introduced from Columbia River populations outside the Clackamas River basin. The naturally produced coho salmon return to spawn between December and March.

4.17.2 Population Dynamics

The ESU historically consisted of 24 independent populations. The vast majority (over 90 percent) of these are either extirpated or nearly so. Of the 24 populations, only two have significant natural production: the Sandy and Clackamas Rivers. Wild coho salmon re-appeared in two additional basins (Scappoose and Clatskanie) after a 10-year period during the 1980s and 1990s when they were largely absent. Prior to 1900, the Columbia River had an estimated annual run of more than 600,000 adults with about 400,000 spawning in the lower Columbia River. By the 1950s, the estimated number of coho salmon returning to the Columbia River had decreased to 25,000 adults (about five percent of historic levels). Massive hatchery releases since 1960 have increased the Columbia River run size. Between 1980 and 1989, the run varied from 138,000 adults to a historic high of 1,553,000 adults. However, only a small portion of these spawned naturally, and available information indicates that the naturally produced portion has continuously declined since the 1950s. The current number of naturally spawning fish during October and late November ranges from 3,000 to 5,500 fish. The majority of these are of hatchery origin. The 1996 to 1999 geometric mean for the late run in the Clackamas River, the only-run which is considered consisting mainly of native coho salmon, was 35 fish. Both long- and short-term trends and median population growth rate for the natural origin (late-run) portion of the Clackamas River coho salmon are negative but with large confidence intervals. The short-term trend for the Sandy River population is close to one, indicating a relatively stable population during the years 1990 to 2002. The long-term trend for this same population shows that the population has been decreasing (trend = 0.54) and there is a 43 percent probability that the median population growth rate was less than one.

4.17.3 Status

NMFS listed Lower Columbia River coho salmon as threatened on June 28, 2005 (70 FR 37160). Lower Columbia River coho salmon have been—and continue to be—affected by habitat degradation, hydropower impacts, harvest, and hatchery production. Out of the 24 populations that make up this ESU, 21 are considered to have a very low probability of persisting for the next 100 years, and none is considered viable. The very low persistence probability for most Lower Columbia River coho salmon populations is related to low abundance and productivity, loss of spatial structure, and reduced diversity. Though data quality has been poor because of inadequate spawning surveys and, until recently, the presence of unmarked hatchery-origin spawners, most populations are believed to have very low abundance of natural-origin spawners (50 fish or fewer). The spatial structure of some populations is constrained by migration barriers (such as tributary dams) and development in lowland areas. Low abundance, past stock transfers, other legacy hatchery effects, and ongoing hatchery straying may have reduced genetic diversity within and among coho salmon populations. It is likely that hatchery effects have also decreased population productivity. The generally poor baseline population status of coho salmon reflects long-term trends: natural-origin coho salmon in the Columbia Basin have been in decline for the last 50 years. Based on these factors, this ESU would likely have very low resilience to additional perturbations.

4.17.4 Critical Habitat

NMFS proposed critical habitat designation of approximately 2,288 miles of freshwater and estuarine habitat in Oregon and Washington on January 14, 2013 (78 FR 2725). A final designation has not been made.

4.18 Coho Salmon (Oregon Coast ESU)

The Oregon Coast coho salmon ESU includes all naturally spawned populations of coho salmon in Oregon coastal streams south of the Columbia River and north of Cape Blanco (63 FR 42587). One hatchery population, the Cow Creek hatchery coho salmon, is considered part of the ESU. We used information available in the status review (Good et al. 2005), “Scientific conclusions of the status review for Oregon coast coho salmon (*Oncorhynchus kisutch*)” (Stout et al. 2012). “Identification of historical populations of coho salmon (*Oncorhynchus kisutch*) in the Oregon

Coast Evolutionarily Significant Unit" (Lawson et al. 2007), listing documents (63 FR 42587; 73 FR 7816), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.18.1 Life History

In general, adults begin to migrate into rivers at the first fall freshet, usually in late October or early November, though there is some variation in run timing among watersheds. A delay in rain can delay river entry considerably. Some coho may spend up to two months in fresh water before spawning. Spawning usually occurs from November through January and may continue into February. Juveniles emerge from the gravel in spring and typically spend a summer and winter in fresh water before migrating to the ocean as smolts, usually in April or May of their second spring. Timing varies between years, among river systems, and based on small-scale habitat variability. Salmon in this ESU generally exhibit a three-year life cycle, though two- year-old males commonly occur in some streams and on average make up 20 percent of spawning males.

4.18.2 Population Dynamics

Lawson et al. (2007) considered the ESU to have historically consisted of 13 functionally independent populations and eight potentially dependent populations. Historical escapement in the 10 largest basins has been estimated to about 2.4 to 2.9 million spawners. The estimated median population of native spawners during the years 1990 to 1999 was 46,291 (min. 21,139, max. 82,661) spawners. After 1999, total ESU abundance increased. A median of 186,769 native spawners was estimated for the period 2000 through 2012 (min. 66,271, max. 356,243) (Oregon Department of Fish and Wildlife 2013). The encouraging increases in spawner abundance in 2000 to 2002 were preceded by three consecutive brood years (the 1994 to 1996 brood years returning in 1997 to 1999, respectively) exhibiting recruitment failure.[2] At the time of the 2005 status report, these three years of recruitment failure were the only such instances observed in the abundance time series since 1950. The increases in natural spawner abundance from 2000 to 2002 increases were primarily observed in populations in the northern portion of the ESU. Despite the increase in spawner abundance in 2000 to 2002, the long-term trends in ESU productivity remained negative due to the low abundances observed during the 1990s. Recent data indicate that the total abundance of natural spawners in the OC coho salmon ESU again steadily decreased until 2007 with an estimated spawner abundance of 66,271 fish or approximately 25 percent of the 2002 peak abundance (258,418 spawners) (Oregon Department of Fish and Wildlife 2013). Thus, recruitment failed during the five years from 2002 through 2007. Abundance increased each year from 179,686 native spawners in 2008 to the highest recorded abundance of native spawners in the time series: 356,243 native spawners in 2012; however, abundance in 2012 was estimated at 99,142 native spawners, indicating another recruitment failure.

4.18.3 Status

NMFS listed the Oregon coast coho salmon as a threatened species on February 11, 2008 (73 FR 7816). The ESU was listed because its biological status had not improved since NMFS's January 19, 2006 determination that the ESU's listing was not warranted (71 FR 3033) and current efforts being made to protect the species did not provide sufficient certainty of implementation or

[2] Recruitment failure is when a given year class of natural spawners fails to replace itself when its offspring return to the spawning grounds three years later.

effectiveness to mitigate the assessed level of extinction risk. Current coho salmon coastal distribution has not changed markedly compared to historical distribution; however, river alterations and habitat destruction have significantly modified use and distribution within several river basins. Genetic diversity has been reduced by legacy effects of freshwater and tidal habitat loss, very low spawner returns within the past 20 years, and past high levels of hatchery releases; however, with recent reductions in hatchery releases, diversity should improve. Based on these factors, this ESU would likely have a moderate resilience to additional perturbations.

4.18.4 Critical Habitat

NMFS designated critical habitat for Oregon Coast coho salmon on February 11, 2008 (73 FR 7816). The designation includes 72 of 80 watersheds within the range of the ESU, totals approximately 6,600 stream miles, and includes all or portions of the Nehalem, Nestucca/Trask, Yaquina, Alsea, Umpqua, and Coquille basins. PCEs include: spawning sites with water and substrate quantity to support spawning, incubation, and larval development; freshwater rearing sites with water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth, foraging, behavioral development (e.g., predator avoidance, competition), and mobility; freshwater migratory corridors free of obstruction with adequate water quantity and quality conditions; and estuarine, nearshore and offshore areas free of obstruction with adequate water quantity, quality and salinity conditions that support physiological transitions between fresh- and saltwater, predator avoidance, foraging and other life history behaviors.

PCEs vary widely throughout the critical habitat area designated the ESU; many watersheds have been heavily impacted and support low quality PCEs, while habitat in other watersheds have sufficient quality for supporting the conservation purpose of designated critical habitat. The spawning PCE has been impacted in many watersheds from the inclusion of fine sediment into spawning gravel from timber harvest and forestry related activities, agriculture, and grazing. These activities have also diminished the channels' rearing and overwintering capacity by reducing the amount of large woody debris in stream channels, removing riparian vegetation, disconnecting floodplains from stream channels, and changing the quantity and dynamics of stream flows. The rearing PCE has been degraded by elevated water temperatures in 29 of the watersheds within the Nehalem, North Umpqua, and the inland watersheds of the Umpqua subbasins. Water quality is impacted by contaminants from agriculture and urban areas in low lying areas in the Umpqua subbasin, and in coastal watersheds within the Siletz/Yaquina, Siltcoos, and Coos subbasins. Reductions in water quality have been observed in 12 watersheds due to contaminants and excessive nutrition. The migration PCE has been impacted throughout the ESU by culverts and road crossings that restrict passage.

4.19 Coho Salmon (Southern Oregon/Northern California Coast ESU)

The Southern Oregon/Northern California Coast coho salmon ESU consists of all naturally spawning populations of coho salmon that reside below long-term, naturally impassible barriers in streams between Punta Gorda, California and Cape Blanco, Oregon. This ESU also includes three artificial propagation programs. We used information available in status reviews (Good et al. 2005, NMFS 2011l, Williams et al. 2011), the draft recovery plan (NMFS 2012d), listing documents (62 FR 24588; 70 FR 37160), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.19.1 Life History

In this ESU, river entry occurs earlier in the north and later in the south. In Oregon, salmon of this ESU enter rivers in September or October; south of the Klamath River Basin to the Mattole River, California salmon entry occurs in November and December; and river entry occurs from mid-December to mid-February in rivers farther south. Because coho salmon enter rivers late and spawn late south of the Mattole River, they spend much less time in the river prior to spawning compared to populations farther north. Juveniles emerge from the gravel in spring, and typically spend a summer and winter in fresh water before migrating to the ocean as smolts in their second spring. Coho salmon adults spawn at age three, spending about a year and a half in the ocean.

4.19.2 Population Dynamics

Data on population abundance and trends are limited for this ESU. Historical point estimates of coho salmon abundance for the early 1960s and mid-1980s suggest that California statewide coho spawning escapement in the 1940s ranged between 200,000 and 500,000 fish. Numbers declined to about 100,000 fish by the mid-1960s with about 43 percent originating from this ESU. In 1994, Brown et al. estimated that about 7,000 wild and naturalized coho salmon were produced in the California portion of this ESU. Though long-term data on salmon abundance are scarce, the available monitoring data indicate that spawner abundance has generally declined for populations in this ESU. The Shasta River population has declined in abundance by almost 50 percent from one generation to the next; two partial counts from Prairie Creek, a tributary of Redwood Creek, and Freshwater Creek, a tributary of Humboldt Bay show negative trends; and data from the Rogue River basin also show recent negative trends. Estimates from Huntley Park in the Rogue River basin show a strong return year of approximately 25,000 spawners in 2004, followed by a decline to 2,566 fish in 2009. The 12-year average estimated wild adult coho salmon in the Rogue River basin between 1998 and 2009 (excluding 2008)[3] is 8,050 fish. Based on extrapolations from cannery pack, the Rogue River had an estimated adult coho salmon abundance of 114,000 in the late 1800s (Meengs and Lackey 2005).

4.19.3 Status

NMFS listed the Southern Oregon/Northern California coast coho salmon as threatened on May 7, 1997 (62 FR 24588), and reaffirmed their status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging, agricultural, and mining activities; road building; urbanization; stream channelization; damming; wetland loss; beaver trapping, water withdrawals; overharvest; drought; flooding; poor ocean conditions and El Niño; and artificial propagation. Though distribution has been reduced and fragmented within the ESU, extant populations can still be found in all major river basins within the ESU. Presence-absence data indicate a disproportionate loss of southern populations compared to the northern portion of the ESU. Though long-term data on salmon abundance are scarce, the available monitoring data indicate that spawner abundance has generally declined for populations in this ESU. Many populations have been extirpated, are near extirpation, or are severely depressed. Based on available data, the draft recovery plan (NMFS 2012d) concluded that this ESU is at high risk of extinction and is not viable. Based on these factors, this ESU would likely have a very low resilience to additional perturbations.

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[3] 2008 data were excluded from the average because the extremely low numbers were not consistent with that seen upstream at Gold Ray Dam, suggesting other reasons (sampling issues, data errors, etc.) for the dramatic drop in fish numbers from 2007 to 2008.

4.19.4 Critical Habitat

NMFS designated critical habitat for Southern Oregon/Northern California Coast coho salmon on May 5, 1999 (64 FR 24049). Designated critical habitat includes all accessible river reaches between Cape Blanco, Oregon, and Punta Gorda, California and consists of the water, substrate, and river reaches (including off-channel habitats) in specified areas. Accessible reaches are those within the historical range of the ESU that can still be occupied by any life stage of coho salmon. Specific PCEs were not designated in the critical habitat final rule; instead five "essential habitat" categories were described: 1) juvenile summer and winter rearing areas; 2) juvenile migration corridors; 3) areas for growth and development to adulthood; 4) adult migration corridors; and 5) spawning areas. The "essential features" that characterize these sites include adequate: 1) substrate; 2) water quality; 3) water quantity; 4) water temperature; 5) water velocity; 6) cover/shelter; 7) food; 8) riparian vegetation; 9) space; and 10) safe passage conditions. Critical habitat designated for this ESU is generally of good quality in northern coastal streams. Spawning essential habitats have been degraded throughout the ESU by logging activities that have increased fine particles in spawning gravel. Rearing essential habitats have been considerably degraded in many inland watersheds from the loss of riparian vegetation resulting in unsuitably high water temperatures. Rearing and juvenile migration essential habitat quality has been reduced from the disconnection of floodplains and off-channel habitat in low gradient reaches of streams, consequently reducing winter rearing capacity.

4.20 Sockeye Salmon (General Overview)

We discuss the distribution, life history, population dynamics, status, and critical habitats of the two species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed sockeye salmon species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across ESUs. We used information available in the status review (Good et al. 2005), various listing documents, and biological opinions (NMFS 2012b) to summarize the status of the species.

Sockeye salmon occur in the North Pacific and Arctic oceans and associated freshwater systems. In North America, the species ranges north from the Klamath River in California to Bathurst Inlet in the Canadian Arctic. In Asia sockeye salmon range from northern Hokkaido in Japan north to the Anadyr River in Siberia. The largest populations occur north of the Columbia River.

4.20.1 Life History

Most sockeye salmon exhibit a lake-type life history (i.e., they spawn and rear in or near lakes), though some salmon exhibit a river-type life history. Spawning generally occurs in late summer and fall, but timing can vary greatly among populations. In lakes, salmon commonly spawn along "beaches" where underground seepage provides fresh oxygenated water. Incubation is a function of water temperature, but generally lasts between 100 to 200 days (Burgner 1991). Sockeye salmon fry primarily rear in lakes; river-emerged and stream-emerged fry migrate into lakes to rear. Juvenile sockeye salmon generally rear in lakes from one to three years after emergence, though some river-spawned salmon may migrate to sea in their first year. Juvenile sockeye salmon feeding behaviors change as they transition through life stages after emergence to the time of smoltification. In the early fry stage from spring to early summer, juveniles forage exclusively in the warmer littoral (i.e., shoreline) zone where they depend mostly on fly larvae and pupae, copepods, and water fleas. In summer, underyearling sockeye salmon move from the littoral habitat to a pelagic (i.e., open water) existence where they feed on larger zooplankton; however, flies may still make up a substantial portion of their diet. Older and larger fish may also prey on fish larvae. Distribution in lakes and prey preference is a dynamic process that changes daily and yearly depending on many factors, including: water temperature; prey abundance; presence of predators and competitors; and size of the juvenile. Peak emigration to the ocean occurs in mid-April to early May in southern sockeye populations (lower than 52ºN latitude) and as late as early July in northern populations (62ºN latitude) (Burgner 1991). Adult sockeye salmon return to their natal lakes to spawn after spending one to four years at sea. The diet of adult salmon consists of amphipods, copepods, squid, and other fish.

Certain populations of *O. nerka* become resident in the lake environment and are referred to as "kokanee". Kokanee and sockeye often co-occur in many interior lakes, where access to the sea is possible but energetically costly; kokanee are rarely found in coastal lakes, where the migration to sea is relatively short and energetic costs are minimal. In some cases a single population will give rise to both the anadromous and freshwater life history form. Both sockeye and kokanee are semelparous.

4.20.2 Population Dynamics

The population dynamics of each sockeye salmon ESU will be discussed separately, below.

4.20.3 Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the *Protective Regulations for Threatened Salmonid Species* section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed prior to release into the wild.

4.20.4 Critical Habitat

Critical habitat for each sockeye salmon ESU is discussed separately, below.

4.21 Sockeye Salmon (Ozette Lake ESU)

The Ozette Lake sockeye salmon ESU includes all naturally spawned anadromous populations of sockeye salmon that migrate into and rear in in Ozette Lake, Ozette River, Coal Creek, and other tributaries flowing into Ozette Lake, near the northwest tip of the Olympic Peninsula in Olympic National Park, Washington. Composed of only one population, the Ozette Lake sockeye salmon ESU consists of five spawning aggregations or subpopulations, grouped according to their spawning locations: Umbrella and Crooked creeks, Big Rive, and Olsen's and Allen's beaches. Two artificial populations are also considered part of this ESU. Sockeye salmon stock reared at the Makah Tribe's Umbrella Creek Hatchery were included in the ESU, but were not considered essential for recovery of the ESU. However, once the hatchery fish return and spawn in the wild, their progeny are considered to be listed under the ESA. We used information available in status reviews (Good et al. 2005, NMFS 2011f), the recovery plan (NMFS 2009d), "Viability Criteria for the Lake Ozette Sockeye Salmon Evolutionarily Significant Unit" (Rawson et al. 2009), listing documents (63 FR 11750, 64 FR 14528), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.21.1 Life History

Salmon of this ESU enter Ozette Lake through the Ozette River from April to early August and spawning is delayed until late October to February. Spawning occurs primarily in lakeshore upwelling areas of the lake, though minor spawning may occur below the lake in the Ozette River or its tributary, Coal Creek. Native sockeye salmon do not presently spawn in tributary streams to Ozette Lake, though spawning may have occurred there historically. Hatchery salmon, however, do spawn in the Ozette Lake tributaries of Umbrella Creek and Big River. Fry in Ozette Lake and the tributaries emerge from late-February through May and disperse to open areas of the lake to rear. Juveniles rear for one year in the lake and emigrate seaward in their second spring. At the time of emigration, smolts are relatively large, averaging four and a half to five inches in length. Most adult salmon of this ESU return from the ocean to spawn as four-year old fish. Ozette Lake also supports a population of kokanee which is not listed under the ESA.

4.21.2 Population Dynamics

The Ozette Lake sockeye salmon ESU is composed of one historical population with multiple spawning aggregations. Historically at least four beaches in the lake were used for spawning; today only two beach spawning locations, Allen's and Olsen's beaches, are used. The historical abundance of Ozette Lake sockeye salmon is poorly documented, but may have been as high as 50,000 individuals (Blum 1988). Declines began to be reported in the 1920s. Escapement estimates (run size minus broodstock take) from 1996 to 2006 are variable and range from a low of 1,404 individuals in 1997 to a high of 6,461 individuals in 2004, with a median of approximately 3,800 sockeye per year (geometric mean: 3,353). No statistical estimation of trends for this ESU are reported. However, comparing four year averages (to include four brood years in the average because the species primarily spawn as four-year olds) shows an increase during the period 2000 to 2006. For return years 1996 to 1999 the run size averaged 2,460 sockeye salmon; for years 2000 to 2003 the run size averaged just over 4,420 fish; and for years 2004 to 2006, the average abundance estimate was 4,167 sockeye. The supplemental hatchery program began with out-of-basin stocks and make up an average of 10 percent of the run. The proportion of beach spawners originating from the hatchery is unknown, but it is likely that straying is low. Based on estimates of habitat carrying capacity, a viable sockeye salmon population in the Lake Ozette watershed would range between 35,500 to 121,000 spawners.

4.21.3 Status

NMFS listed the Ozette Lake sockeye salmon ESU as threatened on March 25, 1999 (64 FR 14528), and reaffirmed their threatened status on June 28, 2005 (70 FR 37160). The ESU was listed due to habitat loss and degradation from the combined effects of logging; road building; predation; invasive plant species; and overharvest. Ozette Lake sockeye salmon have not been commercially harvested since 1982 and only minimally harvested by the Makah Tribe since 1982 (0 to 84 fish per year); there are also no known marine area harvest impacts to fish of this ESU. Overall abundance is substantially below historical levels and it is not known if this decrease in abundance is a result of fewer spawning aggregations, lower abundances at each aggregation, or a combination of both factors. The proportion of beach spawners is assumed to be low; therefore, hatchery originated fish are not believed to have had a major effect on the genetics of the naturally spawned population. However, Ozette Lake sockeye have a relatively low genetic diversity compared to other *O. nerka* populations examined in Washington State (Crewson et al. 2001). Genetic differences do occur between age cohorts, but as different age groups do not spawn with each other, the population may be more vulnerable to significant reductions in population structure due to catastrophic events or unfavorable conditions affecting one year class. Based on these factors, this ESU would likely have a low resilience to additional perturbations.

4.21.4 Critical Habitat

NMFS designated critical habitat for Ozette Lake sockeye salmon on September 2, 2005 (70 FR 52630). It encompasses areas within the Hoh/Quillayute subbasin, Ozette Lake, and the Ozette Lake watershed. The entire occupied habitat for this ESU is within the single watershed for Ozette Lake. PCEs identified for Lake Ozette sockeye salmon are areas for spawning, freshwater rearing and migration, estuarine areas free of obstruction, nearshore marine areas free of obstructions, and offshore marine areas with good water quality. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, and adequate passage conditions. Spawning habitat has been affected by loss of tributary spawning areas and exposure of much of the available beach spawning habitat due to low water levels in summer. Further, native and non-native vegetation as well as sediment have reduced the quantity and suitability of beaches for spawning. The rearing PCE is degraded by excessive predation and competition with introduced non-native species, and by loss of tributary rearing habitat. Migration habitat may be adversely affected by high water temperatures and low water flows in summer which causes a thermal block to migration (La Riviere 1991).

4.22 Sockeye Salmon (Snake River ESU)

The Snake River sockeye salmon ESU includes all anadromous and residual sockeye from the Snake River basin, Idaho, as well as artificially propagated sockeye salmon from the Redfish Lake Captive Broodstock Program. Redfish Lake is located in the Salmon River basin, a subbasin within the larger Snake River basin. We used information available in status reviews (Gustafson et al. 1997, Good et al. 2005, NMFS 2011i), listing documents (58 FR 68543, 70 FR 37160), and previously issued biological opinions (NMFS 2008b, 2012b) to summarize the status of the species.

4.22.1 Life History

Snake River sockeye salmon are unique compared to other sockeye salmon populations. Sockeye salmon returning to Redfish Lake travel a greater distance from the sea (approximately 900 miles) to a higher elevation (6,500 ft) than any other sockeye salmon population and are the southern-most population of sockeye salmon in the world (Bjornn et al. 1968). Salmon of this ESU are separated by 700 or more river miles from two other extant upper Columbia River populations in the Wenatchee River and Okanogan River drainages. These latter populations return to lakes at substantially lower elevations (Wenatchee at 1,870 ft, Okanagon at 912 ft) and occupy different ecoregions.

No natural origin anadromous adults have returned since 1998 and the species is currently entirely supported by adults produced through a captive propagation program. Historically, salmon of this ESU entered the Columbia River system in June and July, and arrived at Redfish Lake between August and September. Spawning occurred in lakeshore gravel and generally peaked in October. Fry emerged in the spring (generally April and May) then migrated to open waters of the lake to feed. Juvenile sockeye remained in the lake for one to three years before migrating through the Snake and Columbia Rivers to the ocean. While pre-dam reports indicate that sockeye salmon smolts migrate in May and June, PIT-tagged sockeye smolts from Redfish Lake pass Lower Granite Dam from mid-May to mid-July. Adult anadromous sockeye spent two or three years in the open ocean before returning to Redfish Lake to spawn. A resident form of Snake River sockeye salmon also occurs in Redfish Lake. The residuals are nonanadromous (i.e. they complete their entire life cycle in fresh water); however, studies have shown that some ocean migrating juveniles are progeny of resident females (Rieman et al. 1994). The resident salmon spawn at the same time and in the same location as anadromous sockeye salmon.

4.22.2 Population Dynamics

The only extant sockeye salmon population in the Snake River basin at the time of listing occurred in Redfish Lake. Other lakes in the Salmon River basin that historically supported sockeye salmon include Alturas Lake above Redfish Lake which was extirpated in the early 1900s as a result of irrigation diversions, though residual sockeye may still exist in the lake. From 1955 to 1965, the Idaho Department of Fish and Game eradicated sockeye salmon from Pettit, Stanley, and Yellowbelly lakes, and built permanent structures on each of the lake outlets that prevented re-entry of anadromous sockeye salmon (Chapman and Witty 1993). Other historic sockeye salmon populations within the Snake River basin now considered extinct include Wallowa Lake (Grande Ronde River drainage, Oregon), Payette Lake (Payette River drainage, Idaho), and Warm Lake (South Fork Salmon River drainage, Idaho).

Adult returns to Redfish Lake during the period 1954 through 1966 ranged from 11 to 4,361 fish (Bjornn et al. 1968). In 1985, 1986, and 1987, 11, 29, and 16 sockeye, respectively, were counted at the Redfish Lake weir. Only 18 natural origin sockeye salmon have returned to the Stanley Basin since 1987. The first adult returns from the captive brood stock program returned to the Stanley Basin in 1999. From 1999 through 2005, a total of 345 captive brood adults that had migrated to the ocean returned to the Stanley Basin. Recent years have seen an increase in returns to over 600 in 2008 and more than 700 returning adults in 2009.

4.22.3 Status

NMFS listed Snake River sockeye salmon as endangered on November 20, 1991 (56 FR 58619), and reaffirmed their status on June 28, 2005 (70 FR 37160). Subsequent to the 1991 listing, the residual form of sockeye residing in Redfish Lake was identified and in 1993, NMFS determined that residual sockeye salmon in Redfish Lake was part of the ESU. The ESU was listed due to habitat loss and degradation from the combined effects of damming and hydropower development; overexploitation; fisheries management practices; and poor ocean conditions. Recent annual abundances of natural origin sockeye salmon in the Stanley Basin have been extremely low. This species is currently entirely supported by adults produced through the captive propagation program. No natural origin anadromous adults have returned since 1998 and the abundance of residual sockeye salmon in Redfish Lake is unknown. Current smolt-to-adult survival of sockeye originating from the Stanley Basin lakes is rarely greater than 0.3 percent (Hebdon et al. 2004). Based on these factors, this ESU would likely have a very low resilience to additional perturbations.

4.22.4 Critical Habitat

NMFS designated critical habitat for SR sockeye salmon on December 28, 1993 (58 FR 68543). It encompass the waters, waterway bottoms, and adjacent riparian zones of specified lakes and river reaches in the Columbia River that are or were accessible to salmon of this ESU (except reaches above impassable natural falls, and Dworshak and Hells Canyon Dams). Specific PCEs were not designated in the critical habitat final rule; instead four “essential habitat” categories were described: 1) spawning and juvenile rearing areas, 2) juvenile migration corridors, 3) areas for growth and development to adulthood, and 4) adult migration corridors. The "essential features" that characterize these sites include substrate/spawning gravel; water quality, quantity, temperature, velocity; cover/shelter; food; riparian vegetation; space; and safe passage conditions. The quality and quantity of rearing and juvenile migration essential habitats have been reduced from activities such as tilling, water withdrawals, timber harvest, grazing, mining, and alteration of floodplains and riparian vegetation. These activities disrupt access to foraging areas, increase the amount of fines in the steam substrate that support production of aquatic insects, and reduce instream cover. Adult and juvenile migration essential habitat is affected by four dams in the Snake River basin that obstructs migration and increases mortality of downstream migrating juveniles. Water quality impairments in designated critical habitat include inputs from fertilizers, insecticides, fungicides, herbicides, surfactants, heavy metals, acids, petroleum products, animal and human sewage, dust suppressants (*e.g.*, magnesium chloride), radionuclides, sediment in the form of turbidity, and other anthropogenic pollutants. Pollutants enter the surface waters and riverine sediments from the headwaters of the Salmon River to the Columbia River estuary as contaminated stormwater runoff, aerial drift and deposition, and via point source discharges.

4.23 Steelhead Trout (General Overview)

We discuss the distribution, life history, population dynamics, status, and critical habitats of the eleven species (here we use the word "species" to apply to distinct population segments, DPSs, and evolutionary significant units, ESUs) separately; however, because listed steelhead trout species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across DPSs. We used information available in the 2005 West Coast salmon and steelhead status review (Good et al. 2005), various salmon ESU listing documents, and biological opinions (NMFS 2012b) to summarize the status of the species.

Steelhead is the common name of the anadromous form of *O. mykiss*. They are a Pacific salmonid with freshwater habitats that include streams extending from northwestern Mexico to Alaska in North America to the Kamchatka peninsula in Russia. Non-anadromous *O. mykiss* do not migrate to the ocean and remain in freshwater all their lives. These fish are commonly called rainbow trout.

4.23.1 Life History

Though steelhead have a longer run time than other Pacific salmonids and do not tend to travel in large schools, they can be divided into two basic run-types: the stream-maturing type (summer steelhead) and the ocean-maturing type (winter steelhead). Summer steelhead enter fresh water as sexually immature adults between May and October (Nickelson et al. 1992, Busby et al. 1996) and hold in cool, deep pools during summer and fall before moving to spawning sites as mature adults in January and February (Barnhart 1986, Nickelson et al. 1992). Winter steelhead return to fresh water between November and April as sexually mature adults and spawn shortly after river entry (Nickelson et al. 1992, Busby et al. 1996). Steelhead typically spawn in small tributaries rather than large, mainstem rivers and spawning distribution often overlaps with coho salmon, though steelhead tend to prefer higher gradients (generally two to seven percent, but up to 12 percent or more) and their distributions tend to extend further upstream than coho salmon. Summer steelhead commonly spawn higher in a watershed than do winter steelhead, sometimes even using ephemeral streams from which juveniles are forced to emigrate as flows diminish.

Fry usually inhabit shallow water along banks and stream margins of streams (Nickelson et al. 1992) and move to faster flowing water such as riffles as they grow. Some older juveniles move downstream to rear in larger tributaries and mainstem rivers (Nickelson et al. 1992). In Oregon and California, steelhead may enter estuaries where sand bars create low salinity lagoons. Migration of juvenile steelhead to these lagoons occurs throughout the year, but is concentrated in the late spring/early summer and in the late fall/early winter periods (Shapovalov and Taft 1954, Zedonis 1992). Juveniles rear in fresh water for one to four years, then smolt and migrate to the ocean in March and April (Barnhart 1986). Steelhead typically reside in marine waters for two or three years prior to returning to their natal streams to spawn as four or five-year olds. Unlike Pacific salmon, steelhead are iteroparous, or capable of spawning more than once before death (Busby et al. 1996). Females spawn more than once more commonly than males, but rarely more than twice before dying (Nickelson et al. 1992). Iteroparity is also more common among southern steelhead populations than northern populations (Busby et al. 1996).

Steelhead feed on a variety of prey organisms depending upon life stage, season, and prey availability. In freshwater juveniles feed on common aquatic stream insects such as caddisflies, mayflies, and stoneflies but also other insects (especially chironomid pupae), zooplankton, and benthic organisms (Pert 1993, Merz 2002). Older juveniles sometimes prey on emerging fry, other fish larvae, crayfish, and even small mammals, though these are not a major food source (Merz 2002). The diet of adult oceanic steelhead is comprised primarily of fish and squid (Light 1985, Burgner et al. 1992).

4.23.2 Status

On June 28, 2005, as part of the final listing determinations for 16 ESUs of West Coast salmon, NMFS amended and streamlined the 4(d) protective regulations for threatened salmon and steelhead (70 FR 37160) as described in the *Protective Regulations for Threatened Salmonid Species* section of this document. Under this change, the section 4(d) protections apply to natural and hatchery fish with an intact adipose fin, but not to listed hatchery fish that have had their adipose fin removed prior to release into the wild.

4.23.3 Population Dynamics

The population dynamics of each steelhead DPS will be discussed separately, below.

4.23.4 Critical Habitat

NMFS designated critical habitat for all but one of the listed steelhead DPSs on September 2, 2005 (70 FR 52488). Proposed designation of critical habitat for the Puget Sound steelhead will be discussed separately in Section 6.6.5. Areas designated as critical habitat are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. At the time of designation, PCEs are identified and include sites necessary to support one or more steelhead life stage(s). PCEs in steelhead designated habitat include freshwater spawning and rearing sites, freshwater migration corridors, nearshore marine habitat, and estuarine areas. The physical or biological features that characterize these sites include water quality and quantity, natural cover, forage, adequate passage conditions, and floodplain connectivity. The critical habitat section for each listed DPS below identifies the areas included as part of the designation and discusses the current status of critical habitat.

4.24 Steelhead (California Central Valley DPS)

The California Central Valley steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in the Sacramento and San Joaquin Rivers and their tributaries, excluding steelhead from San Francisco and San Pablo Bays and their tributaries. The DPS also includes two artificial propagation programs: the Coleman National Fish Hatchery and Feather River Hatchery. We used information available in status reviews (Good et al. 2005, NMFS 2011c), the draft recovery plan (NMFS 2009c), listing documents (69 FR 33102; 71 FR 834), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.24.1 Life History

Members of this DPS have the longest freshwater migration of any population of winter steelhead. Adults return to freshwater essentially continuously from July to May, with peaks in September and February. Spawning occurs from December to April, with peaks from January to March (McEwan and Jackson 1996). Spawning occurs in small streams and tributaries directly downstream of dams. Juvenile steelhead in the Sacramento River basin migrate downstream during most months of the year, but the peak period of emigration occurs in spring, with a much smaller peak in fall. Emigrating juveniles use the lower reaches of the Sacramento River and the Delta for rearing and as a migration corridor to the ocean; some may use tidal marsh areas, non-tidal freshwater marshes, and other shallow water areas in the Delta as rearing areas for short periods prior to their final emigration to the sea (Hallock et al. 1961).

4.24.2 Population Dynamics

The California Central Valley steelhead DPS may have consisted of 81 historical and independent populations (Lindley et al. 2006). Existing wild steelhead stocks in the Central Valley are mostly confined to the upper Sacramento River and its tributaries. Until recently, steelhead were considered extirpated from the San Joaquin River system; in 2004, a total of 12 steelhead smolts were collected in monitoring trawls at the Mossdale station in the lower San Joaquin River (California Department of Fish and Game, unpubl. data). Historically, annual steelhead run size for this ESU may have approached one to two million adults. By the early 1960s, the run size had declined to about 40,000 adults (McEwan 2001). Steelhead were counted at the Red Bluff Diversion Dam until 1993; counts declined from an average of 11,187 from 1967 to 1977 to an average of approximately 2,000 through the early 1990s. Estimated total annual run size for the entire Sacramento-San Joaquin system was no more than 10,000 adults during the early 1990s (McEwan and Jackson 1996, McEwan 2001). Based on catch ratios at Chipps Island in the Delta and using generous survival assumptions, the average number of steelhead females spawning naturally in the entire Central Valley during the years 1980 to 2000 was estimated at approximately 3,600.

4.24.3 Status

NMFS listed the California Central Valley steelhead DPS as threatened on March 19, 1998, and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the loss of most historical spawning and rearing habitat above impassable dams, restriction of natural production areas, the apparent continuing decline in abundance, and lack of monitoring efforts to assess the DPS’s abundance and trends. The DPS’s present distribution has been greatly reduced: about 80 percent of historic habitat has been lost behind dams and about 38 percent of habitat patches that supported independent populations are no longer accessible to steelhead (Lindley et al. 2006). Though previously thought to be extirpated from these areas, populations may exist in Big Chico and Butte Creeks and steelhead have also been observed in Clear Creek and Stanislaus River (Demko and Cramer 2000). A few wild steelhead are produced in the American and Feather Rivers. Though annual monitoring data for calculating trends are lacking, available data indicate the DPS has had a significant long-term downward trend in abundance. The losses of populations and reductions in abundance have reduced genetic diversity in the DPS. Hatchery-origin fish have also compromised the genetic diversity of the majority of the spawning runs. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.24.4 Critical Habitat

Designated critical habitat for the California Central Valley steelhead DPS encompasses about 2,300 miles of stream habitat and about 250 square miles of estuarine habitat in the San Francisco-San Pablo-Suisan Bay estuarine complex and includes stream reaches such as those of the Sacramento, Feather, and Yuba Rivers, and Deer, Mill, Battle, and Antelope creeks in the Sacramento River basin; the lower San Joaquin River to the confluence with the Merced River, including its tributaries, and the waterways of the Delta. The critical habitat is degraded, and does not provide the conservation value necessary for species recovery. In addition, the Sacramento-San Joaquin River Delta provides very little function necessary for juvenile steelhead rearing and smoltification. The spawning PCE is subject to variations in flows and temperatures, particularly over the summer months. The rearing PCE is degraded by channelized, leveed, and riprapped river reaches, and sloughs common in the Sacramento-San Joaquin system. These areas typically have low habitat complexity, low abundance of food organisms, offer little protection from fish or avian predators, and commonly have elevated temperatures. The current conditions of migration corridors are substantially degraded. Both migration and rearing PCEs have reduced water quality from several contaminants introduced by dense urbanization and agriculture along the mainstems and in the Delta. In the Sacramento River, the migration corridor for both juveniles and adults is obstructed by the Red Bluff Diversion Dam gates from May 15 through September 15. The migration PCE is also obstructed by complex channel configuration making it difficult for fish to migrate successfully to the western Delta and the ocean. State and federal pumps and associated fish facilities alter flows in the Delta and impede and obstruct a functioning migration corridor. The estuarine PCE in the Delta is affected by contaminants from agricultural and urban runoff and release of wastewater treatment plants effluent. However, some complex, productive habitats with floodplains remain in the system and flood bypasses (i.e., Yolo and Sutter bypasses).

4.25 Steelhead (Central California Coast DPS)

The Central California Coast steelhead DPS includes all naturally spawned populations of steelhead in coastal streams from the Russian River to Aptos Creek; the drainages of San Francisco, San Pablo, and Suisun Bays eastward to Chipps Island at the confluence of the Sacramento and San Joaquin Rivers; and tributary streams to Suisun Marsh including Suisun Creek, Green Valley Creek, and an unnamed tributary to Cordelia Slough (commonly referred to as Red Top Creek). The DPS does not include the Sacramento-San Joaquin River Basin of the California Central Valley. Two artificial propagation programs are considered to be part of the DPS: the Don Clausen Fish Hatchery, and Kingfisher Flat Hatchery/Scott Creek (Monterey Bay Salmon and Trout Project). We used information available in status reviews (Good et al. 2005, NMFS 2011b), the recovery outline (NMFS 2007a), “An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain" (Bjorkstedt et al. 2005), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (NMFS 2008a, 2012b) to summarize the status of the species.

4.25.1 Life History

The DPS, like those to the south, is entirely composed of winter-run fish. Adults return to the Russian River and migrate upstream from December to April. Most spawning occurs from January to April. Smolts emigrate between March and May (Shapovalov and Taft 1954, Hayes et al. 2004), typically at one to four years of age, though recent studies indicate that growth rates in Soquel Creek likely prevent juveniles from undergoing smoltification until age two (Sogard et al. 2009).

4.25.2 Population Dynamics

The Central California Coast steelhead DPS consisted of nine historic functionally independent populations and 23 potentially independent populations. Of the historic functionally independent populations, at least two are extirpated and most of the remaining populations are nearly extirpated. Historically, the entire CCC steelhead DPS may have consisted of an average runs size of 94,000 adults in the early 1960s. Information on current steelhead populations in the DPS consists of anecdotal, sporadic surveys that are limited to only smaller portions of watersheds. Though it is not possible to calculate long-term trends for individual watersheds or the entire DPS, the limited data that do exist indicate that abundance has declined for all populations sampled compared to historical data. Current runs in the basins that originally contained the two largest steelhead populations for the DPS, the San Lorenzo and the Russian Rivers, both have been estimated at less than 15 percent of their abundances compared to 30 years earlier. The interior Russian River winter-run steelhead has the largest runs with an estimate of an average of over 1,000 spawners.

4.25.3 Status

NMFS listed the Central California Coast steelhead as threatened on August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of sedimentation and channel restructuring due to floods. Spatial structure has been reduced throughout the DPS. Impassible dams have cut off substantial portions of habitat in some basins and it is estimated that 22 percent of the DPS's historical habitat has been lost behind (primarily man-made) barriers, including significant portions of the upper Russian River. Long-term population sustainability is extremely low for the southern populations in the Santa Cruz Mountains and in the San Francisco Bay, and declines in juvenile southern populations are consistent with the more general estimates of declining abundance in the region. The interior Russian River population may be able to be sustained over the long-term, but hatchery management has eroded the population's genetic diversity. Though the information for individual populations is limited, available information strongly suggests that no population is viable. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.25.4 Critical Habitat

Designated critical habitat for the Central California coast steelhead DPS includes the Russian River watershed, coastal watersheds in Marin County, streams within the San Francisco Bay, and coastal watersheds in the Santa Cruz Mountains, southeast to Aptos Creek. The spawning PCE have reduced quality throughout the critical habitat; sediment fines in spawning gravel have reduced the ability of the substrate attribute to provide well oxygenated and clean water to eggs and alevins. The forage PCE has been degraded in some areas where high proportions of fines in bottom substrate limit the production of aquatic stream insects adapted to high velocity water. Elevated water temperatures and impaired water quality have further reduced the quality, quantity, and function of the rearing PCE within most streams. These impacts have diminished the ability of designated critical habitat to conserve the Central California Coast steelhead.

4.26 Steelhead (Lower Columbia River DPS)

The Lower Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams and tributaries to the Columbia River between the Cowlitz and Wind Rivers, Washington, and the Willamette and Hood Rivers, Oregon. The DPS also includes seven hatchery populations. We used information available in status reviews (Busby et al. 1996, Good et al. 2005, Ford 2011, NMFS 2011d), recovery plans (Lower Columbia Fish Recovery Board 2010, Oregon Department of Fish and Wildlife 2010, NMFS 2013c), listing documents (61 FR 41541, 63 FR 13347, 71 FR 834), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.26.1 Life History

The Lower Columbia River steelhead DPS includes populations of summer- and winter-run steelhead. Summer-run steelhead return sexually immature to the Columbia River from May to October, and spend several months in fresh water prior to spawning between February and April. Winter-run steelhead enter fresh water from December to May at sexual maturity. Peak spawning occurs from April to May. Where both races spawn in the same stream, summer-run steelhead tend to spawn at higher elevations than winter-run steelhead. Fry emerge from March to July, with peaks between April and May. Steelhead smolts generally migrate at ages ranging from one to four years, but most smolt after two years in freshwater. Emigration of both summer- and winter-run steelhead generally occurs from March to June, with peak migration in April to May. Both winter- and summer-run adults normally return to freshwater after two years in the ocean.

4.26.2 Population Dynamics

The Lower Columbia River steelhead had 17 historically independent winter-run steelhead populations and six independent summer-run steelhead populations (McElhany et al. 2003, Myers et al. 2006). All historic populations are considered extant. All populations declined from 1980 to 2000, with sharp declines beginning in 1995. Historical counts in some of the larger tributaries (Cowlitz, Kalama, and Sandy Rivers) suggest the population probably exceeded 20,000 fish. During the 1990s, fish abundance dropped to 1,000 to 2,000 fish. Recent abundance estimates of natural-origin spawners range from extirpation of some populations above impassable barriers to over 700 fishes in the Kalama and Sandy winter-run populations. A number of the populations have a substantial fraction of hatchery-origin spawners in spawning areas. Many of the long-and short-term trends in abundance of individual populations are negative.

4.26.3 Status and trends

NMFS listed Lower Columbia River steelhead as threatened on March 19, 1998 (63 FR 13347), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of genetic introgression from hatchery stocks. Spatial structure remains relatively high for most populations (Lower Columbia Fish Recovery Board 2010, Oregon Department of Fish and Wildlife 2010). Except in the North Fork Lewis subbasin, where dams have impeded access to historical spawning habitat, most summer-run steelhead populations continue to have access to historical production areas in forested, mid- to-high-elevation subbasins that remain largely intact. Most populations of winter-run steelhead have maintained their spatial structure, though many of these habitats no longer support significant production (Lower Columbia Fish Recovery Board 2010, Oregon Department of Fish and Wildlife 2010). Out of the 23 populations in this DPS, 16 are considered to have a low or very low probability of persisting over the next 100 years, and six populations have a moderate probability of persistence (Lower Columbia Fish Recovery Board 2010, Oregon Department of Fish and Wildlife 2010). Only the summer-run Wind population is considered viable. The low to very low baseline persistence probabilities of most Lower Columbia River steelhead populations reflects low abundance and productivity. In addition, it is likely that genetic and life history diversity has been reduced as a result of pervasive hatchery effects and population bottlenecks. Although current Lower Columbia River steelhead populations are depressed compared to historical levels and long-term trends show declines, many populations are substantially healthier than their salmon counterparts, typically because of better habitat conditions in core steelhead production areas (Lower Columbia Fish Recovery Board 2010). Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

4.26.4 Critical Habitat

Designated critical habitat for the Lower Columbia River steelhead DPS includes the following subbasins: Middle Columbia/Hood, Lower Columbia/Sandy, Lewis, Lower Columbia/Clatskanie, Upper Cowlitz, Cowlitz, Clackamas, and Lower Willamette. The Lower Columbia River corridor is also included in the designated critical habitat. Critical habitat is affected by reduced quality of rearing and juvenile migration PCEs within the lower portion and alluvial valleys of many watersheds. Contaminants from agriculture further affect both water quality and food production in these degraded reaches of tributaries and in the mainstem Columbia River. Several dams affect adult migration PCE by obstructing the migration corridor. Watersheds which consist of a large proportion of Federal lands (e.g., the Sandy River watershed) have relatively healthy riparian corridors that support attributes of the rearing PCE such as cover, forage, and suitable water quality.

4.27 Steelhead (Middle Columbia River DPS)

The Middle Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in streams from above the Wind River, Washington, and the Hood Rivers, Oregon and upstream to, and including, the Yakima River, Washington, excluding *O. mykiss* from the Snake River Basin. The DPS also includes seven artificial propagation programs. Steelhead from the Snake River basin (described in Section 6.7) are not included in this DPS. We used information available in status reviews (Busby et al. 1996, Good et al. 2005, Ford 2011, NMFS 2011e), the recovery plan (NMFS 2009b), listing documents

(63 FR 11798, 64 FR 14517, 71 FR 834), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.27.1 Life History

Middle Columbia River steelhead populations are mostly of the summer-run type, with the exception of inland winter-run steelhead that occur in the Klickitat River and Fifteenmile Creek. Adult summer-run steelhead enter fresh water from June through August and adults may spend up to a year in freshwater before spawning. The majority of juveniles smolt and emigrate to the ocean as two-year olds. About equal numbers of adults in the DPS return to freshwater after spending one or two years in the ocean; however, summer-run steelhead in Klickitat River have a life cycle more like Lower Columbia River steelhead where most of returning adults have spent two years in the ocean.

4.27.2 Population Dynamics

The Interior Columbia Technical Review Team identified 16 extant populations in four major population groups (Cascades Eastern Slopes Tributaries, John Day River, Walla Walla and Umatilla Rivers, and Yakima River) and one extant unaffiliated population (Rock Creek) (Interior Columbia Technical Review Team 2003). There are three extirpated populations: two in the Cascades Eastern Slope major population group and one in the Walla Walla and Umatilla Rivers major population group. Historic run estimates for the Yakima River indicate that annual species abundance may have exceeded 300,000 returning adults. The 10-year geometric mean for each population ranges from a low of 85 fish (Upper Yakima River) to 1,800 fish (Lower Mainstem John Day). The 10-year average proportion of hatchery-origin spawners ranges from two percent (Walla Walla Mainstem) to 39 percent (Eastside Deschutes); the majority of populations have a hatchery proportion of spawners between six to eight percent. Fifteenmile Creek has no hatchery-origin spawners.

4.27.3 Status

NMFS listed Middle Columbia River steelhead as threatened on March 25, 1999 (64 FR 14517), and reaffirmed their threatened status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as impacts from artificial propagation. NMFS considers spatial structure and diversity of the DPS to be at moderate risk. Relative to the brood cycle just prior to listing (1992 to 1996 spawning year), current brood cycle (five-year geometric mean) natural abundance is substantially higher (more than twice) for seven of the populations, lower for three, and at similar levels for four populations. Three populations have insufficient data to calculate long-term trends. Short-term trends are positive for all but three populations. Viability ratings for the 17 populations are: four viable, seven maintained, one highly variable, and five high risk. Impacts from Tribal fisheries targeting Chinook salmon continue to harvest approximately five percent of summer-run steelhead in the Middle Columbia, Upper Columbia, and Snake River Basins per year. Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

4.27.4 Critical Habitat

Designated critical habitat for the Middle Columbia River steelhead DPS includes the following subbasins: Upper Yakima, Naches, Lower Yakima, Middle Columbia/Lake Wallula, Walla Walla, Umatilla, Middle Columbia/Hood, Klickitat, Upper John Day, North Fork John Day, Middle Fork John Day, Lower John Day, Lower Deschutes, Trout, the Upper Columbia/Priest Rapids subbasins, and the Columbia River corridor. The current condition of Middle Columber River critical habitat is moderately degraded. Quality of juvenile rearing and migration PCEs has been reduced in several watersheds and in the mainstem Columbia River by contaminants from agriculture that affect both water quality and food production. Loss of riparian vegetation from grazing has resulted in high water temperatures in the John Day basin. Reduced quality of the rearing PCEs has diminished its contribution to the conservation value necessary for the recovery of the species. Several dams affect adult migration PCE by obstructing the migration corridor.

4.28 Steelhead (Northern California DPS)

The Northern California steelhead DPS includes all naturally spawned steelhead populations below natural and manmade impassable barriers in California coastal river basins from Redwood Creek southward to, but not including, the Russian River. The DPS also includes two artificial propagation programs: the Yeager Creek Hatchery and the North Fork Gualala River Hatchery (Gualala River Steelhead Project). We used information available in status reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011b), the recovery outline (NMFS 2007b), "An analysis of historical population structure for evolutionarily significant units of Chinook salmon, coho salmon, and steelhead in the North-Central California Coast Recovery Domain" (Bjorkstedt et al. 2005), "A framework for assessing the viability of Threatened and Endangered Salmon and Steelhead in the North-central California Coast Recovery Domain" (Spence et al. 2008), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (NMFS 2008a, 2012b) to summarize the status of the species.

4.28.1 Life History

This DPS includes both winter- and summer-run steelhead. In the Mad and Eel Rivers, immature steelhead may return to fresh water as "half-pounders" after spending only two to four months in the ocean. Generally, a half-pounder will overwinter in fresh water and return to the ocean in the following spring. Juvenile out-migration appears more closely associated with size than age; though juveniles generally, throughout their range in California, spend two years in fresh water. Smoltification occurs when they are between 14 to 21 cm in length.

4.28.2 Population Dynamics

Historically, this DPS encompassed 42 independent populations of winter-run steelhead (19 functionally independent and 23 potentially independent) and 10 independent populations of summer-run steelhead. All historic populations of winter-run salmon are extant. Of the 10 summer-run steelhead populations, four are extant and six are assumed to be either extirpated or extremely depressed. Long-term data sets are limited for the Northern California steelhead. Prior to 1960, estimates of abundance specific to this DPS were available from dam counts. Cape Horn Dam in the upper Eel River reported annual average numbers of adults as 4,400 in the 1930s); Benbow Dam in the South Fork Eel River reported annual averages of 19,000 in the 1940s; and the Sweasey Dam in the Mad River reported annual averages of 3,800 in the 1940s. Estimates of steelhead spawning populations for many rivers in this DPS totaled 198,000 by the mid-1960s. For winter-run populations that have had recent counts, returns have not exceeded more than a few hundred fish, with the exception of a portion of the Gualala River population (counts of adult steelhead have averaged 1,915 fish) and at the Mad River Hatchery (average of 2,300 adults). The only summer-run steelhead population with a comprehensive time series of abundance is the Middle Fork Eel River, which has been monitored since the mid-1960s. Counts have averaged 780 fish over the period of record and 609 fish in the past 16 years. Both short-term and long-term trends are negative, though not significantly.

4.28.3 Status

NMFS listed Northern California steelhead as threatened on June 7, 2000 (65 FR 36074), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issue of the introduction of a salmonid predator, the Sacramento pikeminnow (formerly known as Sacramento squawfish [*Ptychocheilus grandis*], and concern about the influence of hatchery stocks on native fish (i.e., genetic introgression and ecological interactions). Overall, spatial structure of the DPS is relatively intact and all diversity strata appear to be represented by extant populations. However, spatial structure and distribution within most watersheds has been adversely affected by barriers and high water temperatures. The scarcity of time series of abundance at the population level spanning more than a few years hinders assessment of the DPS's status; population level estimates of abundance are available for four of the 42 winter-run populations and for one of the 10 summer-run populations. Trend information from the available datasets suggests a mixture of patterns, with slightly more populations showing declines than increases, though few of these trends are statistically significant. Where population level estimates of abundance are available, only the Middle Fork Eel River summer-run populations are considered to have a low-risk of extinction. The remaining populations for which adult abundance has been estimated appear to be at either moderate- or high-risk of extinction. Although surveys within the summer-run steelhead watersheds do not encompass all available summer habitats, the chronically low numbers observed during surveys suggest that those populations are likely at high risk of extinction. The high number of hatchery fish in the Mad River basin, coupled with uncertainty regarding relative abundances of hatchery and wild spawners is also of concern. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.28.4 Critical Habitat

Designated critical habitat for the Northern California steelhead DPS includes the following CALWATER hydrological units: Redwood Creek, Trinidad, Mad River, Eureka Plain, Eel River, Cape Mendocino, and the Mendocino Coast. The total area of critical habitat includes about 3,000 miles of stream habitat and about 25 square miles of estuarine habitat, mostly within Humboldt Bay. The current condition of designated critical habitat is moderately degraded. Portions of the rearing PCE, especially the interior Eel River, are affected by elevated temperatures from riparian vegetation removal. Spawning PCE attributes (i.e., the quality of substrate that supports spawning, incubation, and larval development) have been generally degraded throughout designated critical habitat by silt and sediment fines. The adult migration PCE function has been reduced by bridges and culverts that restrict access to tributaries in many watersheds, especially in watersheds with forest road construction.

4.29 Steelhead (Puget Sound DPS)

This Puget Sound DPS includes all naturally-spawned anadromous winter-run and summer-run steelhead in the river basins of Strait of Juan de Fuca, Puget Sound, and Hood Canal, Washington. The DPS is bounded to the west by the Elwha River (inclusive) and to the north by the Nooksack River and Dakota Creek (inclusive). Hatchery production of steelhead is widespread throughout the DPS, but only two artificial propagation programs are included in the DPS. On June 26, 2013, NMFS proposed to change the number of artificial propagation programs included in the DPS to six (78 FR 38270). We used information available in status reviews (NMFS 2005b, 2007e, Ford 2011, NMFS 2011g), the recovery outline (NMFS 2013d), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.29.1 Life History

The Puget Sound steelhead DPS contains both winter-run and summer-run steelhead, but is dominated by winter-run fish. Adult winter-run steelhead generally return to Puget Sound tributaries from December to April. Spawning occurs from January to mid-June and peaks from mid-April through May. Less information exists for summer-run steelhead as their smaller run size and higher altitude headwater holding areas have not been conducive for monitoring. Based on information from four streams, adult run time occurs from mid-April to October with a higher concentration from July to September. The majority of juveniles reside in the river system for two years with a minority migrating to the ocean as one or three-year olds. Smoltification and seaward migration occur from April to mid-May. Puget Sound steelhead spend one to three years in the ocean before returning to freshwater (Busby et al. 1996). Due to the protection of the fjord-like marine environment of Puget Sound, juveniles and adults may hold there during emigration and immigration.

4.29.2 Population Dynamics

Fifty-three populations of steelhead have been identified in this DPS, of which 37 are winter-run. In the early 1980s, run size for this DPS was calculated at about 100,000 winter-run fish and 20,000 summer-run fish. Available data for calculating abundance and trends are not comprehensive for the DPS, primarily represent winter-run steelhead populations, and date from 1985. Since 1985 Puget Sound winter-run steelhead abundance has shown a widespread declining trend over much of the DPS. Four of the 16 winter-run populations evaluated exhibit estimates of long-term population positive growth rates, only one significantly. Thirteen winter-run steelhead populations have sufficient data to determine recent annual abundances (2005 to 2009). Of the 13 populations, two have geometric mean abundances greater than 4,500 fish annually. The remaining populations have low geometric mean abundances; none exceeds 1,000 fish annually and only two populations exceed 500 fish annually.

4.29.3 Status

NMFS listed Puget Sound steelhead as threatened on May 11, 2007 (72 FR 26722). Factors contributing to the listing of this DPS include habitat loss and degradation from damming, agricultural practices, and urbanization; historic overexploitation; predation; poor oceanic and climatic conditions; and impacts from artificial propagation. Spatial structure, complexity, and connectivity have been reduced throughout the DPS. Most populations of steelhead in Puget Sound have declining estimates of mean population growth rates (typically three to 10 percent annually) and extinction risk within 100 years for most populations is estimated to be moderate to high. Effects of hatchery fish on the natural populations remain unknown. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.29.4 Critical Habitat

NMFS proposed designation of critical habitat for the Puget Sound steelhead on January 14, 2013 (78 FR 2725). Designated critical habitat would include approximately 1,880 mi (3,026 km) of freshwater and estuarine habitat in Puget Sound, Washington, and exclude a number of areas from designation. Notable is the proposed exclusion of nearshore areas. Though the physical or biological features of critical habitat proposed for Puget Sound steelhead are the same as those designated for Puget Sound Chinook and Hood Canal summer-run chum, watershed conservation values for steelhead may be different because of differences in population structure and habitat use.

4.30 Steelhead (Snake River DPS)

The Snake River basin steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River Basin upstream from the Yakima River, Washington, to the U.S./Canada border. Six artificial propagation programs are also included in the DPS. We used information available in status reviews reviews (Good et al. 2005, Ford 2011, NMFS 2011i), listing documents (62 FR 43937, 71 FR 834), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.30.1 Life History

Snake River basin steelhead are generally classified as summer-run fish. They return to the Columbia River from late June to October and spawn the following spring (March to May). Two life history patterns are recognized within the DPS, primarily based on ocean age and adult size upon return: A-run and B-run. A-run steelhead are typically smaller, have shorter freshwater and ocean residences (generally one year in the ocean), and begin their up-river migration earlier in the year. B-run steelhead are larger, spend more time in fresh water and the ocean (generally two years in ocean), and appear to start upstream migration later in the year. Snake River basin steelhead smoltification usually occurs at two to three years of age.

4.30.2 Population Dynamics

The Interior Columbia Technical Review Team identified six historical major population groups in the Snake River steelhead DPS: Clearwater River, Salmon River, Grande Ronde River, Imnaha River, Lower Snake River, and Hells Canyon Tributaries. The Hells Canyon population is now extirpated; construction of Hells Canyon Dam blocked passage of upstream of the dam. The five extant major population groups support 24 extant independent populations (Interior Columbia Technical Review Team 2003). Population data are lacking for the Snake River steelhead DPS. Annual return estimates are limited to counts of the aggregate return (both A-run and B-run steelhead) over Lower Granite Dam, estimates for two populations in the Grande Ronde major population group, and index area or weir counts for portions of several other populations. The recent geometric five-year mean abundance (2003 to 2008) for Lower Granite Dam was 18,847 natural-origin returning adults. This natural origin return average represented 10 percent of total returns (of both natural and artificial origin fish) over Lower Granite Dam. The previous five-year geometric mean abundance (1997 to 2001) was 10,693 natural-origin returning adults and represented 13 percent of total returns. The five-year periods for the two Grande Ronde populations for which population-level abundance data series are available are the same as above. The recent five-year geometric mean abundance of natural origin steelhead for the Joseph Creek population was 1,925 fish compared to 2,134 fish for the previous five-year period. These returns are made up entirely of natural origin fish. The recent five-year geometric mean abundance of natural origin steelhead for the Upper Grande Ronde River was 1,425 fish compared to 1,332 fish for the previous five-year period. The returns represent 99 and 76 percent of total returns, respectively.

4.30.3 Status

NMFS listed Snake River Basin steelhead as threatened on August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), and, more specifically, widespread habitat blockage from hydrosystem management and potentially deleterious genetic effects from straying and introgression from hatchery fish. The level of natural production in the two populations with full data series and one of the index areas is encouraging, but the status of most populations in the DPS remains highly uncertain. The DPS is not currently considered to be viable due to high risk population ratings, uncertainty about the viability status of many populations, and overall lack of population data. A great deal of uncertainty remains regarding the relative proportion of hatchery fish in natural spawning areas near major hatchery release sites. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.30.4 Critical Habitat

Designated critical habitat for the Snake River Basin steelhead DPS includes the following subbasins: Hells Canyon, Imnaha River, Lower Snake/Asotin, Upper Grand Ronde River, Wallowa River, Lower Grand Ronde, Lower Snake/Tucannon, Upper Salmon, Pahsimeroi, Middle Salmon-Panther, Lemhi, Upper Middle Fork Salmon, Lower Middle Fork Salmon, Middle Salmon, South Fork Salmon, Lower Salmon, Little Salmon, Upper and Lower Selway, Lochsa, Middle and South Fork Clearwater, and the Clearwater subbasins, and the Lower Snake/Columbia River corridor. The current condition of critical habitat designated for Snake River basin steelhead is moderately degraded. Critical habitat is affected by reduced quality of juvenile rearing and migration PCEs within many watersheds. Contaminants from agriculture affect both water quality and food production in several watersheds and in the mainstem Columbia River. Loss of riparian vegetation to grazing has resulted in high water temperatures in the John Day basin. These factors have substantially reduced the rearing PCEs' contribution to the conservation value necessary for species recovery. Several dams affect adult migration PCE by obstructing the migration corridor.

4.31 Steelhead (South-central California Coast DPS)

The South-central California coast steelhead DPS includes all naturally spawned steelhead populations in streams from the Pajaro River watershed (inclusive) to, but not including, the Santa Maria River, (71 FR 5248) in northern Santa Barbara County, California. There are no artificially propagated steelhead stocks within the range of the DPS. We used information available in status reviews reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011j, Williams et al. 2011), the recovery plan (NMFS 2013f), "Steelhead of the South-central/Southern California coast: population characterization for recovery planning" (Boughton et al. 2006), "Viability criteria for steelhead of the South-central and Southern California Coast" (Boughton et al. 2007), listing documents (61 FR 41541, 62 FR 43937; 71 FR 834), and previously issued biological opinions (NMFS 2012b, 2013a) to summarize the status of the species.

4.31.1 Life History

NMFS recognizes two life-history types of winter-run steelhead in the South-central California coast DPS: fluvial-anadromous and lagoon-anadromous. Freshwater resident steelhead (rainbow trout) are not included in the DPS. Fluvial-anadromous fish spend one or two summers (occasionally more) in freshwater streams as juveniles, then smolt and migrate to the ocean, using the estuary only for acclimation to saltwater and as a migration corridor (and occasionally for spring feeding). Lagoon-anadromous fish spend either their first or second summer as juveniles in a seasonal lagoon at the mouth of a stream. Adults of both winter-run types spend two to three years in the ocean before returning to freshwater.

4.31.2 Population Dynamics

The steelhead populations in this region have declined dramatically from estimated annual runs totaling 27,000 adults near the turn of the 19th century to approximately 4,740 adults in 1965, with a large degree of inter-annual variability. These run-size estimates are based on information from only five major watersheds in the northern portion of the DPS. Run-size estimates from coastal and inland watersheds south of the Big Sur have not been estimated or recorded. Only one population in the DPS has sufficient data to compute a trend for adult escapement, the Carmel River above San Clemente Dam. This population experienced a decline of 22 percent per year from 1963 to 1993 and an average five-year adult count of 16 adult spawners. The most recent counts (2012 to 2013) in the Carmel River indicate 452 adults at the San Clemente Dam and 204 adults at the Los Padres Dam.

4.31.3 Status

NMFS listed South-Central California Coast steelhead as threatened August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific concerns about genetic effects from widespread stocking of rainbow trout. The DPS consists of 12 discrete sub-populations which represent localized groups of interbreeding individuals. None of these sub-populations are considered to be viable. Most of the sub-populations are characterized by low population abundance, variable or negative population growth rates, and reduced spatial structure and diversity. Though steelhead are present in most streams in the DPS, their populations are small, fragmented, and unstable, or more vulnerable to stochastic events. In addition, severe habitat degradation and the compromised genetic integrity of some populations pose a serious risk to the survival and recovery of the DPS. The DPS is in danger of extinction. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.31.4 Critical Habitat

Designated critical habitat for the South-Central California coast steelhead DPS includes the following CALWATER hydrological units: Pajaro River, Carmel River, Santa Lucia, Salinas River and Estero Bay. Migration and rearing PCEs are degraded throughout designated critical habitat by elevated stream temperatures and contaminants from urban and agricultural areas. The estuarine PCE is impacted due to breaching of estuarine areas, removal of structures, and contaminants.

4.32 Steelhead (Southern California DPS)

The Southern California Steelhead DPS includes all naturally spawned populations of steelhead in streams from the Santa Maria River, San Luis Obispo County, California (inclusive) to the U.S.-Mexico Border (62 FR 43937; 67 FR 21586). No artificially propagated steelhead stocks are currently recognized within the range of the DPS; however, two artificial propagation programs, the Don Clausen Fish Hatchery and the Kingfisher Flat Hatchery (Monterey Bay Salmon and Trout Project) have been proposed for inclusion in the DPS, as they were inadvertently omitted from the original listing (78 FR 38270). We used information available in status reviews (Busby et al. 1996, Good et al. 2005, NMFS 2011k, Williams et al. 2011), the recovery plan (NMFS 2012f), "Contraction of the southern range limit for anadromous *Oncorhynchus mykiss*" (Boughton et al. 2005), listing documents (62 FR 43937; 71 FR 834), and previously issued biological opinions (NMFS 2012b, 2013b) to summarize the status of the species.

4.32.1 Life History
Life history of the Southern California Steelhead is similar to that of the South-Central California Coast steelhead; see Section 4.31.1 for additional information.

4.32.2 Population Dynamics
Limited information exists for Southern California steelhead runs. Run-size estimates from coastal and inland watersheds south of the Los Angeles Watershed have generally not been estimated or recorded and no long term (greater than 20 years) time-series data are available for any of the populations. Based on combined estimates for only four major watersheds in the northern portion of the DPS, steelhead runs declined from estimated historic levels of 32,000 to 46,000 adults to less than 500 adults in 1996. More recent counts from various monitoring locations in the DPS have reported very small runs of less than 10 fish, with the exception of a monitoring location in Santa Ynez River that reported 16 adults in 2008.

4.32.3 Status
NMFS listed the Southern California steelhead as endangered on August 18, 1997 (62 FR 43937), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific concern about the widespread, dramatic declines in abundance relative to historical levels. Construction of dams and a corresponding increase in water temperatures have excluded steelhead distribution in many watersheds throughout southern California. Streams in southern California containing steelhead have declined over the last decade, with a southward proportional increase in loss of populations. Consequently, the DPS has experienced a contraction of its southern range. This range contraction affects the DPS's ability to maintain genetic and life history diversity for adaptation to environmental change. The 2005 status review concluded the chief causes for the DPS's decline include urbanization, water withdrawals, channelization of creeks, human-made barriers to migration, and the introduction of exotic fishes and riparian plants. The most recent status review indicates these threats are essentially unchanged and the species remains in danger of extinction. Based on these factors, this DPS would likely have a very low resilience to additional perturbations.

4.32.4 Critical Habitat
Designated critical habitat for the Southern California steelhead DPS includes the following CALWATER hydrological units: Santa Maria River, Santa Ynez, South Coast, Ventura River, Santa Clara Calleguas, Santa Monica Bay, Callequas and San Juan hydrological units. All PCEs have been affected by degraded water quality by pollutants from densely populated areas and agriculture within the DPS. Elevated water temperatures impact rearing and juvenile migration PCEs in all river basins and estuaries. Rearing and spawning PCEs have been affected

throughout the DPS by water management or reduction in water quantity. The spawning PCE has been affected by the combination of erosive geology features and land management activities that have resulted in excessive fines in spawning gravel of most rivers.

4.33 Steelhead (Upper Columbia River DPS)

The Upper Columbia River steelhead DPS includes all naturally spawned steelhead populations below natural and man-made impassable barriers in streams in the Columbia River basin upstream from the Yakima River, Washington, to the U.S.-Canada border. The DPS also includes six artificial propagation programs. We used information available in status reviews reviews (Good et al. 2005, Ford 2011, NMFS 2011m), the recovery plan (Upper Columbia Salmon Recovery Board 2007), listing documents (62 FR 43937; 71 FR 834; 74 FR 42605), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.33.1 Life History

All Upper Columbia River steelhead are summer-run fish. Adults return in the late summer and early fall. Most adults migrate quickly to their natal tributaries, though a portion of returning adults overwinter in mainstem reservoirs, beyond upper-mid-Columbia dams in April and May of the following year. Spawning occurs in the late spring of the year following river entry. Juvenile steelhead spend one to seven years rearing in fresh water before migrating to sea. Smolt emigrate primarily at ages two and three, though some smolts in the DPS have been reported at ages up to seven. Most adult steelhead return to fresh water after one or two years in the ocean.

4.33.2 Population Dynamics

The Upper Columbia River steelhead consists of five historic independent populations, four of which are extant (Wenatchee, Entiat, Methow, and Okanogan) and one that is functionally extinct (Crab Creek). Two additional major population groups likely existed prior to the construction of Grand Coulee and Chief Joseph dams. No direct counts of adult steelhead in the DPS are available prior to dam construction. Estimates of spawning escapement for all four extant populations are available through the 2008/2009 cycle year, along with preliminary estimates of the aggregate counts over Priest Rapids Dam for the 2009/2010 cycle year. The most recent five-year geometric mean abundance (2005 to 2009) of natural origin fish ranges from 116 to 819 adults in the four populations and is 3,604 adults for the aggregate count. These abundances represent nine to 47 percent of total spawner abundances (natural origin and hatchey origin). The most recent five-year average of percent of natural origin fish for the aggregate count is 19 percent.

4.33.3 Status

NMFS originally listed Upper Columbia River steelhead as endangered on August 18, 1997 (62 FR 43937). NMFS changed the listing to threatened on January 5, 2006 (71 FR 834). After litigation resulting in a change in the DPS' status to endangered and then again to threatened. On August 24, 2009, NMFS reaffirmed the species' status as threatened (74 FR 42605). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issues of extremely low estimates of adult replacement ratios, habitat degradation, juvenile and adult mortality in the hydrosystem, unfavorable marine and freshwater environmental conditions, overharvest, and genetic homogenization from composite broodstock collections. Though steelhead in the DPS must pass over several dams to access spawning areas, three of the four populations are rated as low risk for spatial structure. The proportions of hatchery-origin returns in natural spawning areas remain extremely high across the DPS and continue to be a major concern. Though there has been an increase in abundance and productivity for all populations, the improvements have been minor, and none of the populations meet recovery criteria. All populations remain at high risk of extinction and the DPS, as a whole, is not viable. Based on these factors, this DPS would likely have a low resilience to additional perturbations.

4.33.4 Critical Habitat

Designated critical habitat for the Upper Columbia River steelhead DPS includes the following subbasins: Chief Joseph, Okanogan, Similkameen, Methow, Upper Columbia/Entiat, Wenatchee, Lower Crab, and the Upper Columbia/Priest Rapids subbasins, and the Columbia River corridor. Currently, designated critical habitat is moderately degraded. Habitat quality in tributary streams varies from excellent in wilderness and roadless areas, to poor in areas subject to heavy agricultural and urban development. The water quality and food production features of juvenile rearing and migration PCEs in several watersheds and the mainstem Columbia River have been degraded by contaminants from agriculture. Several dams affect the adult migration PCE by obstructing the migration corridor.

4.34 Steelhead (Upper Willamette River DPS)

The UWR steelhead DPS includes all naturally spawned winter-run steelhead populations below natural and manmade impassable barriers in the Willamette River, Oregon, and its tributaries upstream from Willamette Falls to the Calapooia River (inclusive). No artificially propagated populations are included in the DPS. Hatchery summer-run steelhead occur in the Willamette Basin, but they are an out-of-basin population and not included in the DPS. We used information available in status reviews reviews (Busby et al. 1996, Good et al. 2005, Ford 2011, NMFS 2011n), the recovery plan (Oregon Department of Fish and Wildlife and NMFS 2011), listing documents (64 FR 14517; 71 FR 834), and previously issued biological opinions (NMFS 2012b) to summarize the status of the species.

4.34.1 Life History

Native steelhead in the Upper Willamette are late-migrating winter-run fish. Steelhead enter fresh water in January and February (Howell et al. 1985), but do not ascend to spawning areas until late March or April, later than other winter-run steelhead. Spawning occurs from April to June. The majority of juveniles smolt and emigrate after two years. Peak smolt emigration past Willamette Falls occurs from early April to early June, with a peak in early- to mid-May (Howell et al. 1985). Smolts generally migrate through the Columbia River via Multnomah Channel rather than the mouth of the Willamette River. Most adults return to fresh water after spending two years in the ocean

4.34.2 Population Dynamics

Four basins on the east side of the Willamette River historically supported independent steelhead populations, all of which remain extant. There is intermittent spawning and rearing in tributaries on the west side of the Willamette River, but these areas are not considered to be independent populations. Because native winter-run steelhead also return outside of the DPS boundaries, Willamette Falls counts represent the best estimate for the DPS abundance. The average number of steelhead passing Willamette Falls in the 1990s was less than 5,000 fish. The number increased to over 10,000 fish in 2001 and 2002. The geometric and arithmetic mean number of steelhead passing Willamette Falls for the period 1998 to 2001 were 5,819 and 6,795 fish, respectively. More recent abundances have declined. The total abundance of steelhead at Willamette Falls in 2008 was 4,915 adults. In 2009, the abundance was 2,110 fish.

4.34.3 Status
NMFS originally listed Upper Willamette steelhead as threatened on March 25, 1999 (64 FR 14517), and reaffirmed their status on January 5, 2006 (71 FR 834). Factors contributing to the listing of this DPS include the generalized listing factors for West Coast salmon (i.e., destruction and modification of habitat, overutilization for recreational purposes, and natural and human-made factors), as well as the more specific issues of damming, water diversions, poor ocean conditions and overharvest. Though access to historical spawning grounds has been lost behind dams, the DPS remains spatially well-distributed. Three populations are considered to be in the moderate to high risk category for spatial structure and one is in the low risk category. The DPS continues to demonstrate an overall low abundance pattern. The elimination of winter-run hatchery releases reduces threats from artificial propagation, but non-native summer steelhead hatchery releases are still a concern. Human population growth within the Willamette Basin continues to be a significant risk factor for the populations. This DPS remains at a moderate risk of extinction. Based on these factors, this DPS would likely have a moderate resilience to additional perturbations.

4.34.4 Critical Habitat
Designated critical habitat for the Upper Willamette River steelhead DPS includes all Columbia River estuarine areas and river reaches proceeding upstream to the confluence with the Willamette River and specific stream reaches in the subbasins: Upper Willamette, North Santiam, South Santiam, Middle Willamette, Molalla/Pudding, Yamhill, Tualatin, and Lower Willamette. Designated critical habitat is currently degraded. The water quality and food production features of juvenile rearing and migration PCEs in several watersheds and the mainstem Columbia River have been degraded by contaminants from agriculture. Several dams affect the adult migration PCE by obstructing the migration corridor.

5 Eulachon
Eulachon are small smelt native to eastern North Pacific waters from the Bering Sea to Monterey Bay, California, or from 61º N to 31º N (Hart and McHugh 1944, Eschmeyer et al. 1983, Minckley et al. 1986, Hay and McCarter 2000) .

5.1 Eulachon (Southern DPS)
Eulachon that spawn in rivers south of the Nass River of British Columbia to the Mad River of California comprise the southern DPS of eulachon. This species is designated based upon timing of runs and genetic distinctions (Hart and McHugh 1944, McLean et al. 1999, Hay and McCarter 2000, McLean and Taylor 2001, Beacham et al. 2005) .

5.1.1 Life History
Adult eulachon are found in coastal and offshore marine habitats (Allen and Smith 1988, Hay and McCarter 2000, Willson et al. 2006) . Larval and post larval eulachon prey upon phytoplankton, copepods, copepod eggs, mysids, barnacle larvae, worm larvae, and other eulachon larvae until they reach adult size (WDFW and ODFW 2001). The primary prey of adult eulachon are copepods and euphausiids, malacostracans and cumaceans (Smith and Saalfeld

1955, Barraclough 1964, Drake and Wilson 1991, Sturdevant et al. 1999, Hay and McCarter 2000) .

Although primarily marine, eulachon return to freshwater to spawn. Adult eulachon have been observed in several rivers along the west coast (Odemar 1964, Moyle 1976, Minckley et al. 1986, Emmett et al. 1991, Jennings 1996, Wright 1999, Larson and Belchik 2000, Musick et al. 2000, WDFW and ODFW 2001). For the southern population of eulachon, most spawning is believed to occur in the Columbia River and its tributaries as well as in other Oregonian and Washingtonian rivers (Emmett et al. 1991, Musick et al. 2000, WDFW and ODFW 2001). Eulachon take less time to mature and generally spawn earlier in southern portions of their range than do eulachon from more northerly rivers (Clarke et al. 2007).

Spawning is strongly influenced by water temperatures, so the timing of spawning depends upon the river system involved (Willson et al. 2006). In the Columbia River and further south, spawning occurs from late January to March, although river entry occurs as early as December (Hay and McCarter 2000) . Further north, the peak of eulachon runs in Washington State is from February through March while Alaskan runs occur in May and river entry may extend into June (Hay and McCarter 2000) . Females lay eggs over sand, course gravel or detritial substrate. Eggs attach to gravel or sand and incubate for 30 to 40 days after which larvae drift to estuaries and coastal marine waters (Wydoski and Whitney 1979) .

Eulachon generally die following spawning (Scott and Crossman 1973). The maximum known lifespan is 9 years of age, but 20 to 30% of individuals live to 4 years and most individuals survive to 3 years of age, although spawning has been noted as early as 2 years of age (Wydoski and Whitney 1979, Barrett et al. 1984, Hugg 1996, Hay and McCarter 2000, WDFW and ODFW 2001) . The age distribution of spawners varies between river and from year-to-year (Willson et al. 2006).

5.1.2 Population Dynamics

Microsatellite genetic work, in addition to other biological data including the number of vertebrae size at maturity, fecundity, river-specific spawning times, and population dynamics (Gustafson et al. 2010) appears to confirm the existence of significant differentiation among populations in the southern DPS of eulachon. NOAA Fisheries' eulachon Biological Review Team separated the DPS into four subpopulations (Gustafson et al. 2010). These are the Klamath River (including the Mad River and Redwood Creek), the Columbia River (including all of its tributaries upstream to RM 180), the Fraser River, and the British Columbia coastal rivers (north of the Fraser River up to, and including, the Skeena River).

Abundance declines have occurred in the Fraser and other coastal British Columbia rivers (Hay and McCarter 2000, Moody 2008). Over a three-generation span of 10 years (1999 to 2009), the overall Fraser River eulachon population biomass has declined by nearly 97% (Gustafson et al. 2010). In 1999, the biomass estimates were 418 metric tons, and by 2010 had dropped to just 4 metric tons. Abundance information is lacking for many coastal British Columbia sub-area populations, but Gustafson et al. (2010) found that eulachon runs were universally larger in the past.

The Columbia River (including all of its tributaries upstream to RM 180) supports the largest known eulachon run. Although direct estimates of adult spawning stock abundance are limited, commercial fishery landing records begin in 1888 and continue as a nearly uninterrupted data set to 2010 (Gustafson et al. 2010). From about 1915 to 1992, historical commercial catch levels were typically more than 500 metric tons (500 metric tons equals approximately 12,728,100 fish at 11.55 fish per pound), occasionally exceeding 1,000 metric tons. In 1993, eulachon catch levels began to decline and averaged less than 5 metric tons from 2005 to 2008 (Gustafson et al. 2010).

From 2003 through 2013, the Fraser River eulachon population in Canada is estimated at 676,599 to 908,966 (median values) adults (COSEWIC 2011). Beginning in 2010, ODFW and WDFW began eulachon biomass surveys similar to those conducted on the Fraser River. Based on the three years of available data that have been collected and analyzed, WDFW calculated a median spawner estimate of 37 million eulachon in the Columbia River in 2011 (range 18,000,000 to 70,000,000 spawners), 34 million in 2012 (range 19,000,000 to 60,000,000 spawners), and 110,000,000 million spawners in 2013 (range 45,000,000 to 200,000,000).

The egg and larvae production estimates for the 2010-2011 sample-years calculated a minimum estimate of 300,000,000,000 (range 1,100,000,000,000 to 300,000,000,000, with a median estimate of 590,000,000,000) egg and larvae for the Columbia River Basin population. The egg and larvae production estimates for the 2011-2012 sample-year provided by WDFW calculated a minimum estimate of 330,000,000,000 (range 1,000,000,000,000 to 330,000,000,000, with a median estimate of 580,000,000,000) egg and larvae for the Columbia River Basin population. The egg and larvae production estimates for the 2012-2013 sample-year provided by WDFW calculated a minimum estimate of 710,000,000,000 (range 3,200,000,000,000,000 to 330,000,000,000, with a median estimate of 1,700,000,000,000) egg and larvae for the Columbia River Basin population.

There are no long-term eulachon monitoring programs in Northern California. Large eulachon spawning aggregations once occurred regularly in the Klamath River, but abundance has declined substantially (Fry Jr. 1979, Moyle et al. 1995, Larson and Belchik 1998, Hamilton et al. 2005). Recent reports from Yurok tribal fisheries biologists report capturing adult eulachon in presence/absence surveys (seine/dip nets) in the Klamath River over a four-year period [2011 (7 eulachon), 2012 (40 eulachon), 2013 (112 eulachon), and 2014 (±1000 eulachon)]. All egg/larvae capture via plankton net tows in the Klamath River during this same period were determined not to be eulachon.

5.1.3 Status

The southern DPS of eulachon was listed as threatened on March 18, 2010 (75 FR 13012). The primary factors responsible for the decline of eulachon are the destruction, modification, or curtailment of habitat and inadequacy of existing regulatory mechanisms. Under the Species at Risk Act, Canada designated the Fraser River population as endangered in May 2011 because of a 98% decline in spawning stock biomass over the previous 10 years (COSEWIC 2011). The eulachon Biological Review Team was concerned that four out of seven coastal British Columbia spawning groups may be at risk of extirpation as a result of phenomena associated with small populations and random genetic effects (Gustafson et al. 2010).

There are few direct estimates of eulachon abundance. Escapement counts and spawning stock biomass estimates are only available for a small number of systems, and catch statistics from commercial and tribal fisheries are available for others. However, inferring population status or even trends from yearly catch-statistic changes requires assumptions that are difficult to corroborate (e.g., assuming that harvest effort and efficiency are similar from year to year, assuming a consistent relationship among the harvested and total stock portion, and certain statistical assumptions, such as random sampling). However, the combination of catch records and anecdotal information indicates that there were large eulachon runs in the past, which have severely declined. As a result, eulachon numbers are at, or near, historically low levels throughout the range of the southern DPS.

Although landings can be biased by level of fishing effort, evidence of persistent low eulachon returns as well as landings in the Columbia River from 1993 to 2000 prompted the states of Oregon and Washington to adopt a Joint State Eulachon Management Plan (WDFW and ODFW 2001). All recreational and commercial fisheries for eulachon were closed in Washington and Oregon in 2011. However, in 2014, WDFW and ODFW opened a limited-duration recreational and commercial fishery for eulachon.

The Biological Review Team was concerned about risks to eulachon diversity because of data suggesting that Columbia River and Fraser River spawning stocks may be limited to a single age class combined with the species' semelparous life history (individuals spawn once and die). These characteristics likely increase the species' vulnerability to environmental catastrophes and perturbations and provide less of a buffer against year-class failure than species such as herring that spawn repeatedly and have variable ages at maturity (Gustafson et al. 2010).

Threats include human activities or natural events (e.g., fish harvest, volcanoes) that alter key physical, biological and/or chemical features and reduce a species' viability. Both natural and human-related threats are outlined and organized under the following five ESA listing factors: (1) destruction or modification of habitat; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease or predation; (4) inadequacy of existing regulatory mechanisms; or (5) other natural or human factors.

5.1.4 Critical Habitat

Critical habitat has been designated for the southern DPS of eulachon (76 FR 65323). The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 539 km (335 mi) of habitat. The physical or biological features essential to the conservation of the DPS include:

(1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles. These features are essential to conservation because without them the species cannot successfully spawn and produce offspring.

(2) Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yolk sac is depleted. These features are essential to conservation because they allow adult fish to swim upstream to reach spawning areas and they allow larval fish to proceed downstream and reach the ocean.

(3) Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. Eulachon prey on a wide variety of species including crustaceans such as copepods and euphausiids (Hay and McCarter 2000, WDFW and ODFW 2001), unidentified malacostracans (Sturdevant et al. 1999), cumaceans (Smith and Saalfeld 1955), mysids, barnacle larvae, and worm larvae (WDFW and ODFW 2001). These features are essential to conservation because they allow juvenile fish to survive, grow, and reach maturity, and they allow adult fish to survive and return to freshwater systems to spawn.

6 Sturgeon

Members of the family Acipenseridae share several life history traits. Sturgeons, or Acipenseriformes, are anadromous, spawning in freshwater and spending part of their lives at sea or in saline waters with some species migrating within or between river systems, or even undergoing coastal migrations. Four species of sturgeon are listed as threatened or endangered under the ESA: shortnose sturgeon, Atlantic sturgeon, green sturgeon, and Gulf sturgeon.

6.1 Shortnose Sturgeon

Shortnose sturgeon were listed as endangered throughout its range on March 11, 1967 (32 FR 4001) pursuant to the Endangered Species Preservation Act of 1966. Shortnose sturgeon remained on the list as endangered with enactment of the ESA in 1973.

Shortnose sturgeon occur along the Atlantic Coast of North America, from the Saint John River in Canada to the Saint Johns River in Florida. The Shortnose Sturgeon Recovery Plan (NMFS 1998a) describes 19 shortnose sturgeon populations that are managed separately in the wild. Two additional geographically separated populations occur behind dams in the Connecticut River (above the Holyoke Dam) and in Lake Marion on the Santee-Cooper River system in South Carolina (above the Wilson and Pinopolis Dams) (NMFS 1998a). While shortnose sturgeon spawning has been documented in several rivers across its range (including but not limited to: Kennebec River, ME, Connecticut River, Hudson River, Delaware River, Pee Dee River, SC, Savannah, Ogeechee, and Altamaha rivers, GA), status for many other rivers remain unknown (Shortnose Sturgeon Status Review Team 2010).

6.1.1 Life History

Sturgeon are a long-lived species, taking years to reach sexual maturity. Male shortnose sturgeon tend to sexually mature earlier than females, and sturgeon residing in more northern latitudes reach maturity later than those at southerly latitudes (Shortnose Sturgeon Status Review Team 2010). Sturgeon are broadcast spawners, with females laying adhesive eggs on hard bottom, rocky substrate at upstream, freshwater sites. When the males arrive at the spawning site, they broadcast sperm into the water column to fertilize the eggs. Despite their high fecundity, sturgeon have low recruitment.

Spawning periodicity varies by species and sex, but there can be anywhere from 1 to 5 years between spawning, as individuals need to rebuild gonadal material. There is difficulty in definitively assessing where and how reliably spawning occurs. Presence of eggs, age-1 juveniles and capture of “ripe” adults moving upstream (i.e., likely on a spawning run) serve as strong indicators, but due to their life history and the impacts sturgeon populations have taken, there are additional hurdles to successful spawning. Because sturgeon are iteroparous, and populations in some areas so depleted, eggs deposited at the spawning grounds may not be fertilized if males do not arrive at the spawning grounds that year.

Hatching occurs approximately 94-140 hrs after egg deposition, and larvae assume a bottom-dwelling existence (Smith et al. 1980). The yolksac larval stage is completed in about 8-12 days, during which time larvae move downstream to rearing grounds over a 6 – 12 day period (Kynard and Horgan 2002). Size of larvae at hatching and at the juvenile stage varies by species. During the daytime, larvae use benthic structure (e.g., gravel matrix) as refugia (Kynard and Horgan 2002). Juvenile sturgeon continue to move further downstream into brackish waters, and eventually become residents in estuarine waters for months or years.

Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Shortnose sturgeon forage over sandy bottom, and eat benthic invertebrates like amphipods (Shortnose Sturgeon Status Review Team 2010).

Juvenile shortnose generally move upstream during spring and summer and downstream for fall and winter; however, these movements usually occur above the salt- and freshwater interface (Shortnose Sturgeon Status Review Team 2010). During summer and winter, adult shortnose sturgeon inhabit freshwater reaches of rivers reaches influenced by tides. During summer, at the southern end of its range, shortnose sturgeon congregate in cool, deep, areas of rivers taking refuge from high temperatures (Kynard 1997). Because they rarely leave their natal rivers, Kieffer and Kynard (1993) considered shortnose sturgeon to be freshwater amphidromous (i.e. adults spawn in freshwater but regularly enter saltwater habitats during their life).

6.1.2 Population Dynamics

Currently, there is no range-wide population estimate for shortnose sturgeon, although many individual river systems have been studied and population estimates have been generated for several rivers (Shortnose Sturgeon Status Review Team 2010). Some rivers have been more intensely studied than others, allowing for multiple estimates. Rivers with the largest shortnose sturgeon population estimates are the Hudson (ranging up to 61,000), St. John (18,000), Kennebec (9,500), Delaware (12,000), and Altamaha (6,300) (Dadswell 1979, Bain et al. 2000a, Brundage and Herron 2003, Squiers 2003, DeVries 2006).

Shortnose sturgeon populations are at risk from incidental bycatch, dams, dredging and pollution (Shortnose Sturgeon Status Review Team 2010). Despite the life span of adult sturgeon, the viability of sturgeon populations is highly sensitive to juvenile mortality resulting in lower numbers of sub-adults recruiting into the adult breeding population (Secor et al. 2002). This relationship caused Secor et al. (2002) to conclude sturgeon populations can be grouped into two demographic categories: populations having reliable (albeit periodic) natural recruitment and those that do not. The shortnose sturgeon populations without reliable natural recruitment are at more risk. Secor et al. (2002) note that sturgeon species are particularly vulnerable to the loss of juveniles from their natal populations. Sturgeon populations cannot survive fishing related mortalities exceeding 5 to 13% of an adult spawning run and they are vulnerable to declines and local extinction if juveniles die from fishing related mortalities (Boreman 1997, Secor et al. 2000).

6.1.3 Status

The shortnose sturgeon is endangered, and much remains unknown about the population status in many rivers throughout its range. The threats that face shortnose sturgeon are likely to continue into the future. However, either due to recovery or increased sampling efficiency, it appears shortnose sturgeon populations are increasing in some rivers or remaining stable in others. The Altamaha River population estimate in 1998 was 2,800 and is now 6,300, the population in the Delaware River is unchanged from 1987 to 2003, the Ogeechee population has grown from roughly 250 in the early 90s to 350 in the late 2000s, Dovel (1979) estimated the Hudson population at 30,300 and Bain et al. (2000b) estimates the population at 61,000, the Kennebec has grown from 7,200 in 1977-1981 to 9,500 in 2003, and the last shortnose in the Penobscot had been seen in 1979 until some were caught in 2005 and now the population is thought to number over 1,000. The larger threat to shortnose sturgeon survival is the habitat fragmentation caused by extirpations throughout Florida, southern Georgia, all of North Carolina except for the Cape

Fear River, all of Virginia, and all of Maryland (Rogers and Weber 1995, Kynard 1997, Kahnle et al. 1998, NMFS 1998c, Collins et al. 2000, Skjeveland et al. 2000, Welsh et al. 2002, Oakley 2003). While it appears some populations may be increasing, none of these extirpated populations have been recolonized for various reasons.

6.1.4 Critical Habitat

No critical habitat has been designated for shortnose sturgeon.

6.2 Atlantic Sturgeon (General Overview)

We discuss the distribution, life history, population dynamics, status, and critical habitats of the five species (here we use the word "species" to apply to distinct population segments, DPSs) separately; however, because listed Atlantic sturgeon species are virtually indistinguishable in the wild and comprise the same biological species, we begin this section describing characteristics common across DPSs. We used information available in the 2007 Atlantic Sturgeon Status Review (ASSRT 2007), and the listing documents (77 FR 5880, 77 FR 5914) to summarize the status of the species.

The range of Atlantic sturgeon includes the St. John River in Canada, to St. Johns River in Florida. Five DPSs of Atlantic sturgeon were designated and listed under the ESA on February 6, 2012 (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic) (77 FR 5880, 77 FR 5914).

6.2.1 Life History

Although the Atlantic sturgeon DPSs are genetically distinct, their life history characteristics are the same and are discussed together below.

As Acipensieriformes, Atlantic sturgeon are anadromous and iteroparus. Like shortnose sturgeon, male Atlantic sturgeon tend to sexually mature earlier than females, and sturgeon residing in more northern latitudes reach maturity later than those at southerly latitudes. Evidence of Atlantic sturgeon spawning has been found in many of the same rivers as shortnose sturgeon (see discussion above). Atlantic sturgeon eggs are between 2.5-3.0mm, and larvae are about 7mm long upon hatching. Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Atlantic sturgeon commonly eat polychaetes and isopods.

Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Atlantic sturgeon commonly eat polychaetes and isopods (ASSRT 2007).

As juveniles, Atlantic sturgeon migrate downstream from the spawning grounds into brackish water. Unlike shortnose sturgeon, subadult Atlantic sturgeon (76-92cm) may move out of the estuaries and into coastal waters where they can undergo long range migrations. At this stage in the coastal waters, individual subadult and adult Atlantic sturgeon originating from different DPSs will mix, but adults return to their natal river to spawn.

6.2.2 Population Dynamics

Subadult and adult Atlantic sturgeon spend time in oceanic waters during coastal migrations. Evaluating the status of the species depends on the status of the smaller extant populations because maintaining those populations maintains genetic heterogeneity and having a broad range prevents a single catastrophic event from causing their extinction. A description of each Atlantic sturgeon DPS, with details regarding the smaller, in-river populations is below.

6.2.3 Status

The status of each Atlantic sturgeon DPS will be discussed separately below.

6.2.4 Critical Habitat

No critical habitat has been designated for any Atlantic sturgeon DPS.

6.3 Atlantic Sturgeon (Gulf of Maine DPS)

The Gulf of Maine (GOM) DPS includes all Atlantic sturgeon that are spawned in the Gulf of Maine watersheds from the Maine/Canada border to Chatham, MA. The GOM DPS was listed as threatened (77 FR 5880). A 4(d) Rule to apply take prohibitions to the GOM DPS was proposed separately (76 FR 34023; June 10, 2011). The proposed rulemaking identified several activities that may take GOM DPS Atlantic sturgeon, including incidental bycatch in fisheries, habitat alteration, and "entrainment and impingement of all life stages of GOM DPS Atlantic sturgeon during the operation of water diversions, dredging projects, and power plants…" (76 FR 34023).

6.3.1 Life History

Although the Atlantic sturgeon DPSs are genetically distinct, their life history characteristics are the same; please see the description in Seciton 6.2.1, above.

6.3.2 Population Dynamics

In the early 1800s, there were estimated to be 10,240 adult Atlantic sturgeon in the Kennebec River (ASSRT 2007); currently, the existing spawning population is thought to be less than 300 adults annually. Spawning is known to occur in the Kennebec River, and it is suspected that the Penobscot River also supports spawning. Recent directed sampling has found eggs in the Kennebec, and ripe adults and age-1 fish have been captured (NMFS 16526 Report). Whether other river systems in the GOM DPS support spawning populations remains unknown. There is no current population estimate for the GOM DPS.

6.3.3 Status

Threats to GOM DPS Atlantic sturgeon include dredging, which can displace sturgeon, alter habitat, and allow saltwater to intrude further upstream, reducing freshwater spawning habitat, water quality degradation from run-off, and bycatch in commercial and recreational fisheries. Dams are also a threat to the GOM DPS, but recent dam removals in the region have begun to restore access to spawning habitat. The Edwards Dam on the Kennebec River was removed in 1999 (Natural Resources Council of Maine 2014). Construction has been underway to remove the Veazie and Great Works dams by the Penobscot River Restoration Trust since 2012 (Penobscot River Restoration Trust 2014).

The removal of dams on the Kennebec and Penobscot rivers is seen as a positive step towards restoring habitat, for the GOM DPS and for other anadromous species in the area. Recent research has detected the presence of adults, age-1 fish, and eggs in rivers where sturgeon were unknown to occur or had not been observed for many years. These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. However, despite some positive signs, there is not enough information to establish a trend for this DPS. Still, in order to recover, the GOM DPS of Atlantic sturgeon can only withstand low levels of anthropogenic mortality because as a threatened species, they are at risk of becoming endangered in the foreseeable future.

6.3.4 Critical Habitat

No critical habitat has been designated for the Gulf of Maine DPS.

6.4 Atlantic Sturgeon (New York Bight DPS)

The New York Bight (NYB) DPS is comprised of all Atlantic sturgeon that are spawned in watersheds that drain into the coastal waters from Chatham, MA, to the Delaware-Maryland border on Fenwick Island. The NYB DPS is listed as endangered (77 FR 5880).

6.4.1 Life History

Although the Atlantic sturgeon DPSs are genetically distinct, their life history characteristics are the same; please see the description in Section 6.2.1, above.

6.4.2 Population Dynamics

The NYB DPS contains two known spawning population on the Delaware and Hudson rivers. The Hudson River is thought to support one of the more robust Atlantic sturgeon populations in its entire range (ASSRT 2007). In the late 1800s, an estimated 6,000-8,000 females contributed to the Hudson River stock; estimates from fisheries data between 1985 and 1995 estimate the population at 870 spawning adults in the Hudson River (600 males and 270 females) (Kahnle et al. 2007). Peterson et al. (2000) reported that there were approximately 4,300 age-1 and -2 Atlantic sturgeon in the Hudson River between 1985 and 1995.

Before 1890, the Delaware River is estimated to have supported around 180,000 adult female Atlantic sturgeon (ASSRT 2007). There have been attempts to generate a population estimate for Atlantic sturgeon on the Delaware River; estimates of juveniles have ranged from 5,600 to less than 1,000. A directed survey by the Delaware Division of Fish and Wildlife from conducted 1991-1998 captured more than 1,700 juveniles, with a high of 565 individuals in 1991, and 14 in 1998 (ASSRT 2007). More recent directed research has found Atlantic sturgeon eggs, mature adults, and juvenile fish present in the river, and it is believed that a remnant population of Delaware River Atlantic sturgeon exists (ASSRT 2007); NMFS 16507, 16431 reports).

There is evidence to support Atlantic sturgeon presence in other New England rivers through either historical records or the existence of past Atlantic sturgeon fisheries (e.g., the Merrimack River (NH/MA), Taunton River (MA/RI), Thames and Housatonic rivers (CT)). Sub-adult individuals have been captured in the estuaries of these rivers, and the habitat is thought to be important for feeding, but there is no evidence that spawning populations occur (ASSRT 2007). Although Atlantic sturgeon are captured in the estuary of the Connecticut River and in the Connecticut waters of Long Island Sound, it is believed that the native population has been extirpated (ASSRT 2007).

6.4.3 Status

Threats to the NYB DPS include habitat loss and water quality degradation through dredging and run-off, and incidental capture in fisheries. In addition, vessel strikes are of particular concern for Atlantic sturgeon in the Delaware River, as there have been numerous reports of recovered Atlantic sturgeon carcasses with injuries consistent with being struck with a boat propeller (i.e., the carcass was severed) (ASSRT 2007).

Although the Hudson River is believed to support one of the more robust populations, the status of Atlantic sturgeon in other rivers of the NYB DPS is either unknown or severely depleted from historic levels. The threats facing the NYB DPS are expected to continue into the future. A loss of any one of the riverine populations within this DPS would represent a loss in the number of reproducing individuals, a gap in the range of the DPS, and fragmentation of the species' habitat.

6.4.4 Critical Habitat
No critical habitat has been designated for the New York Bight DPS.

6.5 Atlantic Sturgeon (Chesapeake Bay DPS)
The Chesapeake Bay (CB) DPS includes Atlantic sturgeon that are spawned in the watersheds that drain into the Chesapeake Bay from Fenwick Island to Cape Henry, VA. Major rivers that are a part of the CB DPS include the York, James, Potomac, Susquehanna, and Rappahannock rivers.

6.5.1 Life History
Although the Atlantic sturgeon DPSs are genetically distinct, their life history characteristics are the same; please see the description in Section 6.2.1, above.

6.5.2 Population Dynamics
Pre-harvest (i.e., before 1890) levels of Atlantic sturgeon in the Chesapeake Bay and its tributaries are estimated to be ~20,000 adult females. The current spawning population in the James River is thought to be less than 300 individuals per year (ASSRT 2007). Recently, evidence of a spawning population on the York River was found when researchers captured mature, ripe adults (Hager et al. In Review). Status of spawning on other major tributaries in the CB DPS is unknown, although spawning once occurred on the Potomac, Susquehanna, and Rappahannock rivers.

6.5.3 Status
The CB DPS is listed as endangered (77 FR 5880). The CB DPS has been reduced to a fraction of its historical levels by overfishing. Although there is no longer a commercial fishery, the species still faces the threats described above throughout its range. Threats to the CB DPS are the same as those facing the NYB DPS (see section 6.4.3, above); Atlantic sturgeon mortality from vessel strikes has been documented on the James River (ASSRT 2007). Many of these threats are expected to continue into the future (e.g., ship strikes, dredging, dams, fisheries bycatch). Low population numbers of every river population in the CB DPS put them in danger of extinction; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. The loss of any one riverine spawning population within the DPS will result in a decrease in genetic diversity, reduction in the number of reproducing individuals, a gap in the range of the DPS that is unlikely to be recolonized, and lower recruitment. NMFS concludes that the resiliency of the CB DPS to further perturbations is low.

6.5.4 Critical Habitat
No critical habitat has been designated for the Chesapeake Bay DPS.

6.6 Atlantic Sturgeon (Carolina DPS)

The Carolina DPS includes Atlantic sturgeon that originated from the Roanoke, Tar/Pamlico, Cape Fear, Winyah Bay, and Santee-Cooper rivers in North and South Carolina.

6.6.1 Life History

Although the Atlantic sturgeon DPSs are genetically distinct, their life history characteristics are the same; please see the description in Section 6.2.1, above.

6.6.2 Population Dynamics

Before commercial harvest began in 1890, it is estimated that there were 7,000-10,500 adult females in North Carolina, and 8,000 in South Carolina. Riverine spawning populations are thought to be at less than 3% of their historic levels (ASSRT 2007).

The spawning population in the Sampit River, part of the Winyah Bay system, is believed to have been eliminated; the status of other spawning populations in the Carolina DPS remain uncertain (ASSRT 2007). The Roanoke River has been confirmed to support a spawning population, as have the Tar-Pamlico, Cape Fear, Waccamaw, Great Pee Dee, Combahee, and Edisto rivers, with possible spawning occurring in the Neuse, Santee and Cooper Rivers (77 FR 5914).

6.6.3 Status

The Carolina DPS is listed as endangered (77 FR 5914). The Carolina DPS has been reduced to a fraction of its historical levels by past commercial harvest. Although there is no longer a commercial fishery, the species still faces threats throughout its range. Threats to the Carolina DPS include habitat loss due to dams, dredging, degraded water quality, and incidental capture in fisheries. Climate change is also expected to exacerbate water quantity and quality problems like elevated water temperatures and lower levels of dissolved oxygen (77 FR 5914). Many of these threats are expected to continue into the future (e.g., dredging, dams, fisheries bycatch), or even grow worse (e.g., climate change). Low population numbers of every river population in the Carolina DPS put them in danger of extinction; none of the populations are large or stable enough to provide with any level of certainty for continued existence of Atlantic sturgeon in this part of its range. The loss of any one riverine spawning population within the DPS will result in a decrease in genetic diversity, reduction in the number of reproducing individuals, a gap in the range of the DPS that is unlikely to be recolonized, and lower recruitment. NMFS concludes that the resiliency of the Carolina DPS to further perturbations is low.

6.6.4 Critical Habitat

No critical habitat has been designated for the Carolina DPS.

6.7 Atlantic Sturgeon (South Atlantic DPS)

The South Atlantic (SA) DPS includes Atlantic sturgeon originating from the ACE Basin (Ashepoo, Combahee, and Edisto rivers) in South Carolina, the Savannah, Ogeechee, Altamaha, and Satilla rivers in Georgia, and the St. Mary’s and St. Johns rivers in Florida.

6.7.1 Life History

Although the Atlantic sturgeon DPSs are genetically distinct, their life history characteristics are the same; please see the Section 6.2.1, above.

6.7.2 Population Dynamics

Prior to 1890, there were thought to be ~11,000 adult females in Georgia, and ~8,000 in South Carolina. The Altamaha River is thought to be the largest spawning population in the Southeast; Peterson et al. (2008) reported that approximately 324 (in 2004) and 386 (in 2005) adults per year returned. Other water systems suspected of still supporting a spawning population are the ACE Basin, the Savannah, Ogeechee, and Satilla rivers, and each is believed to have fewer than 300 adults annually (ASSRT 2007). The Ogeechee River subpopulation is considered to be particularly stressed as research has found that juvenile abundance is rare with high inter-annual variability, indicating spawning or recruitment failure. Spawning populations in the St. Mary's and St. Johns rivers are believed to be eliminated (Florida Fish and Wildlife Conservation Commission 2001).

6.7.3 Status

The SA DPS is listed as endangered (77 FR 5914). Threats to the SA DPS are similar to those faced by the Carolina DPS; see Section 6.6.3, above. These threats will likely continue into the future. Like the other Atlantic sturgeon DPSs, the SA DPS was severely depleted by overfishing, and what little is known about the current population in several rivers indicates that the populations are at low levels or have been extirpated. The loss of any one riverine spawning population within the DPS will result in a decrease in genetic diversity, reduction in the number of reproducing individuals, a gap in the range of the DPS that is unlikely to be recolonized, and lower recruitment. NMFS concludes that the resiliency of the SA DPS to further perturbations is low.

6.7.4 Critical Habitat

No critical habitat has been designated for the South Atlantic DPS.

6.8 Green Sturgeon (Southern DPS)

Green sturgeon occur in coastal Pacific waters from San Francisco Bay to Canada. The Southern DPS of green sturgeon includes populations south of (and exclusive of) the Eel River (75 FR 30714).

6.8.1 Life History

As members of the family Acipenseridae, green sturgeon share similar reproductive strategies and life history patterns with other sturgeon species; see Section 6.1.1, above.

The Sacramento River is the location of the single, known spawning population for the green sturgeon Southern DPS (Adams et al. 2007). Size of larvae at hatching and at the juvenile stage varies by species (see discussion above). Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Little is known specifically about green sturgeon foraging habits; generally, adults feed upon invertebrates like shrimp, mollusks, amphipods and even small fish, while juveniles eat opossum shrimp and amphipods (Adams et al. 2002). Juvenile green sturgeon spend 1-3 years in freshwater, disperse widely in the ocean, and return to freshwater as adults to spawn (about age 15 for males, age 17 for females) (NMFS 2010a).

6.8.2 Population Dynamics

Trend data for green sturgeon is severely limited. Available information comes from two predominant sources, fisheries and tagging. Only three data sets were considered useful for the population time series analyses by NMFS's biological review team: the Klamath Yurok Tribal fishery catch, a San Pablo sport fishery tag returns, and Columbia River commercial landings (NMFS 2005a). Using San Pablo sport fishery tag recovery data, the California Department of Fish and Game produced a population time series estimate for the southern DPS. San Pablo data suggest that green sturgeon abundance may be increasing, but the data showed no significant trend. The data set is not particularly convincing, however, as it suffers from inconsistent effort and since it is unclear whether summer concentrations of green sturgeon provide a strong indicator of population performance (NMFS 2005a). Although there is not sufficient information available to estimate the current population size of southern green sturgeon, catch of juveniles during state and federal salvage operations in the Sacramento delta are low in comparison to catch levels before the mid-1980s.

6.8.3 Status

The Southern DPS is listed as threatened (71 FR 17757; April 7, 2006). On June 2, 2010, NMFS issued a 4(d) Rule for the Southern DPS, applying certain take prohibitions (75 FR 30714). The 5 Year Status Review for the Southern DPS was initiated in 2012 (77 FR 64959). Current threats to the Southern DPS include reduction in spawning habitat (mostly from impoundments), entrainment by water projects, temperature regulations through water releases from upstream dams, contaminants, incidental bycatch and poaching (NMFS 2010a). Given the small population size, the species' life history traits (e.g., slow to reach sexual maturity), and that the threats to the population are likely to continue into the future, we conclude that the Southern DPS is not resilient to further perturbations.

6.8.4 Critical Habitat

Green sturgeon critical habitat for the Southern DPS was designated on October 9, 2009 (74 FR 52300), including coastal U.S. marine waters within 60 fathoms deep from Monterey Bay, CA to Cape Flattery, WA, including the Strait of Juan de Fuca, and numerous coastal rivers and estuaries: see the Final Rule for a complete description (74 FR 52300). Food resources were identified as a primary constituent element.

6.9 Gulf Sturgeon

Gulf sturgeon historically occurred in coastal river systems from the Mississippi River to the Suwannee River, Florida, and in the Gulf of Mexico to the Florida Bay (USFWS and Gulf States Marine Fisheries Commission 1995). Currently, Gulf sturgeon are distributed from the Suwannee River to Lake Pontchartrain and the Pearl River system, Louisiana.

6.9.1 Life History

As members of the family Acipenseridae, Gulf sturgeon share similar reproductive strategies and life history patterns with other sturgeon species; see Section 6.1.1, above..

Evidence of Gulf sturgeon spawning has been found in the Suwannee, Pearl, Pascagoula, Escambia, Yellow, Choctawhatchee, or Apalachicola Rivers (Fox et al. 2000, Heise et al. 2004, USFWS and NMFS 2009). Size of larvae at hatching and at the juvenile stage varies by species (see discussion above). Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Gulf sturgeon eat isopods, amphipods, polychaete and oligochaete annelids, as well as crustaceans (Mason Jr. and Clugston 1993). Gulf sturgeon less than two years old reside in riverine and estuarine habitats throughout the year, but evidence shows that most sub-adult and adult Gulf sturgeon feed for 3-4 months while in the marine environment, and then do not feed for the next 8-9 months after they enter freshwater (Randall and Sulak 2012).

6.9.2 Population Dynamics

There are no range-wide population estimates for Gulf sturgeon, although particular river systems have been studied, including the Suwannee and Apalachicola rivers. The Suwannee River is considered to have the most robust population of Gulf sturgeon, with a population size estimated at 2,250-3,300 (87-211cm, 18kg fish) (USFWS and NMFS 2009). Zehfuss et al. (1999) estimated about 100 Gulf sturgeon (>45cm) at the Jim Woodruff Lock and Dam on the Apalachicola (which is likely an underestimate, based on high rates of tag loss); 293 Gulf sturgeon were captured from 1982-1991.

6.9.3 Status

Gulf sturgeon were listed as threatened on September 30, 1991 (56 FR 49653) and are managed jointly by USFWS and NMFS. Like other sturgeon species, Gulf sturgeon were historically overfished, which played a large role in the decline in its population. Although no directed fisheries are in operation today, Gulf sturgeon are still at risk from incidental bycatch in other state and federal fisheries. Habitat reduction from dams blocking access to spawning areas, dredging, groundwater extraction, poor water quality and contaminants all remain current threats, which will likely continue into the future.

According to the Gulf sturgeon 5 year review, NMFS considers the population stable, with seven riverine systems showing evidence of spawning, although variability in population size has been noted. This variability is attributed to Hurricanes Ivan (2004) and Katrina (2005) (USFWS and NMFS 2009). The 5-Year Review concluded that the threatened status for Gulf sturgeon was still appropriate. We conclude that Gulf sturgeon population is stable and somewhat resilient to further perturbation.

6.9.4 Critical Habitat

Critical habitat has been designated for Gulf sturgeon (68 FR 13370; March 19, 2003) in coastal rivers and estuarine areas of the Gulf of Mexico from Florida to Louisiana. Abundant food items were identified as a primary constituent element in Gulf sturgeon critical habitat.

7 Sawfish

Sawfish, like sharks, skates, and rays, belong to a group of fish called elasmobranchs, whose skeletons are made of cartilage. The proposed project may affect the ESA-listed smalltooth sawfish, described below.

7.1 Smalltooth Sawfish (U.S. DPS)

The smalltooth sawfish is a tropical marine and estuarine elasmobranch (e.g., sharks and rays) that uses its tooth-lined rostrum to forage on fish and benthic invertebrates. The United States DPS of smalltooth sawfish was listed as endangered on April 1, 2003 (68 FR 15674). Smalltooth sawfish can be found in Florida waters, primarily in the southern tip of the state, centered around Charlotte Harbor, Everglades National Park, and Florida Bay. On June 4, 2013, NMFS proposed a rule to list five species of sawfish (Pristis spp.) found outside U.S. waters (78 FR 33300), including the non-listed DPSs of smalltooth sawfish. We used information available in the 2009

Recovery Plan (NMFS 2009e), the 5-year Review (NMFS 2010c), and the proposed listing of other sawfish (78 FR 33300) to summarize the status of the species, as follows.

7.1.1 Life History

At birth, smalltooth sawfish are approximately 31 inches (80cm). For the first three years of life (until they reach about 2.5 m in length), juveniles reside in shallow, red mangrove estuaries with salinities between 18 and 24 ppt. Adults, which can grow to be 18 ft long, remain in warm coastal waters at shallow depths. Estimates of age at maturity range from 10 to 33 years. Gestation is approximately 5 months and females likely produce litters every second year. Litter sizes may be similar to that of the largetooth sawfish, which produces brood sizes of 1-13 individuals (mean: 7.3). Overall, much uncertainty still remains in estimating life history parameters for smalltooth sawfish since very little information exists on size classes other than juveniles.

7.1.2 Population Dynamics

Since actual abundance data are limited, researchers compiled capture and sightings data (collectively referred to as encounter data) in the National Sawfish Encounter Database. From 1998 to 2011, over 3,000 smalltooth sawfish encounters were reported and compiled in the database (Florida Museum of Natural History 2014). Although this data cannot be used to assess the population because of the opportunistic nature in which they are collected (i.e., encounter data are a series of random occurrences rather than an evenly distributed search over a defined period of time), researchers can use this database to assess the spatial and temporal distribution of smalltooth sawfish. We expect that as the population grows, the geographic range of encounters will also increase. Seitz and Poulakis (2002) and Poulakis and Seitz (2004) document recent (1990 to 2002) occurrences of sawfish along the southwest coast of Florida, and in Florida Bay and the Florida Keys, respectively. This information is confirmed by Wiley and Simpfendorfer (2010) who show the core range has expanded.

The majority of smalltooth sawfish encounters today are from the southwest coast of Florida between the Caloosahatchee River and Florida Bay. Outside of this core area, the smalltooth sawfish appears more common on the west coast of Florida and in the Florida Keys than on the east coast, and occurrences decrease the greater the distance from the core area (Simpfendorfer and Wiley 2004). The capture of a smalltooth sawfish off Georgia in 2002 is the first record north of Florida since 1963. New reports during 2004 extend the current range of the species to Panama City, offshore Louisiana (south of Timbalier Island in 100 ft of water), southern Texas, and the northern coast of Cuba. The Texas sighting was not confirmed to be a smalltooth sawfish and may have been a largetooth sawfish.

Despite the lack of scientific data on abundance, recent encounters with young-of-the-year, older juveniles, and sexually mature smalltooth sawfish indicate that the U.S. population is currently reproducing (Seitz and Poulakis 2002, Simpfendorfer 2003). The abundance of juveniles encountered, including very small individuals, suggests that the population remains viable (Simpfendorfer and Wiley 2004) and data analyzed from Everglades National Park as part of an established fisheries-dependent monitoring program (angler interviews) indicate an increase of between 2 and 5% per year in abundance within the park over the past decade (Carlson et al. 2007, Carlson and Osborne 2012). Also, the declining numbers of individuals with increasing size is consistent with the historic size composition data (Simpfendorfer and Wiley 2004).

The effective population size, the number of animals in the population that produce offspring was recently estimated to be between 250 and 350 individuals (Chapman et al. 2011). Given the small effective population size and the increasing number of neonates produced, inbreeding depression was suspected to be a concern for smalltooth sawfish. Given the degree of decline and range contraction that smalltooth sawfish have experienced over the last few generations, it was originally hypothesized that the remnant smalltooth sawfish population has experienced a genetic bottleneck. However, an analysis of tissue samples (fin clips) collected under the previous permit (number 13330) indicates inbreeding is rare (Chapman et al. 2011). Results of this study also suggest that the remnant smalltooth sawfish population will probably retain 90% of its current genetic diversity and there is no evidence of a genetic bottleneck accompanying last century's demographic bottleneck.

The status and trends and recent encounters in new areas beyond the core abundance area suggest that the population may be increasing. However, smalltooth sawfish encounters are still rare along much of their historical range and they are thought to be extirpated from areas of historical abundance such as the Indian River Lagoon and John's Pass (Snelson and Williams 1981, Simpfendorfer and Wiley 2004).

7.1.3 Status

It is believed that sawfish are at less than 5% of its population size than at the time of European settlement. Historically common in coastal waters from Texas to North Carolina, the range of the DPS has been contracted to southwestern Florida. Like other elasmobranchs, smalltooth sawfish are a k-selected species, characterized by a low rate of intrinsic population growth and able to maintain relatively small population sizes in stable environments, but vulnerable to excessive mortalities. The decline in sawfish abundance is attributed to bycatch in fisheries, entanglement in marine debris, and loss of juvenile habitat through destruction of mangroves and dredging and filling projects. These factors continue to be significant threats to smalltooth sawfish survival and recovery. Therefore, the species has little resilience to additional perturbations.

7.1.4 Critical Habitat

Two units of critical habitat were designated for smalltooth sawfish in 2009 (74 FR 45353): the Charlotte Harbor Estuary and the Ten Thousand Islands/Everglades. Primary constituent elements were not identified, although the final rule identified the red mangroves and shallow euryhaline habitats as essential to the conservation of smalltooth sawfish because both serve nursery area functions. Activities that may affect smalltooth sawfish critical habitat include dredging, filling, in-water construction, installation of water control structures, and hard clam aquaculture activities.

8 Rockfish

Rockfish are classified in the taxonomic family Sebastidae. Worldwide, there are about 130 species in the family. The proposed project may affect three ESA-listed species, discussed below.

8.1 Bocaccio (Puget Sound/Georgia Basin DPS)

Bocaccio is a rockfish species that occurs from the central Baja peninsula of Mexico north along the continental shelf and slope as far as Stepovac Bay, Alaska (Love et al. 2002). Genetic analyses suggest is composed of two distinct populations (Wishard et al. 1980, Matala et al. 2004). A southern population exists along the Pacific coasts of Mexican and California and is separated from a northern population by a region of apparent scarcity from northern California to southern Oregon (MacCall and He 2002b). It has been proposed that oceanographic features, such as current patterns restricting larval movement, are responsible for population discreteness (Matala et al. 2004, NMFS 2008d). Bocaccio of the Puget Sound/Georgia Basin were determined to be a DPS and listed as endangered in 2010. However, the presence of a third population has also been suggested (Queen Charlotte Island, Vancouver Island to Point Conception, California, and south of Point Conception) (Matala et al. 2004). For stock management purposes, the NMFS and Pacific Fisheries Management Council recognize these populations as separate stocks.

8.1.1 Life History

Preferred bocaccio habitat is largely dependent upon the life stage of an individual. Larvae and young juveniles tend to be found in deeper offshore regions (1-148 km offshore), but associated with the surface and occasionally with floating kelp mats (Hartmann 1987, Love et al. 2002, Emery et al. 2006). As individuals mature into older juveniles and adults, they transition into shallow waters and settle to the bottom, preferring algae-covered rocky, eelgrass, or sand habitats and aggregating into schools (Eschmeyer et al. 1983, Love et al. 1991). After a few weeks, fish move into slightly deeper waters of 18-30 m and occupy rocky reefs (Feder et al. 1974, Carr 1983, Eschmeyer et al. 1983, Johnson 2006, Love and Yoklavich 2008). As adults, bocaccio may be found in depths of 12-478 m, but tend to remain in shallow waters on the continental shelf (20-250 m), still associating mostly with reefs or other hard substrate, but may move over mud flats (Feder et al. 1974, Kramer and O'Connell 1995, Love et al. 2002, Love et al. 2005, Love and York 2005, Love et al. 2006). Artificial habitats, such as platform structures, also appear to be suitable habitat for bocaccio (Love and York 2006). Adults may occupy territories of 200-400 hectares, but can venture outside of this territory (Hartmann 1987). Adults tend to occupy deeper waters in the southern population compared to the northern population (Love et al. 2002). Adults are not as benthic as juveniles and may occur as much as 30 m above the bottom and move 100 m vertically during the course of a day as they move between different areas (Love et al. 2002, Starr et al. 2002). Prior to severe population reductions, bocaccio appeared to frequent the Tacoma Narrows in Washington State (DeLacy et al. 1964, Haw and Buckley 1971, Miller and Borton 1980).

Bocaccio are live-bearers with internal fertilization. Once females become mature (at 54-61 cm total length), they produce 20,000-2.3 million eggs annually, with the number increasing as females age and grow larger (Hart 1973, Echeverria 1987, Love et al. 2002). However, either sex has been known to attain sexual maturity as small as 35 cm or 3 years of age and, in recent years as populations have declined, average age at sexual maturity may have declined as well (Hart 1973, Echeverria 1987, Love et al. 2002, MacCall 2002b). Mating occurs between August and November, with larvae born between January and April (Lyubimova 1965, Moser 1967, Westrheim 1975, Wyllie Echeverria 1987, Love et al. 2002, MacCall and He 2002b).

Upon birth, bocaccio larvae measure 4-5 mm in length. These larvae move into pelagic waters as juveniles when they are 1.5-3 cm and remain in oceanic waters from 3.5-5.5 months after birth (usually until early June), where they grow at ~0.5-1 mm per day (Moser 1967, Matarese et al. 1989, Woodbury and Ralston 1991, Love et al. 2002, MacCall and He 2002b, MacCall 2003). However, growth can vary from year-to-year (Woodbury and Ralston 1991). Once individuals are 3-4 cm in length, they return to nearshore waters, where they settle into bottom habitats.

Females tend to grow faster than males, but fish may take 5 years to reach sexual maturity (MacCall 2003). Individuals continue to grow until they reach maximum sizes of 91 cm, or 9.6 kg, at an estimated maximum age of 50 years (Eschmeyer et al. 1983, Halstead et al. 1990, Ralston and Ianelli 1998, Love et al. 2002, Andrews et al. 2005, Piner et al. 2006). However, individuals tend to grow larger in more northerly regions (Dark et al. 1983).

Prey of bocaccio vary with fish age, with bocaccio larvae starting with larval krill, diatoms, and dinoflagellates (Love et al. 2002). Pelagic juveniles consume fish larvae, copepods, and krill, while older, nearshore juveniles and adults prey upon rockfishes, hake, sablefish, anchovies, lanternfish, and squid (Reilly et al. 1992, Love et al. 2002).

8.1.2 Population Dynamics

Although population estimates are not available for the northern population, the southern population has been estimated to number 1.6 million fish of 1 year of age or older in 2002 (MacCall 2002a). Of these, 1.0 million were estimated to occur south of Pt. Conception, where recruitment has been stronger. However, individuals north of Pt. Conception tend to be larger and, hence, more fecund. In 2002, the southern population was estimated to produce 720 billion eggs annually (243 billion south of Pt. Conception). North of Pt. Conception, bocaccio are most abundant in the Monterey Bay area, where prime habitat seems to be over the continental slope and, secondarily, over the shelf (Dark et al. 1983).

The rate of decline for rockfish in Puget Sound has been estimated at ~3% annually for the period 1965-2007. Various rebuilding estimates for bocaccio populations have predicted recovery, but require long periods (98-170 years) and assume no mortality from fishing (intentional harvests are closed, but bycatch still occurs) (MacCall and He 2002a, MacCall 2008, NMFS 2008d).

8.1.3 Status

The Puget Sound/Georgia Basin DPS of bocaccio was listed as endangered on April 28, 2010 (75 FR 22276). Bocaccio as a species has undergone severe decline in the past several decades, with the species currently estimated to be 3.6% of its abundance in 1970 (MacCall and He 2002b). In Puget Sound prior to World War II, commercial landings of rockfish species generally remained under 20,000 lbs, but sky-rocketed during the war to 375,000 lbs annually and fluctuated between 50,000 and 220,000 lbs until 1970, when landings increased linearly with fishing effort to a peak of 900,000 lbs by 1980 (Palsson et al. 2009). Levels fluctuated after this between 48,000 and 300,000 lbs for the next decade and clearly crashed in the 1990's, with landings below 30,000 lbs annually. At the cessat*i*on of commercial fishing in 2003, 2,600 lbs of rockfish were harvested. Similar trends are seen in recreational landings from Puget Sound (WDF 1975-1986).

Among rockfish of the Puget Sound, bocaccio appear to have undergone a particular decline (MacCall and He 2002b). This has likely because of the removal of the largest, most fecund individuals of the population due to overfishing and the frequent failure of recruitment classes, possibly because of unfavorable climactic/oceanographic conditions (MacCall and He 2002b).

Bocaccio resistance to depletion and recovery is also hindered by demographic features (Love et al. 1998a). Bocaccio are long-lived fishes, taking several years to reach sexual maturity and becoming more fecund with age (Dorn 2002). As harvesting targeted the largest individuals available, bocaccio have become less capable of recovering population numbers (Love et al.

1998b). Bocaccio reproduction appears to be characterized by frequent recruitment failures, punctuated by occasional high success years (Love et al. 1998b, MacCall and He 2002b). Recruitment success appears to be linked to oceanographic/climactic patterns and may be related to cyclic warm/cool ocean periods, with cool periods having greater success (Sakuma and Ralston 1995, MacCall 1996, Love et al. 1998b, Moser et al. 2000). Harvey et al. (2006) suggested that bocaccio may have recently diverted resources from reproduction, potentially resulting in additional impairment to recovery. Overall, bocaccio have the highest variability of recruitment of any rockfish studied to date, with recruitment exhibiting a random walk and high temporal variability (MacCall and He 2002b, Tolimieri and Levin 2005).

8.1.4 Critical Habitat

NMFS proposed critical habitat designation of approximately 1,185 mi^2 of marine habitat for bocaccio in Puget Sound, Washington, on August 6, 2013 (78 FR 47635). A final designation has not been made.

8.2 Yelloweye Rockfish (Puget Sound/Georgia Basin DPS)

Yelloweye rockfish occur from Baja California to the Aleutian Islands, but are most common from central California to Alaska (Love et al. 2002). This species likely composed of at least two populations and possibly more. Yamanaka et al. (2006) found that those individuals found within the Georgia Basin and Queen Charlotte Strait were genetically distinct from other samples from Oregon to Alaska.

8.2.1 Life History

As with other rockfishes, yelloweye habitat varies based upon life stage. Larvae maintain a pelagic existence but as juveniles, move into shallow high relief rocky or sponge garden habitats (Eschmeyer et al. 1983, Richards et al. 1985, Love et al. 1991). Juveniles may also associate with floating debris or pilings (Lamb and Edgell 1986). As adults, yelloweye rockfish move in to deeper habitats. Individuals have been found in waters as deep as 549 m, but are generally found in waters of less than 180 m (Eschmeyer et al. 1983, Love et al. 2002). However, adults continue to associate with rocky, high relief habitats, particularly with caves and crevices, pinnacles, and boulder fields (Carlson and Straty 1981, Richards 1986, Love et al. 1991, O'Connell and Carlisle 1993, Yoklavich et al. 2000). Yelloweye generally occur as individuals, with loose, residential aggregations infrequently found (Coombs 1979, DeMott 1983, Love et al. 2002). In the Puget Sound region, sport catch records from the 1970’s indicate that Sucia Island and other islands of the San Juans as well as Bellingham Bay had the highest concentrations of catches (Delacy et al. 1972, Miller and Borton 1980).

Yelloweye rockfish are live bearers with internal fertilization. Copulation occurs between September and April, with fertilization taking place later as latitude increases (Hitz 1962, DeLacy et al. 1964, Westrheim 1975, O'Connell 1987, Wyllie Echeverria 1987, Lea et al. 1999). Puget Sound yelloweye mate between winter and summer, giving birth from spring to late summer (Washington et al. 1978). Gestation lasts roughly 30 days (Eldridge et al. 2002). Although yelloweye rockfish were once believed to reproduce annually, evidence exists that indicate the potential for multiple births per year (MacGregor 1970, Washington et al. 1978). Females produce more eggs as they grow older and larger, with each individual producing roughly 300 eggs per year per gram of body weight (1.2-2.7 million eggs per year) (MacGregor 1970, Hart 1973). In addition, older females of several rockfish species may be capable of provisioning their offspring better than their younger counterparts, meaning that they may be more a more influential component in a given year's recruitment success (Sogard et al. 2008).

Larvae are born at 4-5 mm in length and maintain a pelagic existence for the first 2 months of life, before moving to nearshore habitats and settling into rocky reef habitat at about 25 mm in length (DeLacy et al. 1964, Matarese et al. 1989, Moser 1996a, Love et al. 2002). Yelloweye growth is thought to vary by latitudinal gradient, with individuals in more northerly regions growing faster and larger. Year class strength appears to be most strongly linked to survival of the larval stage (Laidig et al. 2007). In general, sexual maturity appears to be reached by 50% of individuals by 15-20 years of age and 40-50 cm in length (Yamanaka and Kronlund 1997). As with other rockfish, yelloweye can be long-lived (reported oldest age is 118 years) (Munk 2001). Maximum size has been reported as 910 cm, but assymptotic size in Alaskan waters for both males and females was estimated to be 690 cm and 659-676 mm along British Columbia (Clemens and Wilby 1961, Westrheim and Harling 1975, Rosenthal et al. 1982, Love et al. 2005, Yamanaka et al. 2006).

Individuals shift to deeper habitats as they age. Juveniles tend to begin life in shallow rocky reefs and graduate to deeper rocky habitats as adults. Once adult habitat is established, individuals tend to remain at a particular site (Love 1978, Coombs 1979, DeMott 1983).

As with other rockfish species, yelloweye rockfish prey upon different species and size classes throughout their development. Larval and juvenile rockfish prey upon phyto- and zooplankton (Lee and Sampson 2009). Adult yelloweyes eat other rockfish (including members of their own species), sand lance, gadids, flatfishes, shrimp, crabs, and gastropods (Love et al. 2002, Yamanaka et al. 2006).

8.2.2 Population Dynamics

Over the period of 1965-2007, it is estimated that rockfish species has declined by 3% per year. Yelloweye rockfish within the Puget Sound/Georgia Basin (in U.S. waters) are very likely most abundant within the San Juan Basin. Though there is no reliable population census (ROV or otherwise) within the basins of Puget Sound proper, the San Juan Basin has the most suitable rocky benthic habitat (Palsson et al. 2009) and historically was the area of greatest numbers of angler catches (Moulton and Miller 1987, Olander 1991). Productivity for yelloweye rockfish is influenced by long generation times that reflect intrinsically low annual reproductive success. Natural mortality rates have been estimated from 2 to 4.6 percent (Yamanaka and Kronlund 1997, Wallace 2007). Productivity may also be particularly impacted by Allee effects, which occur as adults are removed by fishing and the density and proximity of mature fish decreases. Adult yelloweye rockfish typically occupy relatively small ranges (Love et al. 2002) and it is unknown the extent they may move to find suitable mates.

8.2.3 Status

The Puget Sound/Georgia Basin DPS of yelloweye rockfish was listed as endangered on April 28, 2010 (75 FR 22276). It has been estimated that yelloweye rockfish have fallen 30% in abundance within 1/3 of a generation in the past few decades, an astonishing rate of decline. Yelloweye rockfish abundance has been variable in the Puget Sound region over the past 60 years, ranging from less than 1% to greater than 3% of samples, although Wallace (2001) documented large historical population in the Strait of Georgia. The latest samples have been historic lows in abundance. Perhaps more importantly, age classes appear to have been truncated to younger, smaller fish, severely hampering the ability of the species to recover from its primary cause of decline: overfishing (Berkeley et al. 2004).

In Puget Sound, prior to World War II, commercial landings of rockfish species generally remained under 20,000 lbs, but sky-rocketed during the war to 375,000 lbs annually and fluctuated between 50,000 and 220,000 lbs until 1970, when landings increased linearly with fishing effort to a peak of 900,000 lbs by 1980 (Palsson et al. 2009). Levels fluctuated after this between 48,000 and 300,000 lbs for the next decade and clearly crashed in the 1990's, with landings below 30,000 lbs annually. At the cessation of commercial fishing in 2003, 2,600 lbs of rockfish were harvested. Over the period of 1965-2007, it is estimated that rockfish species has declined by 3% per year.

8.2.4 Critical Habitat

NMFS proposed critical habitat designation of approximately 575 mi^2 of marine habitat for yelloweye rockrish in Puget Sound, Washington, on August 6, 2013 (78 FR 47635). A final designation has not been made.

8.3 Canary Rockfish (Puget Sound/Georgia Basin DPS)

Canary rockfish are found from the northern Baja peninsula north to the western Gulf of Alaska, and with the greatest abundance along British Columbia to central California (Miller and Lea 1972, Hart 1973, Cailliet et al. 2000, Love et al. 2002). It is unclear how many populations compose canary rockfish as a species. Genetic analyses have found that individuals south of Cape Blanco in southern Oregon lack an allele that individuals north of this point have (Wishard et al. 1980). The Puget Sound/Georgia Basin DPS includes all canary rockfish in the waters of Puget Sound, the Strait of Georgia, and the Strait of Juan de Fuca east of Victoria Sill. In addition, canary rockfish are managed as two stocks in Canadian waters (COSEWIC in press).

8.3.1 Life History

Canary rockfish occupy a variety of habitats based upon their life stage. Larvae and younger juveniles tend to occupy shallow waters at the beginning of their lives, but generally remain in the upper 100 m of the water column (Love et al. 2002).. Juveniles initially settle into tide pools and rocky reefs (Miller and Geibel 1973, Love et al. 1991, Cailliet et al. 2000, Love et al. 2002). Juveniles have also been observed in diurnal movements, occurring near sand-rock interfaces in groups by day and moving over sandy areas at night (Love et al. 2002). After as much as 3 years, juveniles move into deeper rocky reefs, forming loose schools, rarely on but generally near the bottom (Phillips 1960, Boehlert 1980, Lamb and Edgell 1986, Rosenthal et al. 1998, Starr 1998, Cailliet et al. 2000, Johnson et al. 2003, Methot and Stewart 2005, Tissot et al. 2007). Adults may be found in waters of up to 400 m, but tend to be most common in the 80-200 m range, or even shallower (Moser 1996b, Methot and Stewart 2005, Tissot et al. 2007). Mid shelf locations seem to have the highest concentrations of canary rockfish off Washington and Oregon (Weinberg 1994). Adults tend to occur in shallow areas in higher latitudes than their southern counterparts, although adults do appear to move into progressively deeper waters as they age (Vetter and Lynn 1997, Methot and Stewart 2005). It is believed that, within Puget Sound, canary rockfish were most common in the 1960's and 1970's in Tacoma Narrows, Hood Canal, San Juan Islands, Bellingham, and Appletree Cove (Delacy et al. 1972, Miller and Borton 1980).

A latitudinal gradient may be present by age class, with older and larger individuals preferably occupying more northerly habitat (Dark et al. 1983).

Individual canary rockfish can range widely (up to 700 km over several years), although patterns of residency have been observed (Gascon and Miller 1981, DeMott 1983, Casillas et al. 1998, Lea et al. 1999, Love et al. 2002). In addition, seasonal movements have been found, with individuals moving from 160-210 m depths in late winter to 100-170 m in late summer (COSEWIC in press).

Canary rockfish develop their young internally before giving birth to live young as larvae. During each annual spawning event, a female can produce 260,000 to 1.9 million eggs, depending upon her size and age (Guillemot et al. 1985, NMFS 2008d). Unlike some other rockfish, there does not appear to be a latitudinal or geographic gradient associated with number of eggs produced (Gunderson et al. 1980, Love et al. 2002). Birth takes place in Oregonian and Washingtonian waters between September through March, with a peak in December and January. The peak in British Columbian waters is slightly later (February) (Hart 1973, Westrheim and Harling 1975, Wyllie Echeverria 1987, Barss 1989).

When born, larvae are 3.6-4.0 mm in length and take from 1-4 months to develop into juveniles (Waldron 1968, Richardson and Laroche 1979, Stahl-Johnson 1985, Moser 1996a, Krigsman 2000, Love et al. 2002). As with other rockfish, females seem grow more quickly than do males, with females reaching sexual maturity at 7-9 years of age (35-45 cm in length) versus males at 7-12 years (~41 cm in length) off Oregon (Westrheim and Harling 1975, Boehlert and Kappenman 1980, Lenarz and Echeverria 1991, STAT 1999). Mean length at sexual maturity off Vancouver Island is 41 cm for females and 48 cm for males (Westrheim and Harling 1975). Canary rockfish are known to frequently reach 60-75 years of age and have been found to be as old as 84 years (Cailliet et al. 2000, Cailliet et al. 2001, Andrews et al. 2007). Maximum reported sizes are 76 cm and 4.5 kg (Boehlert 1980, IGFA 1991, Williams et al. 1999, Love et al. 2002, Methot and Stewart 2005).

Canary rockfish prey upon different species as they age. Larvae are planktivores, consuming invertebrate eggs, copepods, and nauplii (Moser and Boehlert 1991, Love et al. 2002). Juveniles feed upon zooplankton, including crustaceans, juvenile polychaetes barnacle cyprids, and euphasiid eggs and larvae (Gaines and Roughgarden 1987, Love et al. 1991). However, adults move into a carnivorous lifestyle as well as eating euphasiids and other crustaceans. Adults consume other fishes such as shortbelly rockfish, mytophids and stomiatiods (Cailliet et al. 2000, Love et al. 2002). However, oceanographic and climactic shifts can alter foraging such that canary rockfish feed on other available species (Lee and Sampson 2009).

8.3.2 Population Dynamics

The rate of decline for rockfish in Puget Sound has been estimated at ~3% annually for the period 1965-2007.

8.3.3 Status

The Puget Sound/Georgia Basin DPS of canary rockfish was listed as threatened on April 28, 2010 (75 FR 22276). Canary rockfish were once considered common in Puget Sound, but has declined at a faster rate than any other rockfish species in the region (Holmberg et al. 1967, NMFS 2008d). In Puget Sound, prior to World War II, commercial landings of rockfish species generally remained under 20,000 lbs, but sky-rocketed during the war to 375,000 lbs annually and fluctuated between 50,000 and 220,000 lbs until 1970, when landings increased linearly with fishing effort to a peak of 900,000 lbs by 1980(Palsson et al. 2009). Levels fluctuated after this between 48,000 and 300,000 lbs for the next decade and clearly crashed in the 1990's, with landings below 30,000 lbs annually. At the cessation of commercial fishing in 2003, 2,600 lbs of rockfish were harvested. Canary rockfish have been noted for being much less frequently caught in the Puget Sound and Georgia Basin region since 1965 (NMFS 2008d). The rate of decline for rockfish in Puget Sound has been estimated at ~3% annually for the period 1965-2007.

Declines have been noted in both numbers as well as frequencies. This likely due to the targeted removal of larger, older, and more fecund individuals by commercial fisheries, reducing the ability of canary rockfish to rebound from excessive mortality (NMFS 2008d). For example, recreational fishing data have not reported any individuals caught greater than 55 cm since 2000, whereas a variety of large size classes had formerly been caught. There are concerns that even now some populations have been lost entirely, primarily due to over harvesting, but also due to low dissolved oxygen levels in some areas of Puget Sound (NMFS 2008d).

8.3.4 Critical Habitat

NMFS proposed critical habitat designation of approximately 1,185 mi^2 of marine habitat for canary rockfish in Puget Sound, Washington, on August 6, 2013 (78 FR 47635). A final designation has not been made.

9 Abalone

Abalone are molluscs classified in the taxonomic family Haliotidae. Two ESA-listed species may be affected by the proposed action and are described below.

9.1 White Abalone

The white abalone is a large marine gastropod mollusk found in deep (20 – 60 m), rocky habitats interspersed with sand channels, from Point Conception, California to Punta Abreojos, Baja California, Mexico. The species was listed as endangered under the ESA on May 29, 2001 (66 FR 29046). We used information available in the status review report (Hobday and Tegner 2000) and the recovery plan (NMFS 2008c) to summarize the status of the species, as follows.

9.1.1 Life History

White abalone are "broadcast" spawners, releasing gametes in synchrony during the winter. Fertilization is reliant upon dense adult aggregations and high gamete density. Fertilized eggs sink and hatch into free-swimming larvae. After one or two weeks, larvae settle and becoming increasingly sedentary with age. They mature at 4 – 6 years of age and can live 35 – 40 years. Females release hundreds of thousands to millions of eggs each year. White abalone are herbivorous, feeding on attached or drifting algae.

9.1.2 Population Dynamics

Surveys conducted in 2002 and 2003 resulted in population estimates of 12,818 (± 3,582) and 7,365 (± 5,340) individuals on two banks in southern California. These estimates are larger than the estimate of total abundance (600 – 1,600 individuals) in the late 1990s. Though current abundance remains unknown, it is likely less than one percent of pre-exploitation population size

9.1.3 Status

Surveys conducted between 1972 and 1997 indicate that the density of white abalone declined by four orders of magnitude (99 percent). Furthermore, juvenile shells are rarely observed, indicating a lack of recruitment. The species is endangered as a result of overharvest by commercial and recreational fisheries. The Californian commercial fishery began in 1968 and peaked at 144,000 lbs (86,000 individuals) in 1972. By 1978, white abalone catch had declined dramatically, such that individuals were rarely landed (< 1000 lbs annually). The Californian recreational fishery peaked in 1975, at ~35,000 individuals. The commercial and recreational fisheries were closed in 1996. White abalone were also harvested in Baja California, Mexico, although catch numbers are not available. Its continued existence is threatened by illegal poaching and low recruitment (the current density of white abalone limits the success rate of fertilization and recruitment). Therefore, species' resilience to future perturbations is low.

9.1.4 Critical Habitat

Critical habitat has not been designated because it was determined to be "not prudent," due to concern that disclosure of white abalone whereabouts would increase the threat of poaching (66 FR 29048).

9.2 Black Abalone

Black abalone is a large marine gastropod mollusk found in shallow (< 6 m) rocky intertidal and subtidal habitats, from Point Arena, California to Bahia Tortugas and Isla Guadalupe, Baja California, Mexico. The species was listed as endangered under the ESA on January 14, 2009 (74 FR 1937). We used information available in the status review report (Butler et al. 2009) to summarize the status of the species, as follows.

9.2.1 Life History

Black abalone are "broadcast" spawners, releasing gametes in synchrony during the spring and summer. Fertilization is reliant upon dense adult aggregations, high gamete density. Within days, fertilized eggs sink and hatch into free-swimming larvae. After 4 – 10 days, larvae settle and becoming increasingly sedentary with age. They mature at ~3 years of age and can live for 30 years. Small females release a hundred thousand eggs each year, but larger individuals release millions of eggs annually. Black abalone are herbivorous, feeding on attached or drifting algal material.

9.2.2 Population Dynamics

Fisheries data indicate that black abalone populations have declined > 95% in recent decades, such that the species now exhibits a patchy distribution along the coasts of California and northern Baja California. The populations appear to be reproductively isolated by distance, emphasizing the importance of local spawning and recruitment.

9.2.3 Status

Long-term monitoring sites from most of the geographical range of black abalone in the United States indicate that black abalone have become locally extinct at 11 of the 32 study locations (34%), have declined between 90–99% in abundance at an additional 10 (31%) study locations, and have declined between 80–89% at 2 sites (Neuman et al. 2010). At 8 northern sites (25%), there have been no instances of declines, and average abundance has increased by 56% (Neuman et al. 2010). Thus, significant declines (>80%) have occurred at the majority (72%) of study sites, including all sites in southern California (Neuman et al. 2010). There is evidence of recent recruitment in northern Baja California. Black abalone are endangered as a result of overharvest and disease. The Californian commercial fishery peaked at 1,860 metric tons in 1879, reached 868 metric tons in 1973, and fell to <20 metric tons in 1993, when the commercial and recreational fisheries were closed. Between 1972 and 1981, over 3.5 million individuals were harvested. The Mexican commercial fishery peaked in 1990 with 28 metric tons and declined to < 0.5 metric tons by 2003. The severe declines were caused primarily by withering syndrome. Withering syndrome is a disease caused by bacteria that prevents assimilation of nutrients in the digestive system. The first appearance along mainland California occurred in 1988, when approximately 85% of the resident black abalone in Diablo Cove died as a result of the disease and warm-water effluent from a nuclear power facility. Previous overharvest, continued poaching, and withering syndrome have resulted in extremely low population densities, which further reduce the potential for fertilization and recruitment and limit the recovery potential of the species. Its resilience to future perturbations is extremely low.

9.2.4 Critical Habitat

On October 27, 2011, the NMFS designated critical habitat for black abalone as follows: rocky areas from mean high water to six meters water depth in the Farallon, Channel, and Año Nuevo islands; the California coastline from Del Mar Ecological Reserve south to Government Point (excluding some stretches, such as in Monterey Bay and between Cayucos and Montaña de Oros State Park); and between the Palos Verdes and Torrance border south to Los Angeles Harbor. These areas include primary constituent elements required by black abalone, such as: rocky substrates, food resources, juvenile settlement habitat, suitable water quality, and suitable nearshore circulation patterns.

10 Corals

Corals include a diverse range of animals that are taxonomically complex. Most corals are classified in the taxonomic Class Anthozoa. Most reef-building corals are further classified in the Order Scleractinia Thousands of species of reef-building corals occur worldwide. The proposed project may affect two ESA-listed coral species and 66 species proposed for ESA-listing, discussed below.

10.1 Elkhorn Coral

Elkhorn coral is a branching coral found in reef crest and fore reef environments (1 – 5 m) in Florida, Bahamas, and the Caribbean. It was listed as threatened under the ESA on May 9, 2006 (71 FR 26852); it was proposed as endangered on December 7, 2012 (77 FR 73219). We used information available in the status review report (*Acropora* Biological Review Team 2005) and the proposed listing (77 FR 73219) to summarize the status of the species, as follows.

10.1.1 Life History

Elkhorn corals reproduce sexually and asexually (i.e., fragmentation). Sexual reproduction is accomplished by releasing sperm and egg during spawning events, which last only a few nights during July, August, and/or September. After fertilization, planktonic planulae larvae form. In response to physical and biological settlement cues, larvae settle on exposed, hard surfaces. Larger colonies have higher fertility and fecundity rates. Colony maintenance is achieved mainly by asexual reproduction, whereas sexual reproduction and recruitment is required for colony growth. Nutrients are provided by symbiotic, photosynthesizing zooxanthellae, which require sunlight and relatively clear, well-circulated water. The species' optimal water temperatures range from 25 to 29°C; elevated temperature may result in bleaching (i.e., loss of zooxanthellae).

10.1.2 Population Dynamics

Once abundant throughout its range, elkhorn coral has experienced precipitous declines since the 1980s. In areas where quantitative data are available, the species has declined in abundance (coverage and colony numbers) by greater than 97 percent. Since 2006, some populations have declined by an additional 50 percent and experienced recruitment failure; however no populations have been extirpated, and the species retains its historical range.

10.1.3 Status

Elkhorn coral was once one of the most abundant and important Caribbean coral species, in terms of accretion of reef structure. Disease, temperature-induced bleaching, and physical damage from hurricanes led to severe declines in the 1980s. Current major threats include climate change (ocean warming and acidification), disease, sedimentation, and nutrient over-enrichment. Current levels of abundance and recruitment are extremely low, and the species continues to decline without any signs of recovery; however, there is no evidence of extirpation. Therefore, the species' resilience to future perturbations is limited.

10.1.4 Critical Habitat

On November 26, 2008, NMFS designated critical habitat for elkhorn coral. They designated marine habitat in four specific areas: Florida (1,329 square miles), Puerto Rico (1,383 square miles), St. John/St. Thomas (121 square miles), and St. Croix (126 square miles). These areas support the following physical or biological features that are essential to the conservation of the species: substrate of suitable quality and availability to support successful larval settlement and recruitment and reattachment and recruitment of fragments.

10.2 Staghorn Coral

Staghorn coral is a branching coral found in reef terraces and outer reef environments (5 – 15 m) in Florida, Bahamas, and the Caribbean. It was listed as threatened under the ESA on May 9, 2006 (71 FR 26852); it was proposed as endangered on December 7, 2012 (77 FR 73219). We used information available in the status review report (*Acropora* Biological Review Team 2005) and the proposed listing (77 FR 73219) to summarize the status of the species, as follows.

10.2.1 Life History

Staghorn corals reproduce sexually and asexually (i.e., fragmentation). Sexual reproduction is accomplished by releasing sperm and egg during spawning events, which last only a few nights during July, August, and/or September. After fertilization, planktonic planulae larvae form. In response to physical and biological settlement cues, larvae settle on exposed, hard surfaces. Larger colonies have higher fertility and fecundity rates. Colony maintenance is achieved mainly by asexual reproduction, whereas sexual reproduction and recruitment is required for colony growth. Nutrients for the coral are provided by symbiotic, photosynthesizing zooxanthellae, which require sunlight and relatively clear, well-circulated water. The species' optimal water temperatures range from 26 to 29°C; elevated temperature may result in bleaching (i.e., loss of zooxanthellae), and lower temperatures reduce growth rates.

10.2.2 Population Dynamics

Once abundant throughout its range, staghorn coral has experienced precipitous declines since the 1980s. In areas where quantitative data are available, the species has declined in abundance (coverage and colony numbers) by greater than 97 percent. Since 2006, some populations have declined by an additional 50 percent and experienced recruitment failure; however no populations have been extirpated, and the species retains its historical range.

10.2.3 Status

Staghorn coral was once one of the most abundant and important Caribbean coral species, in terms of accretion of reef structure. Disease, temperature-induced bleaching, and physical damage from hurricanes led to severe declines in the 1980s. Current major threats include climate change (ocean warming and acidification), disease, sedimentation, and nutrient over-enrichment. Current levels of abundance and recruitment are extremely low, and the species continues to decline without any signs of recovery; however, there is no evidence of extirpation. Therefore, the species' resilience to future perturbations is limited.

10.2.4 Critical Habitat

On November 26, 2008, NMFS designated critical habitat for staghorn coral. They designated marine habitat in four specific areas: Florida (1,329 square miles), Puerto Rico (1,383 square miles), St. John/St. Thomas (121 square miles), and St. Croix (126 square miles). These areas support the following physical or biological features that are essential to the conservation of the species: substrate of suitable quality and availability to support successful larval settlement and recruitment and reattachment and recruitment of fragments.

11 Johnson's Seagrass

Johnson's seagrass is a rare species with an extremely limited distribution. It is found on the east coast of Florida from Sebastian Inlet to central Biscayne Bay. On September 14, 1998, NMFS issued a final rule to list the species as threatened pursuant to the ESA (69 FR 49035). We used information available in the final rule and the 5-year review (NMFS 2007c) to summarize the status of the species, as follows.

11.1.1 Life History

The life history and maintenance of populations is exclusively dependent on asexual reproduction and clonal growth dynamics. No male flowers have ever been reported, and there is no evidence of sexual reproduction. Female flowers, however, are common; they are morphologically and physiologically capable of being fertilized if male pollen was available. Growth and the occupation of space, as well as the dispersal of the species, depend on the division of apical meristems. Populations disappear and reappear on both short- (months) and long-term (years) time scales (NMFS 2007c). Johnson's seagrass is able to colonize and thrive in environments where other seagrasses cannot, as a result of its potential for vegetative expansion, a perennial and intertidal growth habit, and a relatively high tolerance for fluctuating salinity and temperature (Kenworthy and Virnstein 1997).

11.1.2 Population Dynamics

The species distribution is characterized as patchy, disjunct, and temporally fluctuating. Surveys indicate, however, that the present geographic ranges of the southern and northern limits of the species have been stable for at least 10 years. It appears that the populations in the northern range of the species (Sebastian Inlet to Jupiter Inlet) are stable and capable of sustaining themselves despite stochastic events related to severe storms and fluctuating climatology. Although it is disjunctly distributed and patchy, there is some continuity in the southern distribution, at least during periods of relatively good environmental conditions, and no significant large-scale disturbances.

11.1.3 Status

Johnson's seagrass was listed as a threatened species in 1998 because of its limited reproductive potential and energy storage capacity restrict its ability to repopulate an area after anthropogenic or natural disturbances (69 FR 49035). At the time of listing, five threats were identified: dredging, prop scoring, storm surge, altered water quality, and siltation. Given its limited distribution and inability to quickly repopulate, the species' is expected to have little resilience to these perturbations. Despite the continuation, or increase, of these threats, however, abundance and distribution have remained constant over the past decade.

11.1.4 Critical Habitat

Critical habitat for Johnson's seagrass was designated on April 5, 2000 (65 FR 17786). Ten areas were designated: a portion of the Indian River Lagoon, north of the Sebastian Inlet Channel; a portion of the Indian River Lagoon, south of the Sebastian Inlet Channel; a portion of the Indian River Lagoon near the Fort Pierce Inlet; a portion of the Indian River Lagoon, north of the St. Lucie Inlet; a portion of Hobe Sound; a site on the south side of Jupiter Inlet; a site in central Lake Worth Lagoon; a site in Lake Worth Lagoon, Boynton Beach; a site in Lake Wyman, Boca Raton; and a portion of Biscayne Bay. These areas are characterized by one or more of the following criteria: (1) locations with populations that have persisted for 10 years; (2) locations with persistent flowering populations; (3) locations at the northern and southern range limits of the species; (4) locations with unique genetic diversity; and (5) locations with a documented high abundance of Johnson's seagrass compared to other areas in the species' range. Important physical and biological features of the critical habitat areas include adequate water quality, salinity levels, water transparency, and stable, unconsolidated sediments that are free from physical disturbance.

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