NATIONAL MARINE FISHERIES SERVICE
ENDANGERED SPECIES ACT SECTION 7
BIOLOGICAL AND CONFERENCE OPINION

Title: Biological and Conference Opinion on the Issuance of Permit No. 18786-01 to the Marine Mammal Health and Stranding Response Program and Implementation of the Marine Mammal Health and Stranding Response Program (2017 Reinitiation)

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

Action Agency: Marine Mammal Health and Stranding Response Program National Marine Fisheries Service

Permits and Conservation Division, Office of Protected Resources, National Marine Fisheries Service

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1 INTRODUCTION

The Endangered Species Act of 1973, as amended (ESA; 16 U.S.C. 1531 et seq.) establishes a national program for conserving threatened and endangered species of fish, wildlife, plants, and the habitat they depend on. Section 7(a)(2) of the ESA requires Federal agencies to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species or adversely modify or destroy their designated critical habitat. Federal agencies must do so in consultation with the National Marine Fisheries Service (NMFS) for threatened or endangered species (ESA-listed), or designated critical habitat that may be affected by the action that are under NMFS jurisdiction (50 C.F.R. §402.14(a)). If a Federal action agency determines that an action "may affect, but is not likely to adversely affect" endangered species, threatened species, or designated critical habitat and NMFS concurs with that determination for species under NMFS jurisdiction, consultation concludes informally (50 C.F.R. §402.14(b)).

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, NMFS provides an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, NMFS provides a reasonable and prudent alternative that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

The action agencies for this consultation are the NMFS, Office of Protected Resources, Marine Mammal Health and Stranding Response Program (hereafter referred to as "the MMHSRP" or "the Program") for the implementation of its program pursuant to sections 104c, 109(h), 112(c) and Title IV of the Marine Mammal Protection Act (MMPA) and NMFS, Office of Protected Resources, Permits and Conservation Division (hereafter referred to as "the Permits Division") for its issuance of a scientific research and enhancement of propagation or survival permit to the MMHSRP pursuant to section 10(a)(1)(A) of the ESA. The MMHSRP proposes to take all species of marine mammals (ESA-listed and non-ESA-listed) by various means in implementing its program and the Permits Division proposes to authorize this take.

Under the ESA take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Harm is defined by regulation (50 C.F.R. §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." NMFS does not have a regulatory definition of "harass." We rely on our interim guidance, which interprets harass as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFSPD 02-110-19).

Under the MMPA take is defined as "to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill any marine mammal" (16 U.S.C. 1361 et seq.) and further defined by regulation (50 C.F.R. §216.3) as "to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following:

- the collection of dead animals, or parts thereof,
- the restraint or detention of a marine mammal, no matter how temporary,
- tagging a marine mammal,
- the negligent or intentional operation of an aircraft or vessel,
- the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal, and
- feeding or attempting to feed a marine mammal in the wild."

For purposes of this action, harassment is defined under the MMPA as any act of pursuit, torment, or annoyance which:

- has the potential to injure a marine mammal or marine mammal stock in the wild (Level A Harassment); or
- has the potential to disturb a marine mammal or marine mammal stock in the wild by causing disruption of behavioral patterns, including, but not limited to, migration, breathing, nursing, breeding, feeding, or sheltering (Level B Harassment). Under NMFS regulations, Level B harassment does not include an act that has the potential to injure a marine mammal or marine mammal stock in the wild.

This consultation, biological and conference opinion, and incidental take statement, were completed in accordance with section 7(a)(2) of the statute (16 U.S.C. 1536 (a)(2)), associated implementing regulations (50 C.F.R. §§401-16), and agency policy and guidance was conducted by NMFS Office of Protected Resources, Endangered Species Act Interagency Cooperation Division (hereafter referred to as "we"). This biological and conference opinion (opinion) and incidental take statement were prepared by NMFS Office of Protected Resources (OPR) Endangered Species Act Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 C.F.R. §402.

This document represents the NMFS' opinion on the effects of the implementation of the MMHSRP and the issuance of Permit No. 18786-01 on endangered and threatened species and designated critical habitat for those species. A complete record of this consultation is on file at NMFS OPR in Silver Spring, Maryland.

1.1 Background

The NMFS has the statutory authority, delegated from the Secretary of Commerce, to take stranded marine mammals under section 109(h) of the MMPA (16 USC 1379) and to establish and manage the MMHSRP (established in 1992) under Title IV of the MMPA (16 USC 1421 et seq.). Title IV charged the Secretary of Commerce to develop a marine mammal health and stranding response program with three goals: (1) facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild, (2) correlate the health of marine mammals and marine mammal populations, in the wild, with available data on physical, chemical, and biological environmental parameters, and (3) coordinate effective responses to marine mammal unusual mortality events. Because these activities may result in "take" of endangered or threatened species, the MMHSRP must obtain a permit under section 10(a)(1)(A) of the ESA for scientific research or the enhancement of survival of the species.

The impact(s) of the MMHSRP's actions on ESA-listed species, as well as other environmental resources, has previously been analyzed on several occasions. On March 25, 1999, the NMFS published an application for a five year permit (No. 932-1489) pursuant to sections 104(c) 109(h), 112(c), and Title IV of the MMPA and section 10(a)(1)(A) of the ESA to the MMHSRP in the Federal Register (FR) and subsequently entered into formal consultation with us regarding the effects of the MMHSRP's actions on endangered and threatened species (64 FR 14435). On July 2, 1999, we provided our biological opinion concluding that the issuance of permit No. 932-1489 and the actions of the MMHSRP were not likely to jeopardize the continued existence of currently ESA-listed species, nor adversely modify designated critical habitat. Permit 932-1489 was subsequently modified ten times while it was in effect and was superseded by the issuance of a new permit described below.

On December 28, 2005, the NMFS published a Notice of Intent (70 FR 76777-76780) to prepare a Programmatic Environmental Impact Statement (PEIS) concerning the MMHSRP. In preparation of the PEIS, the MMHSRP and the Permits Division consulted with us on the implementation of the MMHSRP and the issuance of a new five year permit (No. 932-1905/MA-009526) respectively. The resulting biological opinion issued on February 26, 2009, concluded that the actions of the MMHSRP and the Permits Division were not likely to jeopardize the continued existence of currently ESA-listed species, nor adversely modify designated critical habitat (NMFS 2009a). Subsequently, the NMFS published a Notice of Availability (74 FR 9817) of the final PEIS on March 6, 2009, which included our biological opinion determination, as well as mitigation measures to avoid, minimize, or eliminate the potential adverse effects on marine mammals and other environmental resources (NMFS 2009b). On April 21, 2009, the NMFS published a Record of Decision on the PEIS stating the environmental impact analysis completed, alternatives considered, decisions made and the basis for those decisions, and the mitigating measures developed to avoid or minimize potential impacts to the environment (NMFS 2009f).

On January 9, 2013, the Permits Division requested re-initiation of formal consultation due to the new ESA listing of four marine mammal species. On June 5, 2013, the Permits Division requested that the MMHSRP's request for a one year extension of permit No. 932-1905/MA-

009526, as allowed by regulation as a minor amendment (50 CFR 216.39), also be considered in this consultation. On February 5, 2014, we issued our biological opinion (public consultation tracking system (PCTS): FPR-2013-9029), which considered both the permit extension and the newly listed species, and concluded that the actions of the MMHSRP and the Permits Division were not likely to jeopardize the continued existence of currently ESA-listed species, nor adversely modify designated critical habitat (NMFS 2014d). Following this, on June 30, 2014, the Permits Division issued a one-year extension to permit No. 932-1905-01/MA-009526.

On March 23, 2015, the Permits Division requested formal consultation on the issuance of a new five year permit (No. 18786) to the MMHSRP. On June 29, 2015, we issued our biological opinion (PCTS: FPR-2015-9113), which evaluated both the issuance of the permit and the implementation of the MMHSRP, and concluded that the actions of the MMHSRP and the Permits Division were not likely to jeopardize the continued existence of currently ESA-listed species, nor adversely modify designated critical habitat (NMFS 2015a).

In September of 2015, the MMHSRP incidentally captured two ESA-listed turtles during a baseline bottlenose dolphin (*Tursiops truncatus*) health assessment study in Brunswick, Georgia. These captures were unexpected, and not authorized under either an ESA permit or our previous biological opinion (NMFS 2015a). As a result of these events, we reinitiated formal consultation with the MMHSRP and Permits Division on June 21, 2016, in order to re-evaluate effects to the non-mammal listed species. On July 13, 2016, we completed our biological opinion on the implementation of the MMHSRP and the modified permit (No. 18786-01), in which we authorized take of several ESA-listed turtle and fish species in an incidental take statement, and concluded that the MMHSRP and the Permits Division were not likely to jeopardize the continued existence of currently ESA-listed species nor adversely modify designated critical habitat. We subsequently identified several typographical errors in this opinion, which were corrected in an updated opinion on July 28, 2016 (NMFS 2016a).

On January 30, 2017, we met with the Permits Division and the MMHSRP to discuss a possible permit amendment in order to separate humpback whale takes by Distinct Population Segments (DPSs), given NMFS recent designation of 14 DPSs of humpback whales (81 FR 62259) and to authorize the possible import of vaquita (*Phocoena sinus*). Given that import of all marine mammals world-wide was previously authorized under Permit No. 18786-01, it was discussed that the only action likely required was to confirm our previous conference opinion on humpback whales as a biological opinion. However, after this meeting it came to our attention that the effects analysis in our previous biological opinion on Permit No. 18786-01 did not include the import of live, foreign ESA-listed marine mammals as at the time of consultation, such import was not reasonably certain to occur (NMFS 2016a). In a meeting on February 17, 2017, we discussed this issue with the Permits Division and the MMHSRP and decided to convene a larger meeting with NOAA's Offices of General Counsel and International Affairs, as well as staff from NMFS Southwest Fisheries Science Center who were involved in the import of vaquita. Prior to this larger meeting, we again met with the Permits Division and the MMHSRP to discuss if any additional activities required reinitiation. On April 7, 2017, we met with the Permits Division, the MMHSRP, NOAA's Offices of General Counsel and International Affairs, and the Southwest Fisheries Science Center, and it was decided that reinitiation was required in order to evaluate effects to foreign species from live import. On this same day, the MMHSRP requested reinitiation of formal consultation on the issuance of Permit No. 18786-01 and the implementation of the MMHSRP. As the initiation package was sufficient at this time, we reinitiated formal consultation on April 7, 2017. As the possible capture of vaquita was not proposed to occur until October 2017, at this time we agreed to conclude consultation by September 1, 2017.

1.2 Consultation History

The following dates are important to the history of the current consultation:

- On May 12, 2017, we emailed the MMHSRP to confirm that concluding consultation by September 1, 2017, met their needs regarding vaquita activities, and at this time they confirmed that September 1, 2017 for a complete biological opinion was sufficient.
- On May 26, 2017, the MMHSRP notified us that if possible, they would like to conclude consultation by the end of June 2017, in order to have our biological opinion in hand for a meeting with the Mexican government in early July, 2017. At this time, the MMHSRP also informed us that at the very latest, they requested consultation be complete by August 1, 2017, so that they can provide our biological opinion to the Mexican government for approval of the possible import of vaquita. We informed the MMHSRP that we would work towards completing consultation by the end of June 2017, and at the very latest would provide our final biological opinion by August 1, 2017. We also asked several questions of the MMHSRP regarding the circumstances under which live import of foreign ESA-listed species would occur, that were partially answered at this time.
- On June 6, 2017, we notified the Permits Division that despite what was listed in the take tables of Permit 18786-01, we did not believe the MMHSRP had any plans to import live ESA-listed marine mammals for baseline health research activities, only enhancement activities, and requested they update the permit to reflect this, once confirmed by the MMHSRP. On this date and the following day, we also received answers to the additional questions we asked the MMHSRP on May 26, 2017.
- On June 13, 2017, we notified the MMHSRP of the best available science we had access to regarding that status of vaquita (e.g., current abundance estimate), and requested they provide any additional information if possible. They confirmed that the information we had was the best available to their knowledge.

2 Description of the Proposed Action

"Action" means all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by federal agencies. The proposed actions for this consultation are the issuance of Permit No. 18786-01 to the MMHSRP, and the MMHSRP's implantation of their program pursuant to Permit No. 18786-01. Reinitiation for these actions was triggered by the MMHSRP's possible import of live foreign ESA-listed marine mammals, in particular vaquita which may soon be captured by the Mexican government, and possibly imported into the U.S. thereafter (CIRVA 2016; CIRVA 2017).

2.1 Issuance of Permit No. 18786-01

The Permits Division within the NMFS OPR previously issued a permit to the MMHSRP for scientific research and enhancement activities. The objectives for this permit for this Permit (No. 18786-01) remain the same as they were prior to reinitiation (NMFS 2016a):

1. Carry out response, rescue, rehabilitation, and release of both ESA-listed and non-listed marine mammals under the NMFS's jurisdiction (Cetacea and Pinnipedia [excluding walrus])[1] pursuant to sections 109(h), 112(c), and Title IV of the MMPA; and carry out such activities as enhancement pursuant to section 10(a)(1)(A) of the ESA.
2. Conduct health-related, *bona fide*[2] scientific research studies on marine mammals and marine mammal parts under the NMFS' jurisdiction pursuant to section 104(c) of the MMPA and section 10(a)(1)(A) of the ESA, including research related to emergency response that may involve compromised animals, and research on healthy animals that have not been subject to emergency response (e.g., baseline health studies).
3. Conduct Level B harassment, as defined by the MMPA, on all marine mammal species under the NMFS' jurisdiction incidental to MMHSRP activities in the United States (U.S.)
4. Collect, salvage, receive, possess, transfer, import, export, analyze, and curate marine mammal specimens.

The purpose of permit is to allow an exemption to the moratoria on takes established under the MMPA and to the prohibition of take established under the ESA. The permit authorizes take of all marine mammal species under NMFS's jurisdiction (including the import of foreign live ESA-listed marine mammals and their parts), and provides measures to minimize the impact of take of several non-mammalian ESA-listed marine species (green turtles, *Chelonia mydas*; hawksbill turtles, *Eretmochelys imbricate*; Kemp's ridley turtles, *Lepidochelys kempii*; leatherback turtles, *Dermochelys coriacea*; loggerhead turtles, *Caretta caretta*; olive ridley

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[1] *Throughout this opinion, the phrase "ESA-listed marine mammal species" refers to those species under NMFS' jurisdiction only.*

[2] ***Bona fide** research is research conducted by qualified personnel, the results of which: likely would be accepted for publication in a refereed scientific journal; are likely to contribute to the basic knowledge of marine mammal biology or ecology; or are likely to identify, evaluate, or resolve conservation problems.*

turtles, *Lepidochelys olivacea*; smalltooth sawfish, *Pristis pectinate*; Atlantic sturgeon, *Acipenser oxyrinchus oxyrinchus*; Gulf sturgeon, *Acipenser oxyrinchus desotoi*; shortnose sturgeon, *Acipenser brevirostrum,* green sturgeon, *Acipenser medirostris*), takes for which were authorized in the incidental take statement of our previous biological opinion on Permit No. 18786-01 and the MMHSRP (NMFS 2016a). Takes that are authorized under the permit are shown in Table 1 and Table 2. It is important to note that in the current Permit No. 18765-01, Table 1 and Table 2 do not specify if live import of ESA-listed marine mammals would occur for both baseline health research as well as enhancement activities. Nonetheless, during consultation with confirmed with the MMHSRP that import of live ESA-listed marine mammals would only occur as part of enhancement activities (personal communication with Stephen Manley, MMHSRP, June 7, 2017). The incidental take statement of this opinion provides the anticipated amount and extent of incidental take of non-mammalian ESA-listed species as determined in our original biological opinion on the issuance of Permit No. 18786-01 and the MMHSRP (NMFS 2016a), and provides an exemption to the prohibition of take for those species pursuant to section 7(o)(2) of the ESA.

Table 1. Emergency response related enhancement and research activities, incidental harassment, and import/export of marine mammals (Endangered Species Act listed and non-listed) and marine mammal parts authorized under Permit No. 18786-01. Activities may occur at any time of year on land, beaches, and coastal waters of the United States (U.S.), waters within the U.S. exclusive economic zone and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammals (Endangered Species Act listed and non-listed) and marine mammal parts.

Line No.	Species	DPS/ Stock	Life Stage	Sex	No. Animals	No. Takes per Animal	Procedures	Details
1	Cetacean, unidentified	Range-wide	All	Male and Female	As warranted to respond to emergencies and conduct response-related research		Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Captive, maintain; Captive, research; Cognitive studies; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Imaging, thermal; Import/export/receive, parts; Incidental harassment; Insert ingestible telemeter pill; Instrument, belt/harness tag; Instrument, dart/barb tag; Instrument, dorsal fin/ridge attachment; Instrument, implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Intentional (directed) mortality; Lavage; Mark, freeze brand; Mark, roto tag; Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Restrain, hand; Restrain, net; Salvage (carcass, tissue, parts); Sample, anal swab; Sample, blood; Sample, blowhole swab; Sample, blubber biopsy; Sample, exhaled air; Sample, fecal; Sample, milk (lactating females); Sample, muscle biopsy; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, stomach lavage; Sample, swab all mucus membranes; Sample, tooth extraction; Sample, urine; Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Unintentional mortality; Weigh; X-ray	Emergency response of ESA-listed cetaceans; and, emergency response research, disentanglement, incidental harassment, and import/export of all cetaceans (ESA-listed and non-listed). All activities as warranted to respond to emergencies including emergency-related research.

Line No.	Species	DPS/ Stock	Life Stage	Sex	No. Animals	No. Takes per Animal	Procedures	Details
2	Pinniped, unidentified	Range-wide	All	Male and Female	As warranted to respond to emergencies and conduct response-related research		Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Calipers (skin fold); Captive, maintain; Captive, research; Cognitive studies; Collect, molt; Collect, scat; Collect, spew; Collect, urine; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Imaging, thermal; Import/export/receive, parts; Incidental harassment; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., PIT); Intentional (directed) mortality; Lavage; Mark, bleach; Mark, clip fur; Mark, dye or paint; Mark, flipper tag; Mark, freeze brand; Mark, hot brand; Mark, other (e.g., neoprene patch); Measure (standard morphometrics); Measure colonic temperature; Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Restrain, board; Restrain, cage; Restrain, hand; Restrain, net; Restrain, other; Salvage (carcass, tissue, parts); Sample, anal swab; Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, exhaled air; Sample, fecal enema; Sample, fecal loop; Sample, fecal swab; Sample, milk (lactating females); Sample, muscle biopsy; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, stomach lavage; Sample, swab all mucus membranes; Sample, tooth extraction; Sample, urine catheter; Sample, vibrissae (clip); Sample, vibrissae (pull); Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Unintentional mortality; Weigh; X-ray	Emergency response of ESA-listed pinnipeds; and, emergency response research, disentanglement, incidental harassment, and import/export of all pinnipeds (ESA-listed and non-listed excluding walrus). All activities as warranted to respond to emergencies including emergency-related research.

Table 2. Research (unrelated to emergency response), incidental harassment, and import/export of marine mammals (Endangered Species Act non-listed) and marine mammal parts authorized under Permit No. 18786-01. Activities may occur year-round on land, beaches, and coastal waters of the U.S., waters within the U.S. exclusive economic zone, and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammals (Endangered Species Act non-listed) and marine mammal parts.

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
1	Dolphin, unidentified; Range-wide	All; Male and Female	As warranted		Harass	Acoustic, passive recording; Collect, feces; Collect, other; Collect, sloughed skin; Count/survey; Incidental harassment; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Tracking; Underwater photo/videography	Small cetacean aerial and vessel surveys (manned and unmanned) and associated non-intrusive sampling in the wild, captivity, and rehabilitation; all small cetaceans (non-listed and ESA-listed); direct and incidental harassment during any research activity

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
2	Dolphin, unidentified (Range-wide)	Non-neonate; Male and Female	200	5	Capture/ Handle/ Release; Harass; Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Captive, maintain temporary; Collect, feces; Collect, other; Collect, sloughed skin; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness tag; Instrument, dart/barb tag; Instrument, dorsal fin/ridge attachment; Instrument, implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Lavage; Mark, freeze brand; Mark, roto tag; Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, anal swab; Sample, blood; Sample, blowhole swab; Sample, exhaled air; Sample, fecal; Sample, milk (lactating females); Sample, muscle biopsy; Sample, other; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine; Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Weigh; X-ray	Small cetacean research activities in the wild, captivity, or rehabilitation; all non-ESA listed small cetaceans; 200 takes/year total for all species; captures, sampling, and direct and incidental harassment
3	Dolphin, unidentified (Range-wide)	Non-neonate; Male and Female	3	1	Unintentional mortality	Unintentional mortality	Small cetacean unintentional mortality; three annually (total for all species); all non-listed small cetaceans during research activities in Line 2; includes euthanasia when deemed medically necessary resulting from research activities; necropsy

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
4	Dolphin, unidentified (Range-wide)	All; Male and Female	500	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Collect, feces; Collect, other; Collect, sloughed skin; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness tag; Instrument, dart/barb tag; Instrument, dorsal fin/ridge attachment; Instrument, implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Lavage; Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Salvage (carcass, tissue, parts); Sample, anal swab; Sample, blood; Sample, blowhole swab; Sample, exhaled air; Sample, fecal; Sample, milk (lactating females); Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine; Ultrasound; Underwater photo/videography; Weigh; X-ray	Small cetacean piggy backing; sample collection during other legal takes/permitted activities (permitted research, subsistence harvests, by-catch, etc.) in the wild, captivity, or rehabilitation; all small cetaceans (non-listed and ESA-listed); 500 takes/yr for all species combined; sampling, and direct and incidental harassment
5	Large whale, unidentified (Range-wide)	All; Male and Female	5000	5	Harass/ Sampling	Acoustic, passive recording; Collect, feces; Collect, other; Collect, sloughed skin; Count/survey; Incidental harassment; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, exhaled air; Tracking; Underwater photo/videography	Large whale aerial and vessel surveys (manned and unmanned) and associated non-intrusive sampling in the wild; all large whales, non-listed and ESA-listed, including sperm whales; up to 5,000 takes/yr for all species combined; direct and incidental harassment

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
6	Large whale, unidentified (Range-wide)	Non-neonate; Male and Female	100	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, injectable sedative; Collect, feces; Collect, other; Collect, sloughed skin; Count/survey; Incidental harassment; Instrument, dart/barb tag; Instrument, implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, blood; Sample, exhaled air; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Underwater photo/videography	Large whale research activities in the wild; all non-ESA-listed large whales; 100 takes/yr total for all species; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and incidental harassment
7	Large whale, unidentified (Range-wide)	All; Male and Female	400	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, injectable sedative; Collect, feces; Collect, other; Collect, sloughed skin; Imaging, thermal; Instrument, dart/barb tag; Instrument, implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Measure; Measure colonic temperature; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Salvage (carcass, tissue, parts); Sample, anal swab; Sample, blood; Sample, blowhole swab; Sample, exhaled air; Sample, fecal; Sample, milk (lactating females); Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine; Ultrasound; Underwater photo/videography	Large whale piggy backing; sample collection during other legal takes/permitted activities (permitted research, subsistence harvests, by-catch, etc.) in the wild; 400 takes/yr for all species combined; all large whales (non-listed and ESA-listed); sampling and direct and incidental harassment; excludes sedating ESA-listed species

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
8	Pinniped, unidentified; Range-wide	All; Male and Female	As warranted		Harass	Acoustic, passive recording; Collect, molt; Collect, scat; Collect, spew; Collect, urine; Count/survey; Incidental harassment; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Underwater photo/videography	Pinniped aerial, ground, and vessel surveys (manned and unmanned) in the wild, captivity, or rehabilitation; all species of pinniped (non-listed and ESA-listed) except Hawaiian monk seals in the wild and walrus; direct and incidental harassment during any research activity

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
9	Pinniped, unidentified; Range-wide	All; Male and Female	300	5	Capture/ Handle/ Release; Harass; Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Calipers (skin fold); Captive, maintain temporary; Cognitive studies; Collect, molt; Collect, scat; Collect, spew; Collect, urine; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Incidental disturbance; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., PIT); Mark, bleach; Mark, clip fur; Mark, dye or paint; Mark, flipper tag; Mark, freeze brand; Mark, other (e.g., neoprene patch); Measure (standard morphometrics); Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Restrain, board; Restrain, cage; Restrain, hand; Restrain, net; Restrain, other; Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal enema; Sample, fecal loop; Sample, fecal swab; Sample, milk (lactating females); Sample, muscle biopsy; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, skin biopsy; Sample, stomach lavage; Sample, swab all mucus membranes; Sample, tooth extraction; Sample, urine catheter; Sample, vibrissae (clip); Sample, vibrissae (pull); Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Unintentional mortality; Weigh; X-ray	Pinniped research activities in the wild, captivity, or rehabilitation; all non-ESA-listed species of pinniped; 300 takes/yr total for all species combined; captures, sampling, and direct and incidental harassment; no hot branding
10	Pinniped, unidentified; Range-wide	All; Male and Female	5	1	Unintentional mortality	Unintentional mortality	Pinniped unintentional mortality; five annually (total for all non-listed pinnipeds) during research activities in Line 9; includes euthanasia when deemed medically necessary resulting from research activities; necropsy

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
11	Pinniped, unidentified; Range-wide	All; Male and Female	500	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular ; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Calipers (skin fold); Cognitive studies; Collect, molt; Collect, scat; Collect, spew; Collect, urine; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Imaging, thermal; Import/export/receive, parts; Incidental harassment; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., PIT); Mark, bleach ; Mark, clip fur; Mark, dye or paint; Mark, flipper tag; Mark, freeze brand; Mark, other (e.g., neoprene patch); Measure (standard morphometrics); Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Salvage (carcass, tissue, parts); Sample, blood ; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal enema; Sample, fecal loop; Sample, fecal swab; Sample, milk (lactating females); Sample, muscle biopsy; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, skin biopsy; Sample, stomach lavage; Sample, swab all mucus membranes; Sample, tooth extraction; Sample, urine catheter; Sample, vibrissae (clip); Sample, vibrissae (pull); Stable isotopes and serial blood samples; Ultrasound; Underwater photo/videography; Weigh; X-ray	Pinniped piggy backing; sample collection during other legal takes/permitted activities (permitted research, subsistence harvest, by-catch, etc.) in the wild, captivity, or rehabilitation; 500 takes/yr for all species combined; all species of pinniped (non-listed and ESA-listed) except walrus; sampling and direct and incidental harassment; no hot branding

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
12	Cetacean, unidentified (Range-wide)	All; Male and Female	As warranted		Import/ export/ receive/ transfer	Import/export/receive/transfer, parts	Receipt, possession, transport, import, export, analysis, and curation of hard and soft parts from all cetacean species (non-listed and ESA-listed); analytical and diagnostic samples may be transported, imported, or exported to laboratories world-wide
13	Pinniped, unidentified (Range-wide)	All; Male and Female	As warranted		Import/ export/ receive/ transfer	Import/export/receive/transfer, parts	Receipt, possession, transport, import, export, analysis, and curation of hard and soft parts from all pinniped species(non-listed and ESA-listed) excluding walrus; analytical and diagnostic samples may be transported, imported, or exported to laboratories world-wide
14	Whale, beluga; Cook Inlet	All; Male and Female	40	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness tag; Instrument, dart/barb tag; Instrument, dorsal fin/ridge attachment; Instrument, implantable (e.g., satellite tag); Instrument,	ESA-listed small cetacean research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
15	Whale, false killer; Main Hawaiian Islands Insular	All; Male and Female	20	5	Harass/ Sampling	suction-cup (e.g., VHF, TDR); Lavage; Mark, freeze brand; Mark, roto tag; Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, anal swab; Sample, blood; Sample, blowhole swab; Sample, exhaled air; Sample, fecal; Sample, milk (lactating females); Sample, muscle biopsy; Sample, other; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine; Tracking; Ultrasound; Underwater photo/videography; Weigh; X-ray	tagging, direct and incidental harassment; no captures in the wild; no spider tagging; no sedation (except in permanent captivity)
16	Whale, killer; Southern Resident	All; Male and Female	20	5	Harass/ Sampling		
17	Whale, blue; Range-wide	All; Male and Female	40	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Auditory brainstem response test; Collect, feces; Collect, other; Collect, sloughed skin; Imaging, thermal; Instrument, dart/barb tag; Instrument, implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, exhaled air; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography	ESA-listed large whale research activities in the wild; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and incidental harassment; no sedation
18	Whale, bowhead; Range-wide	All; Male and Female	40	5			
19	Whale, fin; Range-wide	All; Male and Female	40	5			
20	Whale, humpback; Any DPS	All; Male and Female	40	5			
21	Whale, right; North Atlantic	All; Male and Female	40	5			
22	Whale, right; North Pacific	All; Male and Female	5	5			
23	Whale, sei; Range-wide	All; Male and Female	40	5			
24	Whale, sperm; Range-wide	All; Male and Female	40	5			
25	Seal, ringed; Arctic	All; Male and Female	60	5	Capture/ Handle/	Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug, intramuscular ; Administer	ESA-listed and MMPA-depleted pinniped

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
26	Seal, bearded; Beringia DPS	All; Male and Female	60	5	Release; Harass; Harass/ Sampling	drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Calipers (skin fold); Cognitive studies; Collect, molt; Collect, other; Collect, scat; Collect, spew; Collect, urine; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Incidental disturbance; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., PIT); Mark, bleach; Mark, clip fur; Mark, dye or paint; Mark, flipper tag; Mark, freeze brand; Mark, other (e.g., neoprene patch); Measure (standard morphometrics); Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Restrain, board; Restrain, cage; Restrain, hand; Restrain, net; Restrain, other; Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal enema; Sample, fecal loop; Sample, fecal swab; Sample, milk (lactating females); Sample, muscle biopsy; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, skin biopsy; Sample, stomach lavage; Sample, swab all mucus membranes; Sample, tooth extraction; Sample, urine catheter; Sample, vibrissae (clip); Sample, vibrissae (pull); Stable isotopes and serial blood samples; Ultrasound; Underwater photo/videography; Weigh; X-ray	research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned), captures, and associated sampling and tagging, direct and incidental harassment; no hot branding
27	Seal, Guadalupe fur; Range-wide	All; Male and Female	60	5			
28	Sea lion, Steller; Western DPS	All; Male and Female	60	5			
29	Sea lion, Steller; Eastern DPS	All; Male and Female	60	5			
30	Seal, Northern fur; Eastern Pacific	All; Male and Female	60	5			

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
31	Seal, Hawaiian monk; Hawaiian Islands	All; Male and Female	60	5	Capture/ Handle/ Release; Harass; Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug, intramuscular ; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Calipers (skin fold); Cognitive studies; Collect, molt; Collect, other; Collect, scat; Collect, spew; Collect, urine; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Incidental disturbance; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., PIT); Mark, bleach; Mark, clip fur; Mark, dye or paint; Mark, flipper tag; Mark, freeze brand; Mark, other (e.g., neoprene patch); Measure (standard morphometrics); Metabolic chamber/hood; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/ Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Restrain, board; Restrain, cage; Restrain, hand; Restrain, net; Restrain, other; Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal enema; Sample, fecal loop; Sample, fecal swab; Sample, milk (lactating females); Sample, muscle biopsy; Sample, nasal swab; Sample, ocular swab; Sample, oral swab; Sample, other; Sample, skin biopsy; Sample, stomach lavage; Sample, swab all mucus membranes; Sample, tooth extraction; Sample, urine catheter; Sample, vibrissae (clip); Sample, vibrissae (pull); Stable isotopes and serial blood samples; Ultrasound; Underwater photo/videography; Weigh; X-ray	ESA-listed endangered Hawaiian monk seal research in captive settings (rehabilitation or permanent captivity) only; piggy backing research may occur in the wild under line 11 above; no hot branding
32	Dolphin, bottlenose; Western North Atlantic Coastal	All; Male and Female	100	5	Capture/ Handle/ Release; Harass; Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug, intramuscular; Administer drug, intraperitoneal; Administer drug, intravenous; Administer drug, subcutaneous; Administer drug, topical; Anesthesia, gas w/cone or mask; Anesthesia, gas w/intubation; Anesthesia, injectable sedative; Auditory brainstem response test; Collect, feces; Collect, other; Collect, sloughed skin; Count/survey; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness tag; Instrument, dart/barb tag; Instrument, dorsal fin/ridge attachment; Instrument,	MMPA-depleted small cetacean research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned), captures, and associated sampling including biopsy and tagging; direct and incidental harassment
33	Whale, killer; Non-ESA-listed stocks	All; Male and Female	10	3			

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
34	Dolphin, spinner; Eastern Tropical Pacific	All; Male and Female	40	5		implantable (e.g., satellite tag); Instrument, suction-cup (e.g., VHF, TDR); Lavage; Mark, freeze brand; Mark, roto tag; Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, anal swab; Sample, blood; Sample, blowhole swab; Sample, exhaled air; Sample, fecal; Sample, milk (lactating females); Sample, muscle biopsy; Sample, other; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine; Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Weigh; X-ray	
35	Dolphin, pantropical spotted; North-eastern Offshore	All; Male and Female	40	5			
36	Pinniped, unidentified; Range-wide	All; Male and Female	5	1	Unintentional mortality	Unintentional mortality	Unintentional mortality; each species of ESA-listed pinniped, not including Guadalupe fur seals or Hawaiian monk seals; not to exceed five individuals per species over the lifetime of the permit; includes euthanasia when deemed medically necessary due to research; necropsy
37	Seal, Guadalupe fur; Range-wide	All; Male and Female	1	1			Unintentional mortality; one total for the life of the permit (not annual); includes euthanasia when deemed medically necessary due to research; necropsy

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
38	Seal, Hawaiian monk; Hawaiian Islands	All; Male and Female	1	1			Unintentional mortality; one total for the life of the permit (not annual); animals sampled under line 31 above in captivity, rehab, or piggy backing only; includes euthanasia when deemed medically necessary due to research; necropsy

The permit covers activities of the MMHSRP through June 30, 2020. The exact dates when specific permitted activities will occur are unknown, as they are either of an emergency response nature or pertain to opportunistic field research projects and imports/exports for marine mammal health investigations but are expected to occur year-round and last for the five-year duration of the original permit (Permit No. 18786). In Permit No. 18786-01, the Permits Division specifies terms and conditions designed to help mitigate the impact of the MMHSRP on marine mammals and other ESA-listed species.

2.2 Implementation of the Program

The objectives of the program include emergency response to marine mammals in distress through stranding response, rehabilitation and release; entanglement response of all marine mammals; response to animals in danger due to natural disasters, spills, or disease threats; assessment of, or response to, marine mammal health status or threats through research activities on live and dead marine mammals; and, collection, possession, archival, import/export, and analysis of marine mammal specimens for research and enhancement purposes. The Program is carried out by the MMHSRP itself as well as authorized external partners, including co-investigators and Stranding Agreement holders. The MMHSRP has two separate but interrelated components: "enhancement" activities and "baseline health research." Takes for these two components of the Program are shown separately (see Table 1 and Table 2 above). Further descriptions of both enhancement activities and baseline health research are discussed in further detail below.

It is important to note that in this opinion, and our original opinion on Permit No. 18786-01 and the MMHSRP (NMFS 2016a), we consider the effects to ESA-listed species that may result from those activities in Table 1 and Table 2 that are directed at ESA-listed species and those directed at non-listed marine mammals. Specifically, we consider Capture/Handle/Release activities directed at non-listed marine mammals, as they have the potential to result in incidental take of ESA-listed turtle and fish species.

2.2.1 Enhancement Activities

Enhancement activities conducted by the MMHSRP include:

- Emergency response to all ESA-listed and non-listed marine mammals under the NMFS' jurisdiction (including foreign ESA-listed species), including but not limited to: response to animals that are stranded, sick, injured, trapped out-of-habitat, or in peril.
- Rehabilitation and release of ESA-listed and non-listed marine mammals.
- Temporary holding of non-releasable ESA-listed and non-listed marine mammals until permanent placement is permitted.
- Disentanglement of all ESA-listed and non-listed marine mammal species under the NMFS' jurisdiction.

Enhancement activities are described in further detail below. Takes proposed by the Permits Division for enhancement activities are shown in Table 1.

2.2.1.1 *Stranding Response*

The MMPA defines a stranding as "an event in the wild in which; (A) a marine mammal is dead and is (i) on a beach or shore of the U.S.; or (ii) in waters under the jurisdiction of the U.S. (including any navigable waters); or (B) a marine mammal is alive and is (i) on a beach or shore of the U.S. and is unable to return to the water; (ii) on a beach or shore of the U.S. and, although able to return to the water, is in need of apparent medical attention; or (iii) in the waters under the jurisdiction of the U.S. (including any navigable waters), but is unable to return to its natural habitat under its own power or without assistance" (16 USC 1421h).

NMFS authorizes the National Marine Mammal Stranding Network, a group of approximately 115 external partner organizations, for marine mammal stranding response and/or rehabilitation activities that comprise the MMHSRP. Most of these organizations have been responding to stranded animals for years or decades. The majority of stranding network organizations (79 of 115 at the time of the opinion) are authorized to respond only to non-listed marine mammals under a cooperative agreement between the organization and the NMFS Regional Office issued under Section 112(c) of the MMPA, called a Stranding Agreement. Those responders authorized to respond to ESA-listed marine mammal strandings would be Stranding Agreement holders, but would also need to be authorized as co-investigators under the permit.

Since 2009, the format of the Stranding Agreement has been standardized across all the NMFS regions with the creation of a Stranding Agreement template (Whaley 2009). This template includes numerous "Articles" that spell out the General Provisions (Article I) and Responsibilities (Article II) for both the NMFS and the external partner, lists the personnel authorized to respond to stranding events, provides for effective dates and renewal procedures, and includes a process to review, modify, or terminate the Agreement. There are three different Articles that are awarded or reserved depending upon the suite of actions that are authorized for a specific organization; Article III is for Dead Animal Response (including transport, sample collection including necropsy, and disposal), Article intravenous is for Live Animal Response: First Response (including beach rescue, triage, translocation, and transport), and Article V is for Live Animal Response: Rehabilitation and Final Disposition. External organizations that are Stranding Agreement holders may be awarded only one of these Articles, or any combination of Articles.

Any activities performed under these Stranding Agreement Articles would be considered "emergency response" under the permit (i.e., not considered baseline health research); in order to conduct "intrusive research" on animals that they respond to, or hold in rehabilitation, a Stranding Agreement holder would need to be a co-investigator under the permit with the explicit authorization from the principal investigator to conduct the specified research activity. More information on the baseline health research component of the Program is Section 2.2.2

Table 3. Stranding events involving Endangered Species Act-listed species that were responded to by Stranding Agreement holders under the Marine Mammal Health and Stranding Response Program, from January 2009 through June 2013 (NMFS 2015a; NMFS 2016a).

Species	2009	2010	2011	2012	2013	Total	Annual average
Beluga whale (Cook Inlet DPS)	7	6	2	6	5	26	5.2
Blue whale	2	3	1	0	1	7	1.4
Bowhead whale	1	2	0	1	6	10	2
False killer whale (Main Hawaiian Islands insular DPS)	0	1	0	0	0	1	0.2
Fin whale	9	8	4	8	7	36	7.2
Humpback whale (range-wide, prior to DPS listing)	49	58	30	26	44	207	41.4
Killer whale (Southern resident DPS)	0	1	0	1	0	2	0.4
North Atlantic Right whale	5	2	5	2	1	15	3
North Pacific Right whale	0	0	0	0	0	0	0
Sei whale	2	0	2	0	0	4	0.8
Sperm whale	7	12	14	13	9	55	11
Cetacean total	82	93	58	57	73	363	72.6
Bearded seal*	1	14	4	9	7	35	7
Guadalupe fur seal	15	25	23	60	8	131	26.2
Hawaiian monk seal	15	16	27	25	17	100	20
Ringed seal*	7	4	10	10	6	37	7.4
Steller sea lion*	135	125	90	134	133	617	123.4
Pinniped total	173	184	154	238	171	920	184
Marine Mammal Total	255	277	212	295	244	1283	256.6

**Reports on stranding responses to these species did not differentiate by DPS; as some DPSs of these species are not ESA-listed, numbers shown may be overestimates.*

The MMHSRP and its authorized responders responded to 1,283 strandings of ESA-listed marine mammals during the period January 2009 through June 2013 (Table 4). An average of over 256 stranded animals were responded to annually: an average of 73 cetaceans (primarily humpback whales, sperm whales, fin whales, and Cook Inlet beluga whales) and 184 pinnipeds (primarily Hawaiian monk seals and Steller sea lions). We assume that these whales and pinnipeds consisted of any age, gender, reproductive condition, or health condition; based on MMHSRP annual reports, the majority of these animals were dead upon first response from MMHSRP stranding responders.

2.2.1.2 *Entanglement Response*

The MMHSRP defines entanglements as both external processes where foreign materials (gear, line, debris, etc.) have become wrapped around, hooked into, or otherwise associated with the outside of an animal's body, as well as internal processes whereby animals have ingested gear including hooks, line, or other marine debris. Marine mammals become entangled in, or ingest, many different types of lines, gear and debris; depending upon the configuration of the entanglement or ingestion, it may cause serious injuries and can restrict the ability to move, dive, feed, reproduce, or nurse young. Responses to entanglements are targeted to assess the entanglement and identify the most appropriate action to remove the gear (if warranted), increasing the chance of survival for the individual animal. In some cases of ingested gear or marine debris, the response may entail capture and surgical or non-surgical removal of the gear or debris (specifically for pinnipeds and small cetaceans). NMFS authorizes and oversees numerous external partners to conduct the activities of the MMHSRP, including large whale entanglement response (collectively known as the National Large Whale Entanglement Response Network).

Table 4. Entanglement responses by Marine Mammal Health and Stranding Response Program of Endangered Species Act-listed species, and takes that occurred during those responses, during the period January 2009 through June 2014.

Species	Number of takes	Number of individual animals	Percentage of ESA-listed species involved in entanglement responses
Humpback whale	142	64	67
North Atlantic right whale	108	24	25
Steller sea lion	3	3	3
Sei whale	4	2	2
Hawaiian monk seal	2	2	2

Over the period January 2009 through June 2014, the percentages of entangled ESA-listed species that the MMHSRP responded to were as follows: approximately 67 percent (n = 64) were humpback whales; approximately 25 percent (n = 24) North Atlantic right whales; approximately three percent (n = 3) Steller sea lions; approximately two percent (n = 2) sei whales; and approximately two percent (n = 2) Hawaiian monk seals (Table 4).

2.2.1.3 *Unusual Mortality Event Response*

Response activities may be carried out to respond to marine mammal unusual mortality events. An unusual mortality event (UME) is defined under the MMPA as "a stranding that is unexpected; involves a significant die-off of any marine mammal population; and demands immediate response."

The marine mammal UME program was established in 1991. From 1991 to the present, there have been 60 formally recognized UMEs in the U.S. involving a variety of species and dozens to hundreds of individual marine mammals per event. Causes have been determined for 29 of the 60 UMEs documented since 1991 and have included infections, biotoxins, human interactions, and malnutrition (Figure 1). UMEs can involve any marine mammal species. The majority of UMEs declared from 1991 through 2015 have not involved ESA-listed species. Marine mammal UME investigations are coordinated by the MMHSRP in collaboration with the Regional Stranding Coordinators and the National Stranding Network. UME investigations are conducted in accordance with the National Contingency Plan for Response to Unusual Marine Mammal Mortality Events (Wilkinson 1996).

At the time of this opinion, there are three ongoing UMEs that involved ESA-listed species: Guadalupe fur seal UME in California, pinniped UME in northern Alaska, and large whale UME in Alaska.

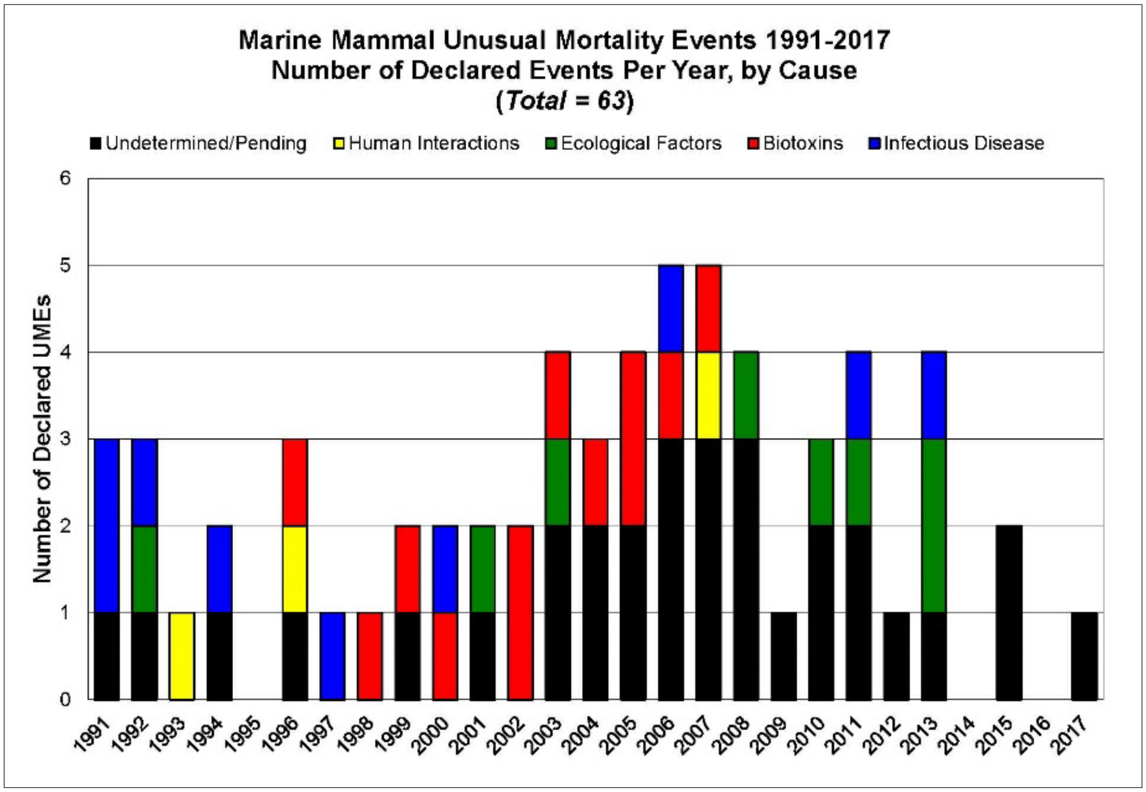

Figure 1. Numbers, and causes, of marine mammal unusual mortality events, from 1991 through 2017. Note that this figure includes both Endangered Species Act-listed and non-listed species.

Research questions, approaches, and protocols regarding UMEs are developed, reviewed, and approved by the Working Group on Marine Mammal Unusual Mortality Events, an external panel of experts on marine mammal health, in consultation with additional subject matter experts (e.g., additional virologists if an infectious viral disease is suspected). The primary role of the Working Group is to determine when a UME is occurring and to help direct the response and investigation. The Working Group developed a set of criteria to be used in determining a UME; a single criterion, or combination of criteria, may indicate the occurrence of a UME. These criteria are as follows:

- A marked increase in the magnitude or a marked change in the nature of morbidity, mortality or strandings when compared with prior records.
- A temporal change in morbidity, mortality or strandings is occurring.
- A spatial change in morbidity, mortality or strandings is occurring.

- The species, age, or sex composition of the affected animals is different than that of animals that are normally affected.
- Affected animals exhibit similar or unusual pathologic findings, behavior patterns, clinical signs, or general physical condition (e.g., blubber thickness).
- Potentially significant morbidity, mortality or stranding is observed in species, stocks or populations that are particularly vulnerable (e.g., listed as depleted, threatened or endangered or declining). For example, stranding of three or four right whales may be cause for great concern whereas stranding of a similar number of fin whales may not.
- Morbidity is observed concurrent with or as part of an unexplained continual decline of a marine mammal population, stock, or species.

2.2.1.4 *Emergency Response-Related Research*

Research activities are conducted by the MMHSRP to better understand issues surrounding marine mammal health. In the context of this opinion, research activities of the MMHSRP fall into two distinct categories:

1. "Emergency response-related research" is any research that occurs either during an emergency or after the fact and directly derives from an emergency event investigation. This type of research is classified as an "enhancement" activity for the purposes of this opinion.
2. "Baseline health research" is any research not directly related to an emergency response. This type of research is not considered an enhancement activity for the purposes of this opinion, and is described in Section 2.2.2.

Examples of "emergency response-related research" projects that derive from an emergency event investigation include conducting captures for health assessments of marine mammals during and after a UME or oil spill. For these examples, the Working Group on Marine Mammal Unusual Mortality Events or scientists through the natural resource damage assessment process, respectively, may recommend continued monitoring, assessment, and study of a population (or several populations) for a number of years, even after the UME has ended or some of the oil spill restoration has been conducted; in other situations, a different expert group may be consulted. These assessments may include monitoring of animals that appear outwardly healthy within those populations. In these cases, such research would be considered a part of the emergency response because the target animals may still be affected by the incident and the purpose of the research is to determine to what extent the animals may still be affected or are recovering. As long as the research activities are part of the approved research plans of the expert body (Working Group on Marine Mammal Unusual Mortality Events, natural resource damage assessment, etc.), these "emergency response-related research" projects would be considered part of an emergency response. Emergency response-related research would be conducted by co-investigators listed on the permit, and would receive prior approval by the principal investigator following a review of the research proposal. Take associated with "emergency response-related research" activities is included in Table 1.

2.2.1.5 *Rehabilitation*

In addition to the stranding agreement application and review process, rehabilitation facilities (which were all stranding agreement holders at the time of this opinion) must meet a separate set of requirements, the *Standards for Rehabilitation Facilities* (NMFS 2009d). These standards identify minimum requirements for rehabilitation facilities based upon taxa (cetaceans or pinnipeds) in several sections including: facilities, housing and space; water quality; quarantine; sanitation; food, handling and preparation; veterinary medical care; and record keeping and data collection. Some of these minimum requirements relate to the physical facility (e.g., adequacy of perimeter fencing), while others address actions on the part of the stranding agreement holder (e.g., how data is reported, or how records are maintained).

Rehabilitation facilities are inspected on a rotating basis, approximately every five years, by a team of inspectors to assess compliance with the minimum standards. The inspection team has consisted of personnel from NMFS and the U.S. Department of Agriculture Animal and Plant Health Inspection Service. Inspectors evaluate each facility on each applicable minimum standard. If inspectors find deficiencies in meeting the minimum standards, those deficiencies are identified as non-compliance issues. These non-compliance issues are verbally shared with the organizations and are written into a formal inspection report for the facility. Any identified non-compliance issues must be addressed by the facility to the satisfaction of the NMFS Regional Stranding Coordinator prior to the renewal of the stranding agreement. The *Standards for Rehabilitation Facilities* were also evaluated as part of the PEIS process. The issuance of the Standards, and subsequent compliance with them, was determined to be the preferred alternative to be implemented to minimize impacts on the human environment from the marine mammal rehabilitation activities of the MMHSRP.

2.2.1.6 *Release of Animals from Rehabilitation Facilities*

NMFS marine mammal veterinarians developed best practices for the release of stranded marine mammals in 2009, called the *Standards for Release* (NMFS 2009e). These guidelines provide an evaluative process for marine mammal rehabilitation facilities to determine if a stranded marine mammal in their care is suitable for release to the wild. Following a thorough assessment by the attending veterinarian and the rehabilitation team, animals are recommended to be releasable, conditionally releasable, conditionally non-releasable (manatees only), or non-releasable. Animals that are recommended to be releasable or conditionally releasable are believed to pose no risk of adverse impact to other marine mammals in the wild, and will likely be successful given the physical condition and behavior of the animal. Once the animal has been evaluated by the attending veterinarian, a summary of that evaluation is provided to the NMFS Regional Stranding Coordinator. For animals deemed releasable, the recommendation also includes a release plan with at least 15 days prior notification, unless this notification has been waived (e.g., for the typical annual cluster of cases where the etiology is known and diagnosis and treatment are routine). For animals deemed conditionally releasable, a contingency plan for how to recapture or treat the animal should it re-strand must also be included. The NMFS Regional

Administrator reviews the information provided and either: concurs with the recommendation of releasability and proposed release plan; requires additional information or changes to be made to the release plan; or does not concur with the recommendation and orders other disposition of the animal (such as placement in a public display facility). Only in rare instances does the NMFS Regional Office not concur with the recommendation of the attending veterinarian and onsite team. The standards for release document was evaluated as part of the PEIS process and issuance of the criteria in the standards for release, and subsequent compliance with them, was determined to be the preferred alternative to be implemented to minimize impacts on the human environment from the release of rehabilitated animals activities of the MMHSRP.

2.2.2 Baseline Health Research

One of the main goals of the MMHSRP is to facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild. One way this goal can be accomplished is through research projects that do not derive from an emergency event investigation. For the purposes of this opinion, these research projects are considered baseline health research and may include the following: baseline monitoring of "healthy" animals to gain reference data on the population; research and development of tools and techniques that would be tested on animals in public display, rehabilitation, or the wild; or surveillance of presumed healthy animals for the detection of new threats such as infectious diseases.

Baseline health research is research that is not conducted in direct response to an emergency response and is therefore not considered an enhancement activity (described above, Section 2.2.1) for the purposes of this consultation. Any research activities undertaken or approved by the MMHSRP, that are not conducted in response to an emergency and are not part of the approved research plans of an expert body (Working Group on Marine Mammal Unusual Mortality Events, natural resource damage assessment, etc.), would be considered baseline health research. As baseline health research is not considered an enhancement activity, takes associated with baseline health research are considered separately in this opinion from takes associated with enhancement activities (which include takes resulting from "emergency response-related research"). Takes authorized for baseline health research are presented in Table 2. While not explicitly stated in Permit No. 18786-01 or Table 2, no baseline research activities would be conducted on foreign ESA-listed species.

To the extent possible, the MMHSRP will work with researchers, who are separately permitted to capture and/or closely approach to sample marine mammals, to perform baseline health research activities. The MMHSRP may request a separately permitted researcher to collect samples that are different from, or additional to, those that the researcher is permitted for (e.g., extra blood, swabs), to aid in a health investigation that would be classified as baseline health research. Thus any takes associated with procedures performed on these animals would occur under the permits of those other permitted researchers, while samples collected for the MMHSRP would be takes under this permit. This coordination with separately permitted researchers is termed “piggy-backing.” These other researchers would hold existing permits from the Permits Division, and those permits would have previously undergone section 7 consultation.

In addition to the types of research described above, a considerable amount of other research is conducted on marine mammal parts collected legally under the permit or other authorized projects (including foreign projects, with the subsequent import of the part). This research helps the marine mammal community better understand the health of these animals and develop tools and techniques that can be used to study or assist these populations.

Detailed protocols for *bona fide* scientific research takes of ESA-listed species authorized in Table 2 must be submitted to the Permits Division in advance of the proposed activities. As necessary, the protocols will be reviewed in consultation with the Marine Mammal Commission, the U.S. Department of Agriculture Animal and Plant Health Inspection Service, and the NMFS OPR Interagency Cooperation Division. Approvals for specific research projects will be granted at the discretion of the Permits Division. These research projects will only be conducted by co-investigators listed on the permit, and must receive prior approval by the principal investigator and the Permits Division following a review by the MMHSRP of a detailed research proposal and qualifications of the personnel. This requirement does not apply in cases in which baseline health research is “piggy-backed” on other, external research permitted by the NMFS.

2.2.3 Procedures Authorized by the Permit

The Permits Division proposes to authorize the MMHSRP to conduct and oversee several procedures as part of the implementation of the Program. These procedures, described below, may occur during either enhancement or baseline health research activities as specified in Table 1 and Table 2. For some procedures, proposed protocols for implementation vary based on whether the activity falls under enhancement or baseline health research; in those cases, details on these differences in proposed protocols are provided below. The number of takes authorized for each ESA-listed species associated with each of these particular activities is shown in Table 1 and Table 2. The proposed permit includes all activities described below.

2.2.3.1 *Close Approach*

The Permits Division proposes to authorize the MMHSRP to closely approach ESA-listed marine mammals by aircraft, including unmanned aerial systems (UASs or drones) for observations, assessments, monitoring, photo-identification, photogrammetry, behavioral observation, hazing, and incidental harassment. Animals may be taken through close approaches by ground or vessel, including unmanned underwater vehicles including gliders or remotely operated vehicles for disentanglement, assessments, monitoring, photo-identification, photogrammetry, behavioral observation, capture, tagging, marking, biopsy sampling, skin scrapes, swabs, collection of sloughed skin and feces, breath sampling, blood sampling, administration of drugs, video recording, hazing, and incidental harassment. More than one aircraft and vessel may be involved in close approaches and aircraft and vessels may approach an animal more than once. Incidental harassment of non-target animals may occur during close approaches by aircraft or vessel. During both enhancement and baseline health research activities, close approaches may occur for any age class, sex, and species. Methods and protocols for close approach and associated activities are described in further detail below.

2.2.3.2 *Aerial Surveys*

The Permits Division proposes to authorize the MMHSRP to use aerial surveys to: locate imperiled marine mammals including tagged individuals; monitor behavior or disease in a given population or individual; monitor body condition and extent of entanglement or injury; survey the extent of disease outbreaks or die-offs; and locate carcasses. During emergency response and research activities, aerial surveys may occur for any age class, sex, and species.

The aircraft type used during emergency response activities depends upon the aircraft available at the time of the response and the logistics of the activity. Manned aircraft type includes helicopters and fixed-wing aircraft. Each UAS may be either remotely-operated or autonomous. Common types of UAS currently in use include fixed wing aircraft and vertical takeoff and landing multi-rotor craft (e.g., quad and hexa-copters), but the field is rapidly advancing and additional types are likely to be available during the project period. The frequency of surveys depends on the circumstances of the involved stranded or entangled animals, the disease, or the occurrence of a UME. Aerial surveys using manned aircraft are typically flown along predetermined transect lines at a set altitude and air speed while observers scan the water for signs of marine mammals.

The speed and altitude of the aircraft depend on the aircraft and the response or research situation and many vary depending upon the research or response need. For large cetaceans, manned surveys typically would be flown at an altitude of 230 to 300 meters (750 to 1,000 feet) at approximately 110 knots (203 kilometers per hour). For right whales, manned surveys would typically be flown at 100 knots (185 kilometers per hour). For smaller cetaceans, manned surveys typically would be flown at an altitude of approximately of 230 meters (750 feet). Large survey aircraft would generally be flown at 110 knots (203 kilometers per hour) and small aircraft would generally be flown at 97 knots (179 kilometers per hour). When an animal or group of animals is sighted, the survey aircraft may descend and circle over the animal or animals to obtain photographs and assess the animal(s), as needed.

For manned aircraft, a minimum altitude of 153 meters (500 feet) would be used for pinniped research surveys. The typical altitude would be between 182 to 244 meters (600 to 800 feet) at 80 to 100 knots (148 to 185 kilometers per hour). For Steller sea lion surveys during the breeding season, an altitude of at least 214 meters (700 feet) would be used to collect photographs. In the non-breeding season, surveys would be flown between 150 to 200 meters (492 to 655 feet) at a speed of 100 to 150 knots (185 to 278 kilometers per hour). All aerial surveys would be flown according to the National Oceanic and Atmospheric Administration (NOAA) Aviation Safety Policy (NOAA Administrative Order 209-124), with trained observers and pilots.

The Program proposes to fly unmanned aircraft at lower altitudes than those listed above, but no lower than necessary to collect the data sought. The most frequent use of UASs would be to carry a small camera to relay images to responders in real time or to record video and still images of animals in distress that may be reviewed later, or to carry another digital sensor such as thermal imaging. Currently available vertical takeoff and landing UASs are typically no heavier than five lbs. in weight with a battery life of an average 20 to 30 minutes, while currently available fixed wing UASs are heavier with battery lives of several hours. As this technology is rapidly evolving, we anticipate that UASs with different parameters are likely to be developed over the five year period of the permit, and MMHSRP proposes to utilize newly developed UASs as they become available. The altitude in these emergency response cases would be determined by the operational conditions, but is expected to be 10 to 50 feet in order to appropriately visualize wounds, lesions, entanglements, or other body condition parameters.

For research studies, a higher altitude would generally be used; operational requirements for UASs in research studies are currently being developed by the NMFS Science Centers and Office of Protected Resources, and MMHSRP will follow the protocols developed by these groups for research. The MMHSRP proposes to use UASs to collect additional samples; for example, an exhalate sample may be collected on an apparatus mounted beneath the UAS; the minimum altitude for this activity will be just above the whale’s blowhole (approximately 10 feet). If the UAS is equipped to take skin scrapes, collect a biopsy sample, or apply a tag, then the minimum altitude is zero feet as the UAS will make contact with the animal for a brief period of time. These techniques are currently in development and may be used within the duration of the permit. Given the relatively novel nature and use of UASs, MMHSRP proposes that when UASs are used, all attempts will be made to learn about and report the effects of altitude, payload, and other factors on the subject(s) in specific scenarios. Additionally, whenever possible, the MMHSRP proposes that trials of new techniques would be conducted on carcasses prior to use in the field. All UAS operations under the permit conducted by NOAA employees or contractors will be conducted pursuant to NOAA UAS Policy 220-1-5, including aircraft airworthiness certification, pilot and crewmember training, aircraft authorization through the Federal Aviation Administration, preflight and operational checklists, and appropriate agency notifications. All non-NOAA operators under the permit will be required to comply with Federal Aviation Administration regulations and other applicable laws. All operators will be required to have obtained appropriate training on any given airframe and meet all Federal Aviation Administration requirements for licensing prior to being authorized under this permit.

2.2.3.3 *Vessel Surveys*

The Permits Division proposes to authorize the MMHSRP to conduct vessel surveys to: collect data on animal abundance; assess animals; locate animals for research and enhancement activities; track radio tagged individuals; and collect research samples. The vessels themselves may be used as a platform for conducting animal sampling. Vessel surveys using manned and unmanned surface and underwater vessels may be used to conduct assessment, post-release monitoring of rehabilitated or disentangled animals, photo-identification, photogrammetry, and monitoring/tracking. Vessel surveys may also be used to track extralimital/out-of-habitat animals and entangled animals. During emergency response and research activities, vessel surveys may occur for any age class, sex, and species.

For small cetaceans and pinnipeds, inshore monitoring surveys are typically conducted using small (five to seven meters) outboard motor powered boats. Animals are located by having crew members visually search waters as the boat proceeds at slow speeds (eight to 16 kilometers per hour). Animals outfitted with Very High Frequency (VHF) radio tags are located by listening for the appropriate frequency and, after detecting a signal, maneuvering the boat toward the animal using a combination of signal strength and directional bearings. Frequencies and remote sensors may also be monitored. Once an animal or group of animals is located, the boat approaches them so that crew members can assess their physical and medical condition. Photographs of individual animals may be taken for later identification and matching to existing photo-identification catalogs, for post-release monitoring of a rescued and released cetacean, or to confirm identification, health, and behavior of an animal that has been recently caught for a health evaluation. A telephoto lens would be used for photographs, so vessels would generally be at least 10 meters from animals. In some instances the vessel may need to approach closely (within a few meters) for assessment or response purposes. During disentanglement operations the vessel will be within one meter of the whale.

Multiple approaches may be required to obtain appropriate quality photographs, particularly if there are multiple individuals within a group. Close approach would be terminated and the boat moved away from the group if animals were to display behavior that indicates undue stress that could possibly be related to the approach (e.g., significant avoidance behavior such as chuffing [forced exhalation], tail slapping, or erratic surfacing).

2.2.3.4 *Hazing and Attractants*

The Permits Division proposes to authorize the MMHSRP to conduct hazing of ESA-listed marine mammals. Hazing in the context of wildlife response is defined as a process to disturb an animal’s sense of security to the extent where it moves out of an area or discourages an undesirable (and potentially dangerous) activity. Hazing of a marine mammal may occur if the animal is in the vicinity of an oil (or hazardous material) spill, harmful algal bloom, is out-of-habitat, or is in another situation determined to be harmful to the animal. Cetaceans may also be hazed to deter a potential mass stranding. The goal of a deterrent is to create aversive stimulus that excludes the animal from certain resources or habitats and capitalize upon the mechanisms of threat detection and avoidance (Schakner and Blumstein 2013). Hazing deterrence methods include, but are not limited to, the use of acoustic deterrent or harassment devices, visual deterrents, vessels, physical barriers, tactile harassment, capture and translocation, or capture and temporary holding. The correct use of deterrents incorporates the element of surprise, while minimizing the potential for habituation and injury. Attractants may also be used to attempt to encourage animals to move to a different area. Incidental harassment of non-target animals may occur as a result of hazing activities.

Acoustic deterrents that may be used to deter cetaceans include, but are not limited to: pingers, bubble curtains, Oikomi pipes, acoustic deterrent devices, seal control devices (seal bombs), airguns, mid-frequency and low-frequency sonar, predator calls, aircraft, vessels, and fire hoses. Pinniped acoustic deterrents include, but are not limited to: seal bombs, Airmar devices, predator calls, bells, firecrackers, and starter pistols. Visual deterrents for pinnipeds and cetaceans include flags, streamers, and flashing lights. Exclusion devices for pinnipeds and cetaceans may include nets or fencing. The specific parameters of a hazing/attractant effort would be determined by the co-investigators prior to beginning the effort, in consultation with the principal investigator if circumstances permit.

Pingers, which are typically used in the commercial fishing industry, produce high-frequency pulses of sound to deter animals. The standard pinger emits a signal of 10 kHz (with harmonics to at least 60 kHz) with a source level of 132 decibels relative to one micro Pascal root mean square at one meter (dB re: 1 µPa at 1 m [rms]), which is within the hearing range of most cetaceans (Reeves et al. 1996). Bubble curtains may be used as a barrier from other acoustics. Oikomi pipes are banged together by personnel on boats. They have been effective in herding cetaceans, but may not be as effective in keeping animals out of a large area.

Airmar acoustic harassment devices are transducers with a source level of 195 dB re: 1 µPa at 1 m (rms) and peak energy at 10 kilohertz (kHz) with higher harmonics. These devices may be moved at low speeds on small boats or may be hull mounted on boats to allow faster movement. They may be able deter animals three kilometers away. A line of directional Airmar devices could be deployed at the site of a spill near cetaceans to cause them to move them away from the oiled area. The received levels needed to cause deterrence without acoustic trauma are unknown, however they would only be used at low levels for baseline health research; source levels used in emergency scenarios (enhancement) may be greater. In those scenarios the risk associated with the use of the Airmar device would be balanced against the risk associated with not deterring the animals from the site (whether an oil spill or other hazard).

Seal bombs are explosive devices that are weighted with sand to sink and explode at two to three meters underwater, producing a flash of light and an acoustic signal of less than two kHz and a source level of approximately 190 dB. The sound and light would potentially startle marine mammals, but not cause any injuries (Petras 2003). Airguns are generally a towed array that is deployed behind a ship. Their peak energy is dependent on size, and may range from 10 hertz (Hz) to 1 kHz. Airguns produce broadband pulses with energy at frequencies ranging over 100 kHz. The higher frequencies are less intense and attenuate faster. Airguns have not been used by the MMHSRP but may be used in the future.

Mid-frequency sonar may be used to deter cetaceans. It has caused deterrence in killer whales in Haro Strait during the 2003 *USS Shoup* transit episode (Miller 2009). The sonar had a source level of approximately 235 dB (exact level is classified) and the frequency ranged from 2.6 to 3.3

kHz over one to two second signals emitted every 28 seconds. Mid-frequency sonar could be effective over 25 kilometers, which would be important for deterring animals during a large oil spill. Low-frequency sonar may also be used, especially for mysticete deterrence, but is too low for some cetaceans to hear.

Predator calls (typically killer whale calls) may be played to deter potential prey. In most situations, predator calls have proven ineffective in changing prey behavior. Aircraft, such as helicopters, generate a fair amount of sound and wave movement at close range and could produce a startle or avoidance response. This may be effective initially, but animals would likely habituate quickly. Aircraft could also be used to deploy seal bombs, if necessary. Vessels may be used to herd animals back out to open water or away from a hazardous situation. Booms or line on the water may be used to displace small odontocetes from stranding. Fire hoses may be used at close range as a physical deterrent. Fire hose spray on the surface of the water proved successful at causing two out-of-habitat humpback whales to change course, although responders were unable to use them with lasting herding effect (Gulland et al. 2008).

Attractants that may be used include playbacks of acoustic calls of conspecifics or prey and release of chemosensory stimuli that could lure marine mammals from one harmful area to another that would be safer. Dimethyl sulphide is a naturally occurring scented compound that is produced by phytoplankton in response to zooplankton grazing. Dimethyl sulphide has been experimentally proven to be an attractant to seabirds (Nevitt et al. 1995); extreme olfactory sensitivity to Dimethyl sulphide has been shown in harbor seals (Kowalewsky et al. 2006). It is currently under investigation as a potential attractant for mysticete whales; if proven to work it could be used during an emergency response although specific methods have not been developed.

As there are few established protocols or documented results of different hazing methodologies, the MMHSRP may implement research studies to evaluate various methods. For research purposes, the use of hazing and attractants would be for method development and testing, to determine if a particular method was effective or how it could be refined to be effective. All research on deterrents and attractants would be conducted on surrogate non-ESA-listed species whenever possible. In order to ensure emergency responders are properly trained in hazing methodologies, the MMHSRP proposes to use these tools in non-emergency training scenarios (e.g., during an exercise or drill). Drills can be designed to minimize impacts on marine mammals (taking into account geography, season, etc.), but there is still the potential for incidental harassment.

2.2.3.5 *Capture, Restraint, and Handling*

The Permits Division proposes to authorize the MMHSRP to capture any species of cetacean and pinniped as may be necessary during enhancement activities, and to capture any species of pinniped, excluding Hawaiian monk seals, during baseline health research activities; captures of ESA-listed cetaceans, and of Hawaiian monk seals, are not proposed for baseline health research.

Captures may occur to perform a veterinary examination; evaluate a wound, disease, entanglement, or injury; attach tags and/or scientific instruments; and collect specimens.

To the extent possible, during their scheduled capture programs, the MMHSRP will collaborate with other researchers who hold existing permits to collect different or additional samples for evaluation, diagnostics, or surveillance purposes. In these cases, the capture of these animals would occur under the permits of these other researchers, while the samples collected for the MMHSRP would be takes under this permit (see the description of "piggy-backing in Section 2.2.2, above). In the event that the need arises to capture additional animals (beyond those permitted elsewhere), or to conduct a sampling trip outside of the scheduled programs of researchers permitted separately from the MMHSRP – e.g., to a different geographic area or in a different season – the capture of the animals (as well as subsequent sampling) will occur under the proposed permit. This applies to ESA-listed pinnipeds (excluding Hawaiian monk seals) as listed in Table 2.

During enhancement activities, including import and export activities related to enhancement, capture, restraint, and handling may occur on any age class, sex, and species of cetacean or pinniped. For baseline health research activities, capture, restraint, and handling may occur on any non-listed small cetacean species, any non-ESA-listed pinniped species, bottlenose dolphins (Western North Atlantic Coastal), killer whales, spinner dolphins (Eastern Tropical Pacific), pantropical spotted dolphin (Northeastern Offshore), Steller sea lions (Eastern and Western DPSs), Guadalupe fur seals, ringed seals (Arctic subspecies), bearded seals (Beringia DPS), and Northern fur seals (Eastern Pacific) including pregnant and lactating females and pups; capture, restraint, and handling of ESA-listed cetaceans and of Hawaiian monk seals is not proposed for baseline health research.

During emergency response (enhancement), non-target ESA-listed marine mammals may be incidentally harassed. Healthy pinnipeds on a haul-out near a stranded animal may be flushed from the haul-out during a capture operation. In very rare instances, capture operations for a stranded or entangled animal may result in the accidental mortality of a non-target marine mammal. For example, when capturing a free-swimming entangled dolphin, an associated dolphin may also be netted and may drown. All precautions will be taken to minimize the likelihood that non-target marine mammals are caught in the net, and if caught, will be released as quickly as possible. In the unlikely event that one of these associated marine mammals were to die, the Permits Division proposes to permit that incidental mortality (see Table 1). If a non-target marine mammal is accidentally killed during emergency response activities, the circumstances surrounding the death would immediately be reviewed and future similar responses would be modified as appropriate, which may include cessation (in the example given, ceasing all capture operations for free-swimming entangled dolphins) if appropriate modifications or mitigation cannot be identified. If the target (entangled, debilitated, injured) marine mammal is accidentally killed (i.e. not euthanized) during the response, the circumstances would likewise be reviewed, but these deaths are more likely given the compromised nature of the target animals in these instances.

Capture and restraint of cetaceans may occur during enhancement activities, such as emergency response and disentanglement, and baseline health research. Capture methods for cetaceans may include, but are not limited to: hand, nets, traps, behavioral conditioning, and anesthesia/chemical immobilization. Typical methods currently used during health assessment studies and for emergency response are described below. These methods may vary depending on the species and location, and may change during the requested five-year permit authorization period depending upon advances in technology. For health assessment studies of small cetaceans, small groups of animals would be approached for identification (see description under vessel surveys). The animals would be encircled with a 400-600 meters long by four to eight meters deep seine net, deployed at high speed from an eight-meter long commercial fishing motor boat. Small (typically five to seven meters) outboard-powered vessels may be used to help contain the animals until the net circle is complete. These boats make small, high-speed circles, creating acoustic barriers. This type of net deployment is what lead to the incidental capture of two sea turtles, and is the only type of net deployment likely to incidentally take ESA-listed fish and turtle species.

Once the net corral is completed, about 15-25 handlers would be deployed around the outside of the corral to correct net overlays and aid any animals that may become entangled in the net. In the event that a non-target species is captured (e.g., turtle or fish) researchers will follow the procedures outlined in the proposed amendment appropriate to that species. While the MMHSRP may coordinate its activities with available fish and turtle biologists, any sampling or further data collection on incidentally captured turtles or fishes would not be conducted under the MMHSRP’s permit, and thus these activities are not considered here further. While these handlers check the outside of the corral, the remaining 10-20 or more team members prepare for sampling and data collection and begin the process of isolating the first individual for capture. Isolation may be accomplished by pinching the net corral into several smaller corrals. Handlers may be able to hand catch the selected marine mammal as it swims slowly around the restricted enclosure. After marine mammals are restrained by handlers, an initial evaluation would be performed by a trained veterinarian. Once cleared by the veterinarian, the animal would be transported to the processing boat via a U.S. Navy mattress or in the water by a team of handlers, accompanied by a veterinarian. A specially-designed sling is used to bring the animal aboard the examination vessel, and at the end of the exam, to place the animal back in the water for release.

In some cases, cetaceans may be captured in deep waters. A break-away hoop-net would be used to capture individuals as they ride at the bow of the boat. When the animal surfaces to breathe, the hoop would be placed over the animal’s head, and as they move through the hoop, the net would be released. The additional drag of the net would slow the animals substantially, but the design allows the animal to still use its flukes to reach the surface to breathe. The net would be attached to a tether and large float, and the animal would then be retrieved, maneuvered into a sling and brought onboard the capture boat.

Small cetaceans in shallow water may be caught using a net deployed from a boat with methods similar to those described above. In rivers and canals, responders may use their bodies, boats, sounds or nets to herd an animal and then capture it by hand. In deep water, a hoop net may be used to capture animals.

For land captures of pinnipeds, net types may include, but are not limited to: circle, hoop, dip, stretcher, and throw nets. Net guns and pole nooses may be used for capture of pinnipeds. An injectable immobilizing agent administered remotely by a dart or pole syringe or by hand, may also be used to subdue animals if warranted by the circumstances (e.g., older or larger animals). Herding boards may be used to maneuver animals into cages. For water captures of pinnipeds the use of the devices for capture include (but are not limited to): dip nets, large nets, modified gill nets, floating or water nets (nets with a floating frame that may be brought adjacent to a haul-out which the animals jump in to), and platform traps. Purse seine or tangle nets may be used offshore of haul-out sites to capture animals when they stampede into the water. Animals become entangled by the net as it is pulled ashore (seine) or in the water (tangle). Once removed from the net, animals are placed head first into individual hoop nets. Pups may be restrained by hand, in a hoop net, with injectable sedatives or anesthetics, or with the inhalation of a gas anesthesia (administered through a mask over their nose). Older animals may be restrained by hand, using gas anesthesia (administered through a mask or endotracheal tube), a fabric restraining wrap, a restraining net, a restraint board or through sedation (either intramuscular or intravenous), as determined by an attending veterinarian, veterinary technician, or experienced biologist (see *Administration of Medications*, below).

2.2.3.6 *Transport*

The Permits Division proposes to authorize the MMHSRP to use vehicles, boats, or aircraft to transport marine mammals both within the United States and for purposes of import/export. Transport times may vary from a few minutes to several days, depending upon the stranding and rehabilitation locations. For example, transporting a stranded pinniped from a remote part of Alaska to rehabilitation at the Alaska SeaLife Center in Seward, Alaska may take 48 hours, likely occurring via a combination of plane (or helicopter) and vehicle (including snowmobile, truck, or van). In contrast, the transport (and import) of vaquita from Mexican facilities near San Felipe, Mexico to U.S. Navy Marine Mammal Program facilities in San Diego, California, is approximately 4.5 hour transit by vehicle.

Cetaceans may be transported on stretchers, foam pads, or air mattresses. For short-term transport, closed-cell foam pads are preferred because they are rigid and do not absorb water. Open cell foam pads are typically used for long-term transport of cetaceans because it can contour to the animal’s form. Boxes may be constructed to transport the animal upright in a stretcher in water. Cetaceans must be protected from exhaust fumes, sun, heat, cold, and wind, as transport often occurs on the flatbed of a truck. Animals are kept moist and cool, to avoid overheating (CIRVA 2016; Geraci and Lounsbury 2005).

Small pinnipeds are typically transported in plastic kennel cages or metal cages. Cages are large enough for animals to turn around, stretch out, and raise their heads, and allow proper air circulation. As with cetaceans, pinnipeds traveling by vehicle must be protected from the sun, heat, cold, wind, and exhaust fumes. Pinnipeds may overheat during transit and wetting the animal helps to prevent hyperthermia (excessively high body temperature which could lead to muscle rigidity, brain damage, or death) (Geraci and Lounsbury 2005). Fur seals would be transported in a cage with a double base to allow separation between the animal and fluids and excrement that may soil the fur. Large pinnipeds would be transported in appropriately sized crates or containers, which may need to be custom made. If animals cannot be appropriately contained, or to reduce the stress experienced, some animals may need to be sedated during transport.

Transport procedures for marine mammals used in scientific research under U.S. jurisdiction follow the Animal and Plant Health Inspection Service's "Specifications for the Humane Handling, Care, Treatment, and Transportation of Marine Mammals" (9 CFR Ch. 1, 3.112). The "Live Animal Regulations" published by the International Air Transport Association , and accepted by the Convention on International Trade in Endangered Species of Wild Fauna and Flora, are followed for the air transport of animals under foreign jurisdiction. Both sets of standards have specifications for containers, food and water requirements, methods of handling, and care during transit. In emergency response situations the MMHSRP proposes to use Animal and Plant Health Inspection Service or International Air Transport Association standards when possible, but may modify them (such as not having an attendant with the animal) in remote locations or for short flights.

2.2.3.7 *Holding*

The Permits Division proposes to permit the MMHSRP to oversee short-term holding of animals in a captive setting for enhancement purposes only. No holding is proposed or would be authorized for baseline health research. Stranded and/or imported animals may be held for rehabilitation purposes in a facility holding a Stranding Agreement following a medical determination that rehabilitation is the appropriate course of action. Additionally, healthy animals may be held in short-term holding as a mitigation measure during an oil spill or other disaster for protection. As previously described, all facilities holding a Stranding Agreement will have been evaluated by the MMHSRP under the *Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release* and will have been determined by the MMHSRP to meet the criteria for an issuance of a Stranding Agreement as well as the *Standards for Rehabilitation Facilities* (NMFS 2009d). Facilities holding ESA-listed marine mammals must also follow *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012d); under these standards, facilities rehabilitating ESA-listed species are required to have quarantine protocols to minimize the spread of infectious diseases within the facility. ESA-listed and non-listed animals may be held (short term) under this permit in rehabilitation facilities or research facilities authorized by the U.S. Department of Agriculture Animal and Plant Health Inspection Service.

The MMHSRP aims to return animals to the wild (which may include export to foreign countries) following intervention. However, certain situations may prevent the release of animals back to the wild. For instance, if an animal is unlikely to thrive in the wild due to medical status or habituation, the animal will be deemed non-releasable and a permanent placement in humane care will be sought; if an animal poses a risk to the wild population, such as being a carrier of a novel pathogen, the animal will be permanently placed or humanely euthanized. If a rehabilitated ESA-listed marine mammal is determined to be non-releasable into the wild, the animal may be placed in permanent captivity, pending the approval of the NMFS Regional Administrator and the Permits Division (and any necessary permits issued to the recipient facility). A non-releasable individual may be maintained in captivity under the authority of the permit after the non-releasability determination has been made by the NMFS Regional Office, until permanent placement occurs. Any procedure deemed medically necessary by the attending veterinarian (in consultation with the principal investigator) may be conducted while the animal is being held. Research procedures described herein could also be performed on non-releasable animals.

2.2.3.8 *Release*

Stranded and/or imported ESA-listed marine mammals are admitted into rehabilitation with the intent to release them back to the wild or export them back to their home country once healthy. As previously described, animals are assessed following the *Standards for Release* (NMFS 2009e) by the attending veterinarian at the rehabilitation facility. Rehabilitation facilities must also follow *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012d) when rehabilitating ESA-listed marine mammals. Once an animal is deemed releasable by NMFS, the animal would be captured from its rehabilitation pool or pen, loaded into an appropriate container based on species and size, and transported to a release site, which may involve export to a foreign country if the animal was originally imported. As described above, transport may occur by truck, boat, plane, or any combination of the three. Animals may be released from the beach or may be transported some distance offshore for an at-sea release. If an animal was imported for enhancement purposes, it may be exported and released to its country of origin, at which point the foreign country may release it into the wild with assistance from the MMHSRP, or may further hold the animal in captivity. In accordance with the *Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release*, all rehabilitated marine mammals would be marked prior to release. Every effort will be made to facilitate post-release monitoring and follow-up observation and tracking, when feasible.

2.2.3.9 *Attachment of Tags and Scientific Instruments*

The Permits Division proposes to permit the MMHSRP to use a variety of tags (including scientific instruments) that may be attached to, or implanted in, an animal during both enhancement and baseline health research activities. During enhancement activities, tags or scientific instruments may be attached to any age class, sex, and species. During baseline health research activities, tags will not be attached to large cetacean calves less than six months of age or females accompanying such calves (note that this does not apply to enhancement activities, when tags may be attached to large cetacean calves or females with accompanying calves in distress). For small cetaceans, no tagging will occur on calves less than one year of age (the exception would be emergency scenarios such as stranding responses or entanglement, in which case roto-tags may be used to facilitate post-response identification of calves; this would only occur under enhancement activities and not under baseline health research). Tags may be attached to pinnipeds of all age classes, sex, and species for research and response activities, including pups (nursing and weaned), lactating females, and pregnant females.

Attachment methods for cetaceans include, but are not limited to: bolt, tethered-buoy, tethered, punch, harness, suction cup, implant, or ingestion. Pinniped attachment methods include, but are not limited to: glue, bolt, punch, harness, suction cup, surgical implant, or ingestion. Types of tags that may be used include, but are not limited to: roto-tags (cattle tags), button tags, VHF radio tags, satellite-linked tags, passive integrated transponder (PIT) tags, radio frequency identification (RFID) tags, digital archival tags (DTAGs), low impact minimally percutaneous electronic transmitter (LIMPET tags), code division multiple access (CDMA) tags, pill (e.g., stomach temperature telemeters), time-depth recorders (TDRs), life history transmitters (LHX tags), and Crittercams (video cameras).

Tags may be affixed to an animal in hand (rehabilitation or health assessment) or deployed remotely on a free-swimming animal (entangled or out-of-habitat; see below). The method of tagging will be chosen based upon the criteria of the situation including the subject species, the data needs from the tag, the required tag duration, the number of animals to be tagged, and the supplies on hand for the tagging (including available funding). Specific tags and methods of attachment will be evaluated for each situation in consultation with biologists, veterinarians, and other personnel with recent experience with a particular tag or type of tag to determine optimal protocols. The least invasive tagging method possible that meets the requirements of the situation will be chosen. As new technologies are developed, and the best available science improves, the standard techniques will likely change.

Attachment of instrumentation on marine mammals is used to monitor animal locations and assess animal movements after immediate release (from a stranding site), release after rehabilitation, after disentanglement, or after emergency response-related research or baseline research activities. Tags or scientific instruments deployed on animals as part of enhancement or baseline health research may be used to obtain physiological data (dive depth, dive duration, heart rate, electrocardiography, electroencephalography, stomach temperature, etc.), oceanographic data (water temperature, light levels, chlorophyll levels, etc.) and/or acoustic data (animal and other underwater sounds). Based upon the size, age class, and species being tagged, as well as the other procedures being conducted while the animal is in hand, animals may be sedated or anesthetized for marking, as described below (Section 2.2.3.14).

Tags would generally be attached to free-swimming cetaceans by crossbow, compound bow, rifles, spear guns, slingshot (or throwing device), pole or jab spears. Tags will only be applied by experienced marine mammal biologists, trained in the relevant techniques for the chosen tag type. Prior to deployment, new tag types and attachment methods will be tested first on carcasses to ensure appropriate function of the dart prior to being used on live animals, and will then be approved by the Permits Division. The tag attachments typically occur via a suction cup device or implant, and tag attachment duration is variable from hours to months or even years. Scientific instruments attached via suction cups include, but are not limited to: DTAGs, TDRs, VHF tags, satellite-linked tags, acoustic tags, physiologic tags, and video cameras. Bow-riding animals may be tagged using a hand held pole. Crossbows would be the preferred method for tagging fast-moving toothed whales (e.g., killer whales, false killer whales). Large, slow moving whales may be tagged via suction cups using a pole delivery system, handheld or cantilevered on the bow of a boat. Tags would be attached on the dorsal surface of the animal behind the blowhole, closer to the dorsal fin, to ensure the tag would not cover or obstruct the blowhole even if the cup migrates after placement (as any movement would be toward the tail).

Implantable tags may be attached on free-swimming cetaceans by mounting the instrument on an arrow tip or other device designed to penetrate the skin of the animal. Any part that would be implanted in an animal would be thoroughly cleaned and sterilized using the best techniques available in the given location (e.g., capabilities of laboratories) and appropriate to the material (e.g., antibacterial soap, bleach solution, ethanol solution, autoclave) prior to being brought into the field and would be maintained as sterile as possible in the field (e.g., wrapped in foil, stored in sterile sample bags, etc.) prior to use. Currently many tags are typically deployed by crossbow and may include, but are not limited to LIMPET tags, satellite-linked tags, VHF tags, DTAGs, and TDRs. There continues to be significant research and development on tag technology and deployment. As new information on efficacy and risks become available, testing followed by use may occur. Tethered buoys are used to attach VHF, GPS, and/or satellite-linked tags to gear on entangled whales. Buoys may also be attached to increase drag and buoyancy in an attempt to slow a whale’s swim speed and maintain it at the surface during entanglement response activities. Animal monitoring systems such as digital still cameras or video cameras, passive acoustic recorders, drag load cells, TDRs, etc., may also be attached to gear trailing from an entangled whale.

For animals in hand, tags may be attached for longer deployments. Roto-tags may be attached to cetaceans with a plastic pin to the trailing edge of the dorsal fin (Balmer et al. 2011). Single pinned satellite-linked and VHF tags would be applied along the trailing edge of the dorsal fin. The attachment pin is a 5/16 inch delrin pin, machine-bored to accept a zinc-plated flathead screw in each end. A stainless steel washer would be inserted between the screw head and the tag attachment wings. The tag attachment site will be cleaned with chlorhexiderm scrub followed by a methanol swab, rinsed with methanol and injected with lidocaine. A sterilized or disinfected biopsy punch will be used to make a 5/16 inch diameter hole in the desired region of the fin (where the fin is sufficiently thin that tag will swing freely and not apply pressure to the fin).

Visible space (about the thickness of a playing card) will be left between the tag and the fin to ensure the tag is not too tight. Photographs of the fin will be taken both before and after the tags are attached. The pin on each type of tag is held in place by screws that will corrode in seawater and allow the tag to be released. Roto-tags will be applied using similar techniques and in a similar location as described for the electronic tags, with the exception that anesthetic injection will be optional based upon veterinary discretion, no delrin pin will be needed, and there is no corrodible release mechanism.

A fast drying adhesive, generally but not exclusively epoxy, may be used to glue scientific instruments to pinnipeds. Instruments may be attached to the dorsal surface, head, or flippers, and will release when the animal molts. Roto-tags may be attached to flippers using a single plastic or metal pin. Tags can also be injected or surgically implanted subcutaneously, intramuscularly or into the body cavity of pinnipeds. Implanted tags include but are not limited to PIT, radio, satellite-linked, and LHX tags.

A PIT tag is a glass-encapsulated microchip that is programmed with a unique identification code. When scanned at close range with an appropriate device, the microchip transmits the code to the scanner, enabling the user to determine the exact identity of the tagged animal. PIT tags are biologically inert and are designed for subcutaneous injection using a needle and syringe or similar injecting device. The technology is well established for use in fish and is being used successfully on sea otters (Thomas et al. 1987), manatees (Wright et al. 1998), and southern elephant seals (Galimberti et al. 2000). PIT tags may be injected just below the blubber in the lumbar area, approximately five inches lateral to the dorsal midline and approximately five inches anterior to the base of the tail. Tags may also be injected at alternative sites on a pinniped's posterior, but only after veterinary consultation. Tags may be injected into the alveolus of small cetaceans following tooth extraction; this would allow for the future identification of stranded animals too decomposed to identify by other means such as the dorsal fin, but which are known to have been previously sampled because they are missing the tooth taken during a health assessment study. The injection area would be cleansed with Betadine (or equivalent) and alcohol prior to PIT tag injection. PIT tags are currently being used in Hawaiian monk seals (NMFS Permit No. 16632-00) and harbor seals (NMFS Permit No. 16991) and have been used without known complications for over 10 years.

Surgically implanted tags other than PIT tags will require sedation and local or general anesthesia for surgical implantation and may include VHF or other type tags. Life History tags (LHX tags) are implantable, satellite-linked life history transmitters used to measure mortality events in pinnipeds. The tag allows continuous monitoring from up to five built-in sensors, including pressure, motion, light levels, temperature, and conductivity. Specifically for LHX tags, the tag is surgically implanted by a veterinarian into the abdominal cavity while the animal is anesthetized. An incision of 7-8 centimeters long through the abdominal wall, including abdominal muscles and peritoneal layers, is required to insert the tag (this measurement may change if the specifications of the tags change, but the MMHSRP reports that it is likely to be reduced in size as technology improves). The incision is closed using absorbable sutures and may be further secured with surgical glue or dissolvable staples. When the animal dies, the tag is released from the body and floats to the surface or falls out onshore. Data from the tag are transmitted to a NOAA satellite and then processed via the Advanced Research and Global Observation Satellite (ARGOS) system. The battery life of an LHX tag is approximately 15 years. LHX tags have been authorized under current and previous MMPA/ESA research permits issued by the NMFS (e.g., Permit No. 1034-1685 [California sea lions] and No. 1034-1887, 14336, and 14335 [Steller sea lions]). These tags could be used for long-term monitoring of rehabilitated animals as well as research animals. A recently developed second generation LHX tag, known as LHX2, is only 3.8 inches long and should require a smaller incision than the original LHX model; these may be used on smaller marine mammals such as fur seals.

For all types of tags, once the parameters needed from the tag were determined and used to identify a particular tag type, biologists and veterinarians with expertise in using that particular kind of tag would be consulted with and would form part of the expert group to generate the protocols to use for the emergency response or research.

2.2.3.10 *Marking*

The Permits Division proposes to authorize the MMHSRP to mark all ESA-listed marine mammals, regardless of age, sex, or species for enhancement activities. Marking methods include: bleach, crayon, zinc oxide, paint ball, notching, hot branding, and freeze branding. The method of marking would be chosen based upon the criteria of the situation including, but not limited to, the subject species, the distance from which the mark must be distinguishable (e.g., the approachability of the animal, and whether it will be recaptured and in hand or would need to be identified from farther away), the intent for the marking (e.g., identify previously handled individuals for researchers or rehabilitators, Natural Resource Damage Assessment purposes, identification for subsistence hunters, mark/recapture population assessment), whether a tag could be used instead of, or in addition to the mark, the potential user groups that would be reading the mark (e.g., subsistence hunters, biologists, oil spill responders, general public), the needed duration of the mark (days, weeks/months during a given field season, multiple years, lifetime of the animal), the number of animals to be marked, and the supplies on hand for marking. The least invasive marking method possible that meets the requirements of the situation will be chosen. Based upon the size, age class, and species being marked, as well as the other procedures being conducted while the animal is in hand, individuals may be sedated or anesthetized for marking, as described below (Section 2.2.3.14).

The MMHSRP proposes to use crayons, zinc oxide, and paint balls on cetaceans and pinnipeds for temporary, short-term marking, and bleach or dye (human hair dye) markings on pinnipeds. These marks are temporary, with duration dependent on molting (in the case of pinnipeds), and non-invasive.

The MMHSRP proposes to use notching to permanently mark cetaceans by cutting a piece from the trailing edge of the dorsal fin. Notching in pinnipeds would remove a piece of skin from the hind flipper of phocids and the fore flipper of otariids. Notching is slightly invasive as it does involve removal of tissue but it can generally be accomplished quickly.

The MMHSRP proposes to mark cetaceans using freeze branding, which would typically occur on both sides of the dorsal fin and/or just below the dorsal fin. Freeze branding may occur under enhancement or baseline health research. Protocols developed as part of other cetacean health assessment projects will be used (Irvine et al. 1982; Irvine and Wells 1972; Odell and Asper 1990; Scott et al. 1990; Wells 2009). Freeze branding uses liquid nitrogen to destroy the pigment producing cells in skin. Each brand (typically letters and/or numbers approximately two in high) is super cooled in liquid nitrogen and applied to the dorsal fin for 15-20 seconds. After the brand is removed, the area is wetted to return the skin temperature to normal. Branded areas may eventually re-pigment, but may remain readable for more than 10 years. Freeze brands provide long-term markings that may be important during subsequent observations for distinguishing between two animals with similar fin shapes and natural markings. Freeze branding may be used to produce two types of marks on pinnipeds. Short contact by the branding iron destroys pigment producing cells, leaving an unpigmented brand, while longer contact with the brand destroys these cells and the hair, leaving a bald brand (Merrick et al. 1996). During health assessments, each animal is photographed and videotaped to record the locations of freeze brands.

The MMHSRP proposes to use hot-iron brands to mark ESA-listed pinnipeds, excluding Hawaiian monk seals, as part of emergency response (enhancement) activities; hot branding is not proposed for use in baseline research activities. Hot branding of Hawaiian monk seals and of ESA-listed cetacean species, either for enhancement or baseline research, is not proposed. Hot branding is used in several existing longitudinal studies of certain populations of pinnipeds to assess long-term survival and reproduction. Hot branding uses heat to kill both hair follicles and pigment-producing cells to leave a bald brand, similar to the longer contact freeze-branding method. Each brand (typically letters and/or numbers approximately 8 centimeter high) is heated in a propane forge until red-hot. Brands are applied with less than five lbs. of pressure for a maximum of four seconds per digit. Details of hot branding techniques on pinnipeds are documented in Merrick et al. (1996). Hot brands have been documented to be long-lasting, with Steller sea lions resighted with readable marks at least 18 years after having been branded (Merrick et al. 1996).

In general, MMHSRP proposes to choose freeze branding over hot branding when a long-term mark is needed and it has been determined through previous work on that species or a closely related species to be a viable means of long-term identification (e.g., freeze brands could not be read on Southern elephant seals when they were resighted in subsequent years; (McMahon et al. 2006)), but there may be situations in which hot branding is the best option. In remote locations, or if the situation demands a more immediate response, a propane forge may be simpler to acquire, maintain, transport, and handle in a field situation than a supply of liquid nitrogen which would be required for freeze branding. For some species, hot brands may also be more readable. Only highly experienced and well-trained personnel as determined by the principal investigator will be involved in branding operations. Typically, branding is the last procedure to occur when handling the animal. Therefore, immediately after branding and recovery from anesthesia (if used), the animal would be returned to the water (or near the water, for pinnipeds). Animals would be observed for deleterious effects during recovery (aberrant respiration rate, sluggishness, lack of response, signs of injury). Once returned to the ocean, the sea water acts as the best analgesic to alleviate any pain associated with branding and begins the healing process.

2.2.3.11 *Disentanglement*

The Permits Division proposes to permit the MMHSRP to oversee entanglement response activities. For large whales, entanglement response efforts may include vessel and aerial surveys as described above for the affected animal and incidental harassment of non-entangled animals during these searches. Close approaches may occur to assess and document the extent of the entanglement and the health of the animal. Disentanglement, close approach, and biopsy sampling activities may occur on any age class, sex, and species of large whale that is observed entangled. The animal may be either physically or chemically restrained. Physical restraint of the animal may be used to slow down an animal, provide control, and maintain large whales at the surface. Physical restraint is accomplished by attaching or determining control line(s); attaching floats or buoys, and/or sea anchors to the entangling gear with a grappling hook or other means (e.g., skiff hook deployed from pole); or by attaching new gear (e.g., tail harnesses) to the animal to hold it. The drag and buoyancy from small boats may also slow down an animal and maintain it at the surface. Remote sedation may also be used to restrain the animal. Remote administration of chemical agents (e.g., antibiotics) may be used to improve the animal's prognosis. Animals may be tagged with buoys, telemetry or other tagging devices, to monitor their location and enhance the probability of relocating the individual. Responders use control lines to pull themselves up to the whale. Specialized crossbow tips bearing blades can be used to cut ropes remotely. These would be used rarely, and only by skilled marksmen when there was judged to be no alternative available to access the entangling line(s). Cutting of lines and possibly flesh (when the line is embedded) may occur during disentanglement through the typical use of pole-mounted and remotely-delivered cutting tools. Skin sampling may occur, either through the use of a remote dart (described below under biopsy sampling), the collection of tissues from the removed fishing gear, or the collection of sloughed skin from the water. The animal may be monitored and recorded acoustically through the use of passive acoustics during the entanglement response process.

The Permits Division proposes to permit the MMHSRP to use tools for disentanglement that may not have been developed at the time of this opinion, as advances in technology may result in new tool development within the five year duration of the permit. Any newly developed disentanglement tools will be provided to the Permits Division for review and approval on a case-by-case basis prior to use on live animals. Documentation of the reaction of the animal, the effectiveness of the tool, and the tissue response would be provided to the Permits Division following use when possible. Some new gear may include means to control the release of the gear such as corrodible or degradable links.

For pinnipeds and small cetaceans, disentanglement efforts may include capture with incidental disturbance of non-entangled animals, restraint, surgery under sedation (with gas or injectable anesthesia), rehabilitation, administration of chemical agents (sedatives and/or antibiotics), and release. Response to entangled small cetaceans sometimes can be accomplished from small boats through the use of long-handled cutting tools without capture, but typically requires in-water capture of free-swimming animals using the methods previously described. Some animals may have impaired locomotion if the gear is heavy or anchored. Entangled pinnipeds are typically but not always captured on land when they are hauled out. They may also be captured using a net with a floating frame as they jump off of a haul-out into the water or in-water purse-seine or tangle net techniques. Remote sedation may be used to improve the ability of responders to capture and restrain the animal. Animals may be freed of gear and immediately released, or brought into a rehabilitation facility for a period of time prior to release. These capture methods are described above. Incidental harassment of all ESA-listed marine mammals may occur during disentanglement.

2.2.3.12 *Diagnostic Imaging*

The Permits Division proposes to permit the MMHSRP to oversee diagnostic imaging, including but not limited to thermal imaging, ultrasound, x-ray, magnetic resonance imaging (MRI), and computed tomography (CT) scans, on ESA-listed marine mammals during enhancement or baseline health research activities. Diagnostic imaging that occurs as part of enhancement activities may occur on free ranging animals, animals captured during emergency response, animals undergoing rehabilitation, and as part of post-mortem examination, and may be conducted on animals of any age/sex including pregnant females.

Ultrasound may be used to evaluate a variety of anatomic structures including, but not limited to, blubber thickness, bone density, wounds, lesions, reproductive organs (including pregnancy status assessment), and blood vessels. Ultrasound may also be used to evaluate cardiac function, lung condition, other internal organs, and the presence of fat or gas emboli. B-mode, 2-D, 3-D and doppler imaging may be used on all marine mammals. Any diagnostic ultrasound unit with a “scroll” or “zoom” capability (to visualize deeper structures) would be used to examine marine mammals (Brook et al. 2001; Brook 2001). Transducer type will depend on the area of interest and the size of the patient. Chapter 26 of the *CRC Handbook of Marine Mammal Medicine* will be used as a reference for equipment and methods of ultrasonography for marine mammals (Brook et al. 2001). External and internal (transvaginal and transrectal) ultrasound procedures may be conducted. During transvaginal and transrectal ultrasounds, a well lubricated transducer probe is inserted into the appropriate orifice to the minimum depth required to visualize the structures being observed. The length and diameter of the probe will be determined by the species and individual anatomy. Sedation may be necessary for the comfort of the animal. The level of sedation/restraint is at the discretion of the attending veterinarian. Ultrasounds on cetaceans will be conducted while the animal is in water, when possible.

Radiographic methods may include radiographs, dual-energy X-ray absorptiometry (DXA), CT, and MRI. Radiographs, DXA, CT and MRI may be used for a variety of diagnostic reasons including, but not limited to, detection and assessment of entanglements, ingested foreign objects (e.g., hooks), wounds, lesions, parasites, infection, pregnancy, bone density, and dental health including age estimation. Additionally, radiographs, CT and MRI may also be used to evaluate cardiac function, other internal organs, and the presence of fat or gas emboli.

Any diagnostic radiograph unit including digital, portable field, and dental units will be used to examine marine mammals. Plate and film type will depend on the area of interest and the size of the marine mammal. Any CT or MRI could be used to examine marine mammals which would typically involve transport of the marine mammal to a veterinary or human facility (e.g., for brain scans, bone scans, specialized cardiac scans, etc.). Chapter 25 of the *CRC Handbook of Marine Mammal Medicine* will be used as a reference for equipment and methods of radiography for marine mammals (Van Bonn et al. 2001). For some species, sedation and/or anesthesia may be necessary for the comfort of the animal and to limit movement for radiography; or, imaging may be conducted concurrently with other scheduled medical procedures requiring sedation or anesthesia. The level of sedation/restraint will be at the discretion of the attending veterinarian.

2.2.3.13 *Sample Collection*

The Permits Division proposes to permit the MMHSRP to conduct and oversee the collection of specimen samples from ESA-listed marine mammals during baseline health research activities, enhancement activities, and necropsy activities. During baseline health research activities, samples will not be collected from young-of-the-year small cetaceans. Samples may be collected from pinnipeds of all ages, including pups, and lactating and pregnant females, as called for in the research protocols, during “baseline research” activities. Specific methods for biopsies, blood, breath, and other sampling are described below.

Specimen materials may include, but are not limited to: earplugs, teeth, bone, tympanic bullae, ear ossicles, baleen, eyes, muscle, skin, blubber, internal organs and tissues, reproductive organs, mammary glands, milk or colostrum, serum or plasma, urine, tears, blood or blood cells, cells for culture, bile, fetuses, internal and external parasites, stomach and/ or intestines and their contents, feces, air exhalate, flippers, fins, flukes, head and skull, and whole carcasses. Specimens may be acquired opportunistically with ongoing studies, or as part of baseline health research that will be planned beforehand but had not been planned at the time of this opinion; therefore specific numbers and kinds of specimens cannot be predetermined. Because most specimens will be acquired opportunistically, the MMHSRP will have minimal control over the age, size, sex, or reproductive condition of any animals that are sampled. During necropsy of dead animals, any specimens of interest may be collected.

Marine mammal specimens collected for analysis or archiving will be legally obtained from the following sources:

- ESA-listed marine mammals stranded (alive or dead) or in rehabilitation in the U.S. (for live animals, sample collection will be at the discretion of the attending veterinarian and the principal investigator and combined with necessary medical sampling whenever possible);
- Any marine mammal stranded (alive or dead) or in rehabilitation abroad;
- Soft parts sloughed, excreted, or discharged by live animals (including blowhole exudate) as well as excrement (feces and urine);
- Permitted marine mammal research programs conducted in the U.S. and abroad, including research programs authorized under this MMHSRP permit;
- Any captive marine mammal (public display, research, military, or rehabilitation) sampled during husbandry, including samples beyond the scope of normal husbandry or normal rehabilitation practices;
- Marine mammals taken in legal fisheries targeting marine mammals abroad;
- Marine mammals killed during legal subsistence harvests by native communities in the U.S. and abroad;
- Marine mammals killed incidental to recreational and commercial fishing operations or other human activities in the U.S. or abroad; or
- Marine mammals or their parts confiscated by law enforcement officials.

Specimen and data collection from marine mammal carcasses may follow the necropsy protocols for pinnipeds (Dierauf and Gulland 2001), right whales (and other large cetaceans) (McLellan et al. 2004), killer whales (Raverty and Gaydos 2004), small cetaceans, and all marine mammals (Pugliares et al. 2007). These protocols provide details on how samples should be stored, transported, and analyzed. During live animal response or research, specimen and data collection protocols will depend on the samples being collected and the intended analyses. Sample analyses occur at various diagnostic and research laboratories in the U.S. and abroad.

Biopsy Sampling

Biopsy sampling would be conducted to collect samples of skin, blubber, muscle, or other tissue (see below for details). Sampling may occur on free ranging animals (live and dead, including healthy, compromised, and entangled animals), animals in rehabilitation, animals in managed care, and captured animals during research activities. For enhancement activities including emergency response, biopsy samples may be collected from any species, age, and sex animals.

Skin and blubber samples can be analyzed to investigate genetic relationships (species identification, stock structure, relatedness), foraging ecology (stable isotopes, fatty acid signatures), contaminants (including polycyclic aromatic hydrocarbons, heavy metals, persistent organic pollutants, etc.), disease exposure or state, reproductive status, stress, wound healing processes (Noren and Mocklin 2012), and transcriptomics (Ellis et al. 2009). Skin has also recently been investigated as a way of constructing a health index for marine mammals by investigating skin-associated bacterial communities (Apprill et al. 2014). Skin and blubber biopsy sampling from a vessel may be conducted with (but not limited to) crossbows, compound crossbows, dart guns, or pole spears. The dimensions and type of the biopsy tip will vary depending on the species being sampled, the need, and the depth of their blubber layer. For small cetaceans, the biopsy tip used to collect blubber for contaminant analysis penetrates to a depth of approximately 1.0-2.5 centimeters. Shorter tips may be used when only epidermal sampling is required. Samples will be collected from free-swimming marine mammals within approximately 3-30 meters of the bow of a vessel.

Remote biopsy darts may be used to collect skin and blubber biopsy samples from free-swimming cetaceans. This standard technique involves using a blank charge in a modified 0.22 caliber rifle to propel a dart with small cutting head into the side of a small cetacean, below the dorsal fin from a distance of three to six meters away from the animal. A stopper prevents the dart from penetrating to a depth greater than the thickness of the blubber and aids in the removal of the sample from the animal. The floating dart is retrieved, and the approximately one centimeter diameter by 1.5-2 centimeter long sample is processed for archiving and analysis. As new technologies are developed, the standard techniques may change; all new technologies will be tested first on carcasses to ensure appropriate function of the dart prior to being used on live animals. If a newly developed biopsy technique is potentially more invasive than the techniques analyzed in this opinion, those new techniques must be reviewed and approved for use by the Permits Division.

Pole spears would be used to collect skin and blubber biopsy samples from small, bow-riding cetaceans. The biopsy tip would be attached to the pole spear (approximately 5.5 meters in length), which would be tethered to a vessel. The pole spear would be lowered to within 0.5 meters of the target animal prior to sampling, which would allow a specific area of the animal to be targeted with a high degree of accuracy.

Blubber biopsies may be taken during health assessment studies. Protocols developed as part of other cetacean health assessment projects will be followed (e.g., (Hansen et al. 2004; Hansen and Wells 1996; Schwacke et al. 2002; Wells and Balmer 2005; Wells et al. 2004)). An elliptical wedge biopsy would be obtained from each cetacean. The sampling site would be located on the left side of a small cetacean, below and just behind the posterior insertion of the dorsal fin. Local anesthetic (typically Lidocaine) would be injected in an L-block at the biopsy site. A veterinarian would then use a clean scalpel to obtain a sample that is up to approximately five centimeters long and three centimeters wide, through nearly the full depth of blubber (approximately 1.5-2.0 centimeter). A cotton plug soaked with ferric subsulfate would be inserted into the site once the sample is removed in order to stop bleeding. The sample would then be partitioned into separate containers to allow different analyses. Skin obtained with the blubber biopsy is used for genetic analyses. Additionally, during health assessments skin scrapings, biopsy samples including muscle samples, or needle aspirates may be collected for clinical diagnoses from sites of suspected lesions. These samples would be processed by various diagnostic laboratories and a subsample would be sent to the National Marine Mammal Tissue Bank when appropriate.

Biopsy sampling may also occur on cetaceans and pinnipeds in rehabilitation or in hand during health assessment studies for diagnostic purposes. Skin and blubber may be collected as described above for capture animals. Biopsy sampling for diagnostic purposes may also include surgical procedures. Samples may be taken from muscle, lymph nodes, masses, abscesses, other lesions, gingiva, liver, kidneys, and other organs, including the oral cavity and genital region. The number of biopsies per animal will vary depending on number of lesions. The lesion biopsy site will be wiped with an appropriate antiseptic (e.g., chlorhexiderm) scrub followed by an alcohol swab, rinsed with alcohol, and injected with and appropriate anesthetic (e.g., two percent lidocaine with epinephrine). For gingival biopsies, an appropriate anesthetic (e.g., two percent lidocaine with epinephrine or carbocaine) will be used to anesthetize the biopsy site. Using pre-cleaned instruments and a sterile scalpel blade or sterile punch biopsy the lesion or gingival tissue will be collected in its entirety if less than 10 millimeters or subsampled if larger. Surgical procedures will be performed by experienced marine mammal veterinarians.

Skin, blubber and/or muscle biopsies may be collected from pinnipeds. Prior to sampling, a local anesthetic will be injected subcutaneously and intramuscularly at the sampling site to minimize pain. The sampling site will be cleaned with an antiseptic scrub and a small incision may be made with a scalpel blade or biopsy punch. All biopsies will be taken using appropriately sized sterile biopsy punches. The punch will be pushed through the blubber and into the muscle layer, the biopsy then withdrawn, and pressure applied to the wound. The biopsy site will be irrigated with an antiseptic (e.g., Betadine). Sutures are not needed for the wound.

Lung biopsies may be taken from cetaceans or pinnipeds that are found to have moderate to severe lung disease on ultrasound examination during health assessments or rehabilitation, when deemed appropriate by the principal investigator or co-investigator and the lead veterinarian. Lung biopsies will be taken via lung fine needle aspirate or core biopsy and will be used to determine the etiology of the lung disease (bacterial, viral, fungal, neoplastic, etc.). For both methods, the skin will be cleaned with an antiseptic scrub and alcohol, followed by a local anesthetic block to take effect from the skin to the intercostal muscle layer. The anesthetic will be given approximately five minutes to take effect, the area prepared again with antiseptic scrub and alcohol, and then a stab incision made with a scalpel blade. For the fine needle aspirate method, an 18 gauge or 20 gauge spinal needle attached to either a syringe or a standard bore three-way stopcock with an extension set and a syringe will be used to aspirate the mass, under ultrasound guidance. For masses that are difficult to aspirate, a small volume of sterile saline may be infused to facilitate removal of material. Lung core biopsies may be collected if fine needle aspiration is not productive, or if the lesions meet the following criteria (as assessed via ultrasound) superficial, easy to access, limited blood supply, not filled with fluid, and greater than one centimeter in diameter. For the core biopsy method, a 10 centimeter, 18 gauge BioPince full core biopsy instrument or similar is used. In some cases, a 6.8 centimeter, 17 gauge coaxial introducer needle (or similar) may first be placed using ultrasound guidance through the skin, blubber, and intercostal muscle layers to facility entry of the biopsy device to the lung, but in other cases the biopsy instrument will be used alone. The biopsy instrument passes through the skin, blubber, and muscle layers, and is then advanced through the pleural lining and into the mass, carefully timing advancement of the instrument with respiration. Multiple biopsies may be taken using slightly different angles for each biopsy. Samples will be processed as deemed appropriate by the veterinarian. The mass will be reevaluated with ultrasound immediately following the procedure, and the veterinarian may administer a post-procedure single dose of antibiotic if deemed appropriate for prophylaxis.

Blood Sampling

Blood samples taken from cetaceans may be collected from the dorsal fin, caudal peduncle, pectoral flipper, or, typically, the flukes. Sampling at any of these sites will be done using an 18-20 gauge 4 centimeter needle, with a scaled down needle bore for calves. Blood sampling of cetaceans during health assessments may occur in the water prior to coming aboard the vessel, or once aboard the vessel. Typically, the blood sample is drawn from a blood vessel on the ventral side of the fluke, using an 18-20.75 gauge inch butterfly catheter.

Blood samples in phocids may be collected through the bilaterally divided extradural vein, which overlies the spinal cord. Otariids may be sampled using the caudal gluteal vein. Additionally, both phocids and otariids can be sampled using the plantar interdigital vein on the hind flippers, or the subclavian or jugular veins if sedated (Geraci and Lounsbury 2005). Sampling will generally be done with an 18-20 gauge, 4 centimeter needle or butterfly needle, although larger spinal needles maybe needed for larger animal or those with thick blubber layers. For pinnipeds undergoing anesthesia indwelling catheters may be placed in the jugular or another accessible vein per veterinary discretion.

The volume of blood taken from individual animals at one time would not exceed more 1.0 percent of its body weight, depending on taxa (Dein et al. 2005). No more than three attempts (needle insertions) per sampling location are expected when collecting blood. If an animal that is awake cannot be adequately immobilized for blood sampling, efforts to collect blood will be discontinued to avoid the possibility of serious injury or mortality from stress. Sterile, disposable needles will be used to minimize the risk of infection and cross-contamination.

From animals that are being euthanized, blood may be collected from the heart after heavy sedation and prior to administration of euthanasia solution into the heart. Blood may be collected from dead animals wherever and however is feasible during the necropsy. Blood may also be collected by an entanglement or stranding response team during the response enhancement activities.

Blood samples will be used for: standard chemistry, hematology, and hormonal analysis; contaminant analyses; biotoxins; immune function studies; serology; polymerase chain reaction; aliquots for culturing for assessment of pathogens; genetics; a variety of “omics;” and other preparations as necessary (e.g., (Bryan et al. 2007; Mancia et al. 2014; Maucher et al. 2007; Romano et al. 1992; Venn-Watson and Ridgway 2007).

Breath Sampling

Breath sampling may be conducted on ESA-listed cetaceans and pinnipeds to assess their nutritional status and health. Exhaled breath is collected as an ambient gas or liquid (exhaled breath condensate), and exhaled particulates (in cetaceans, "blow") may also be collected. At the time this opinion was written, the field of marine mammal breath and blow analysis was in the early stages. However, there have been many recent advancements in human breath research that have accelerated interest in developing this methodology for marine mammals (Hunt et al. 2013a; Hunt et al. 2013b; Hunt et al. 2013c), and the MMHSRP anticipates that it will continue to grow during the project period of this five year permit. New tools and technologies may be developed and field tested by the MMHSRP and co-investigators on the permit.

For non-restrained animals (e.g., free-swimming whales, hauled out pinnipeds), breath may be collected with a variety of sampling devices positioned as close as possible to the blowholes or nares; positioning may be done with long poles or with remote-controlled vehicles such as helicopters or hexa-copters. Previous sampling devices have included nylon fabric in a plastic framework, inverted funnels connected to a vacuum cylinder, and Petri dishes (a review of previous marine mammal breath-sampling collection is available in (Hunt et al. 2013a)). A plastic gasket may also be used around the blowhole in order to minimize water contamination (Thompson et al. 2014).

To collect a gas sample, a funnel may be used attached to a vacuum cylinder via plastic tubing; the cylinder valve is manually opened during exhalation to collect the gas sample. Cooling this gas sample can provide the exhaled breath condensate for analysis (Cumeras et al. 2014). An algal culture plate or mesh web may be used in combination (inside a funnel) or independently of the funnel to collect particulates. Exudate collected off of the algal plate or web can be used for cultures of potential pathogens in the breath as well as for other potential tests such as those currently being used in human medicine (Schivo et al. 2013). The equipment typically will not touch the animal, although in some instances there may be brief (less than 10 seconds) contact. For "baseline research" projects, an individual animal may be approached up to three times to obtain a breath sample; if an animal exhibits rapid evasion during approaches, the animal will not be pursued.

A second methodology is used during health assessment captures (which, for ESA-listed species, are only proposed during enhancement activities, and are not proposed for "baseline research"). While a cetacean is being held on the deck or in the water, a mask would be held above the blowhole to allow the collection of exhaled air and gas along a glass tube surrounded by dry ice inside a hard plastic sleeve. The animal is allowed to breathe normally for approximately five minutes, or 6-10 breaths; the one-way valve opens during inhalation and closes during exhalation thus routing expired breath inside collection tube. The breath condensate will be collected and evaluated to determine the types and levels of biomarker compounds associated with petroleum product exposures in breath of marine mammals. The apparatus is cleaned between animals using ethanol. This device was used successfully with bottlenose dolphins in Sarasota Bay in May 2011 (Aksenov et al. 2014).

Recently, UASs have been shown to be an effective tool to collect breath/exudate samples (e.g., (Acevedo-Whitehouse et al. 2010), and the MMHSRP anticipates that this technology will continue to improve and may become more commonly available and used during the duration of this permit.

Breath samples and exhalate may be collected during health assessments, emergency response activities, during rehabilitation, and during captive research or on any live captured animal including both cetaceans and pinnipeds. Samples will be taken from targeted populations at specific times to compare with visual assessments and/or biopsies. The samples will then be examined using gas chromatography-mass spectrometry for volatile compounds to evaluate respiratory disease, nutritional status, and physical condition. A recent study also showed that cortisol can be detected and monitored through breath samples from both captive and wild beluga (Thompson et al. 2014).

Tidal volume and end expiratory carbon dioxide and oxygen may also be measured to assess lung function and calculate metabolic rate in concert with respiratory rate, as part of a health assessment. To measure these parameters, a pneumotachometer flow cell would be placed non-obstructively over the blowhole for a series of five breaths. The pneumotachometer records data which are subsequently analyzed.

For animals in a captive setting (including in rehabilitation), or in certain field settings (e.g., a pinniped foraging under ice with access to only an isolated air hole) a metabolic chamber, hood, or dome may be placed over the water’s surface such that all respirations occurring within the hood may be collected (e.g., (Williams et al. 2001)). Flow rate, oxygen consumption, other respiratory gases, and other samples of interest are measured on the exhaust air coming out of the metabolic chambers.

Tooth Extraction

The age determination of animals is conducted using the deposition of growth layer groups in teeth. A tooth will be extracted from an animal in hand by a veterinarian or biologist trained in this procedure.

Tooth extraction typically occurs during cetacean and pinniped health assessment studies. Tooth extraction in cetaceans requires capture and manual restraint (and would therefore not occur as part of “baseline research” activities for ESA-listed species, as capture of cetaceans for “baseline research” is not proposed for ESA-listed species) and in pinnipeds requires capture, restraint, and sedation. For cetaceans the tooth removed would usually be #15 in the lower left jaw, though any tooth may be extracted and in pinnipeds the post-canine or incisor teeth are generally extracted.

For cetaceans, protocols developed as part of other cetacean health assessment projects will be used (Hansen et al. 2004; Hansen and Wells 1996; Norman 2012; Norman et al. 2012; Schwacke et al. 2002; Wells and Balmer 2005; Wells et al. 2004). In both cetaceans and pinnipeds the tissue surrounding the tooth is infiltrated with lidocaine or carbocaine (three percent) without epinephrine (or equivalent local anesthetic), applied through a standard, high-pressure, 30 gauge needle dental injection system or regular syringe through a small gauge needle (25 gauge). Once the area is anesthetized, the tooth is elevated and extracted using dental extraction tools. For cetaceans, a cotton plug soaked in gel foam is inserted into the alveolus (pit where the tooth was) to stop bleeding. All dental tools will be sterilized before each use. If necessary, after extraction, pressure will be applied to the cavity until bleeding has stopped, and antibiotics will be used at the discretion of the veterinarian to prevent infection. For pinnipeds, an attending veterinarian or other qualified personnel will monitor the respiration and temperature of the animal due to the need to sedate the animal. This procedure is modified from that described by Ridgway et al. (1975) for cetaceans and is similar to that described by Arnbom et al. (1992) for pinnipeds. The revised procedure has been used for cetaceans in captivity and in live capture and release sampling for many years. Extracted teeth are sent to a laboratory for age determination.

Orifice Sampling (Blowhole/Nasal/Oral/Uro-genital/Vaginal/Prepucial/Lesions)
Samples may be collected from any orifice (blowhole, nasal, oral, uro-genital, vaginal, prepucial) or from wounds/lesions as described below. A sterile unbreakable swab would be inserted into the blowhole/nares, oral cavity, or uro-genital slit/vaginal/prepucial opening of a restrained individual, gently swabbed and removed. The number of swabs that would be taken will vary depending upon a number of factors, including the type of pathogen(s) being investigated (in a disease outbreak of unknown etiology, separate swabs could be taken for virus, bacteria, and fungi, with multiple swabs taken for each depending upon the testing to be performed or the need to archive and the parameters around archival techniques), the preferred transport medium for those pathogens, the logistics of sampling (e.g., whether cold storage is available), and the animal (which would vary for different species, and based on whether the animal was under sedation or anesthesia versus being manually restrained). As a general guideline, 8 or fewer swabs would be taken per site, but this number could be exceeded given the factors listed above. Samples are sent to a laboratory for culturing, polymerase chain reaction for species identification, or further analyses as necessary.

Ocular Sampling and Examination
Samples may be collected from the eye of a cetacean or pinniped. A sterile swab would be inserted at the medial or lateral canthus of the eye, gently swabbed along the conjunctiva or cornea and removed. A complete ocular examination may be performed via visual examination and through use of an ophthalmoscope and tonometer (an example standard methodology for ophthalmic evaluation is presented in (Wright et al. 2015). Additionally, if a corneal ulcer is suspected, fluorescein stain may be administered into the eye via a strip or drops and the cornea examined visually or with an ophthalmoscope to determine if a corneal ulcer is present. Samples are sent to a laboratory for culturing, polymerase chain reaction identification, or further analyses as necessary. Additional types of tests may be performed at the discretion of a veterinary ophthalmologist (e.g., infrared photography, ultrasound, or pachymetry). Pachymetry is the

process of measuring the thickness of the cornea using a device called a pachymeter, which may be either ultrasonic (using ultrasonic transducers) or optical (using specialized cameras). General sedation or anesthesia, with or without local anesthesia, may be needed to facilitate safe animal handling and reduce discomfort associated with certain evaluation procedures.

Urine Sampling
Urine analyses are diagnostically useful to evaluate the urinary system (kidneys, ureters, bladder, and urethra). Important diagnoses can be made by determining the color, pH, turbidity, chemical constituents, presence or absence of blood, and by identifying any bacteria or yeast present in the urine. Urine is also useful for the detection of pathogens that are spread through urine (for example, *Leptospira* spp.). Urine samples may be collected using urinary catheterization and aseptic cystocentesis (in pinnipeds under general anesthesia). A veterinarian experienced with cetaceans or pinnipeds and/or a qualified veterinary technician would perform the catheterization or aseptic cystocentesis procedure.

For small cetaceans, the animal will be lying on its side on the foam-covered deck of the boat serving as the veterinary laboratory during health assessment studies. Wearing sterile surgical gloves, the assistant would gently retract the folds of the genital slit to allow visualization of the urethral orifice. The veterinarian/veterinary technician (wearing sterile gloves) would carefully insert a sterile urinary catheter, lubricated with sterile lubricating gel, into the bladder via the urethra. A 50 ml collection tube without additive is used to aseptically collect the urine as it flows from the catheter. The catheter is removed after the urine is collected.

Pinnipeds would be restrained and sedated or anesthetized before the catheter is inserted as described above. The respiration, heart rate, and temperature of the animal would be monitored during the procedure and the animal would be monitored after the procedure until it is released. Urine may also be collected opportunistically, by holding an open sterile container in the urine stream.

By definition, a cystocentesis is a procedure during which the bladder is punctured for the purpose of obtaining an uncontaminated urine sample (Ettinger and Feldman 2009). The animal would be placed in dorsal recumbence while under general anesthesia. The pubis then palpated, and the needle inserted through cleansed skin while maintaining negative pressure on the syringe. The syringe is then used to aspirate 3-5 cc of urine, and withdrawn from the animal while negative pressure is maintained at all times.

Fecal Sampling
In both cetaceans and pinnipeds, fecal samples would be obtained either from a small catheter, or fecal loop, inserted about 10 centimeter into the colon, from a sterile swab of the rectum, or enema. Additionally, cetacean feces may also be collected in the water column either from a vessel or a diver in the water. Pinniped feces may be collected from land from haul-out or rookery sites. Samples will be sent to a laboratory for culturing, pathogen species identification, parasitology, or further analyses as necessary.

Milk Sampling

In both cetaceans and pinnipeds, adult females may be checked for lactation and milk samples will be collected from lactating females when feasible. A breast-pump apparatus or finger milking would be used to obtain the milk sample. Milk is expressed with gentle manual pressure exerted on the mammary gland while suction is provided by a 60 cc syringe attached by tubing to another 12 cc syringe placed over the nipple. Samples of 30-50 ml may be collected. Among other testing, milk samples can be measured for the levels of lipophilic organic contaminants and to determine composition (percent fat, etc.).

Oxytocin, a hormone, may be used to enhance collection of milk samples in pinnipeds and cetaceans. Oxytocin would generally be administered via intermuscular injection of 10-60 international units (a unit of measurement for the amount of a substance) of commercially available, synthetic hormone, with dosage dependent upon animal size, species and situation (e.g., field vs. rehabilitation).

Sperm Sampling

In both cetaceans and pinnipeds, for adult males, ejaculate samples may be collected through manual manipulation of the penis when feasible. Additionally, semen may be obtained in males during urinary catheterization. Samples are examined for sperm count, motility, and condition, providing a direct measurement of male reproductive function. These data will inform the study of the potential reduction of reproductive capabilities from environmental contaminants.

Gastric Sampling

In both cetaceans and pinnipeds, gastric samples may be obtained using a standard small or large animal stomach tube to evaluate health and evidence of toxin exposure. The stomach tube would be inserted through the mouth and down the esophagus into the stomach, taking care to avoid the trachea. Slight suction enables the collection of gastric fluid; with slight flushing with water, gastric particles and some foreign bodies can be flushed from the stomach and collected (Sweeney and Ridgway 1975). In rehabilitation and in the field, the animal can be tube fed or delivered drugs such as double-labeled water or stomach temperature probes using this same procedure.

Gas Sampling

In cetaceans and pinnipeds, gases may be collected from carcasses during necropsies for diagnostic analysis such as assessment of decompression or decomposition (e.g., (Bernaldo De Quiros et al. 2013), or further analyses as necessary. Gas would be sampled by inserting the needle of a syringe into the bubble, using the suction of the syringe to collect the gas present in the bubble, and depositing the gas into a glass vacutainer (if not collected directly into the vacutainer).

Sloughed Skin

Skin that sloughs off a cetacean or pinniped (e.g., during molt) may be collected. Pieces of skin may be collected floating on the surface of the water, from land (haul-out/rookery), off of equipment used to capture or disentangle animals, off of entangling gear, or by hand as the animal is being handled. Skin could be used in the same analyses as described above for skin biopsy samples (genetics, pathogen/disease, contaminants, etc.).

Hair, Nails, and Vibrissae Sampling

In pinnipeds, a vibrissa may be pulled from anesthetized pinnipeds (animals older than two months) or clipped from animals not sedated. Vibrissae are pulled by gripping with forceps or fingers and pulling forcefully and rapidly in one smooth motion. Nails would be clipped close to the base of the nail bed without causing bleeding. Hair samples would be collected with scissors at the base of the hair without removing the follicle or by shaving with electric clippers. Hair, nails, and vibrissae provide a minimally invasive sample that may be analyzed for toxicology (McHuron et al. 2014; Wenzel et al. 1993), a time series for stable isotopes (Greaves et al. 2004; McHuron et al. 2014), and may be used for other tests (some to be developed).

Colonic Temperature

In both cetaceans and pinnipeds, colonic temperature is collected to understand vascular cooling and reproductive status (Rommel et al. 1994). Temperature measurements are obtained with a linear array of thermal probes interfaced to a laptop computer. The probes are typically housed in a three millimeter outside diameter flexible plastic tube. The probe is sterilized, lubricated, and then inserted into the colon through the anus to a depth of 0.25-0.40 meters, depending on the size of the animal. Temperature is continuously monitored.

2.2.3.14 *Administration of Medications*

The Permits Division proposes to permit the MMHSRP to conduct and oversee the administration of medications, including vaccines, to ESA-listed marine mammals. In both cetaceans and pinnipeds, drugs may be administered for sedation/chemical restraint and/or veterinary treatment during enhancement activities such as stranding response, disentanglement, rehabilitation, and release activities, and during “baseline research” activities. Anesthetics, analgesics, and antibiotics may be used during research before or after performing biopsies, tooth extractions, and other procedures. Antibiotics, antifungals, anesthetics, analgesics, de-wormers, vaccinations, and other medicines may be administered during response and rehabilitation of ESA-listed species as well as during research procedures. Medications may be given to induce abortion, when determined to be the appropriate veterinary medical treatment for a pregnant female in rehabilitation. Chapter 31 of the *CRC Handbook of Marine Mammal Medicine* will be used as a reference for potential drugs and doses for marine mammal species (Gulland et al. 2001). Medications would be administered at the discretion of the attending veterinarian or the principal investigator.

Marine mammals in captivity may be used for drug therapy or diagnostic test validation. The name and location of the facility and the specific animals (identified by their NOAA identification number, where applicable) will be provided to the Permits Division prior to the start of any research activity. The research activity will only proceed after review and approval by the facility’s Institutional Animal Care and Use Committee (IACUC). Vaccinations and other medications such as de-wormers may be administered prospectively to wild, captive, or rehabilitating marine mammals. When testing new techniques, medications, or vaccinations, the MMHSRP will aim to conduct the study in a controlled setting, such as a captive facility where the animals are well known and can be closely monitored, and are of the same species as the target wild population. If this is not possible, the next preference would be to use a closely-related surrogate species. If a suitable captive population cannot be found, a cohort in a rehabilitation center would be the next choice, particularly animals of the same species or a closely-related surrogate. Drugs may be administered orally or through injection, intubation, or inhalation. Orally administered medications are typically hidden in fish but may also be given via stomach tube.

Subcutaneous, intramuscular, intravenous, and intraperitoneal injections may be used to deliver drugs. All of these methods would require some level of animal restraint. Subcutaneous injections are made in the interface between the blubber layer and the skeletal muscle layer. The most common site for subcutaneous injections in pinnipeds is the craniodorsal thorax between the scapulae but other sites may be used. Subcutaneous injections would not be used in cetaceans.

Intramuscular drug injections require longer needles because of the thickness of skin and blubber. Caution is taken to avoid accidental injection into the blubber, which may cause sterile abscess formation or poor absorption (Gulland et al. 2001). Injection sites for phocids are the muscles surrounding the pelvis, femur, and tibia. These sites, as well as the large muscles overlying the scapulae, are appropriate for otariids (Gulland et al. 2001). Intramuscular injections in cetaceans may be made off the midline, slightly anterior to, parallel to, or just posterior to the dorsal fin. Caution is taken to avoid the thoracic cavity if the injection is anterior to the dorsal fin (McBain 2001). Multiple injection sites may be used.

In general in marine mammals, intravenous injections are complicated and generally used under sedation/anesthesia or during emergency procedures. Intravenous injections sites for pinnipeds include the jugular or subclavian vein if sedated and if awake for phocids the extradural vein and for otariids the caudal gluteal vein. In cetaceans, medications may be injected in the fluke vessel, dorsal fin vessel, or peduncle if the volume is low and the medicine is not harmful if delivered perivascularly. An indwelling catheter may be used if repeated administration or slow infusion occurs (McBain 2001).

Intraperitoneal injections deliver medications into the abdominal cavity. Non-irritating drugs may be delivered by this method including sterile isotonic fluids and dextrose. During injection, caution will be taken to avoid damaging major organs. Additionally, some euthanasia solutions can be administered intraperitonealy (Gulland et al. 2001).

Administration of Medications: Vaccinations

The MMHSRP has proposed a pinniped and cetacean vaccination program to address potential infectious disease threats to marine mammals under the NMFS' jurisdiction and to outline a process to address these threats with vaccination. The vaccination of all ESA-listed marine mammals, other than Hawaiian monk seals, is proposed. The vaccination of Hawaiian monk seals has already undergone ESA section 7 consultation, and is not part of the proposed action (NMFS 2014b).

Vaccines currently used for prevention of infectious diseases (viral, bacterial, fungal or parasitic) in domestic animals can be divided into three types:

- Vaccines using live attenuated pathogens;
- Vaccines based on dead inactivated pathogens; and
- Vaccines consisting of recombinant pathogen.

The vaccination of ESA-listed marine mammals using live attenuated pathogens is not proposed; the use of recombinant and dead inactivated vaccines is proposed. Recombinant pathogen vaccines can use a vector virus that does not typically infect the target host but expresses antigen from the pathogen of interest, stimulating an immune response against it (Griffin and Oldstone 2009). Vaccines using a dead pathogen are considered the safest as the pathogen cannot replicate in the host or cause disease. This lack of replication often means that the immune response generated following vaccination is short lived and may not be protective.

Currently, vaccines that have been used or could be used in wildlife have been developed for three viruses that have been identified as potential high risk to pinnipeds and for one virus that has been identified as potential high risk to cetaceans. These are as follows:

- Morbillivirus (specific for canine distemper virus and used in monk seals and harbor seals);
- West Nile virus (used in managed care phocids); and
- Avian influenza (specific to certain types of avian influenza viruses);
- Cetacean morbillivirus.

The MMHSRP proposes to administer vaccines that have previously been developed and tested on marine mammals, and to administer vaccines that were not yet developed or tested on marine mammals at the time of this opinion. Vaccination studies to determine the safety and efficacy of vaccines against specific pathogens considered most likely to spread to pinnipeds and cetaceans would be conducted to determine the effectiveness of the vaccine in mitigating or preventing the impacts of the infectious disease and to evaluate any adverse effects of the vaccine. If previous research on the safety and efficacy of a particular vaccine have not been conducted on a particular species, captive studies would be conducted in collaboration with the managed care veterinarian to determine whether the newly developed vaccine is safe and effective for use with that species. Safety and efficacy testing of any new vaccine would occur on a surrogate species in captivity (e.g., captive bottlenose dolphins would be a potential surrogate species for false killer whales) and on members of the target species in captivity (if available). Testing would follow the methods outlined in Quinley et al. (2013) and would evaluate the presence of a proper immune response, the number of vaccines (including boosters) needed to generate this response, and the duration of immunity against the pathogen.

In brief, a total of five animals (surrogate or target species) would be vaccinated, and blood samples collected prior to vaccination and on days 0, 30, 180 and 365 after vaccination. Additionally, two of the five animals in testing would also receive one booster injection 30 days after the initial vaccination and have a blood sample taken one month following the second vaccination. Vaccination of captive animals would be pursued with the MMHSRP partner organizations, including aquariums such as Sea World. If safety and efficacy research indicated that the vaccine was safe and effective, the vaccine may be administered in response to an outbreak or preventatively to wild or rehabilitating pinnipeds and cetaceans. When feasible, vaccination risk assessment and modeling studies would be undertaken prior to the vaccination of wild marine mammals to determine the effectiveness of the proposed response and prophylactic vaccination protocols for the species in question.

As new disease threats emerge, the procedures outlined in the Vaccination Plan would be used for any emerging pathogens (other viral, bacterial, fungal or parasitic infectious diseases) that would require vaccination as part of a response or enhancement activity including the development of new vaccines. The Vaccination Plan outlines the procedures that would be followed for vaccine selection, safety and efficacy testing of new vaccines, surveillance for pathogens of concern, triggers for vaccination response, and response procedures for both outbreak and prophylactic vaccinations of free-ranging cetaceans and pinnipeds.

2.2.3.15 *Auditory Brainstem Response/Auditory Evoked Potential*

The Permits Division proposes to authorize the MMHSRP to oversee and conduct Auditory Brainstem Response (ABR) and Auditory Evoked Potential (AEP) procedures as a method to evaluate the hearing abilities of individual animals or species (Mulsow et al. 2012; Nachtigall et al. 2007). Procedures may be conducted on stranded animals, animals in rehabilitation, or on animals captured during research studies. The ABR technique involves repeatedly playing a test sound stimulus while simultaneously recording the neural evoked potential from non-invasive surface electrodes contained within suction cups. AEP provide a non-invasive way to test hearing by measuring the small voltages generated by neurons in the auditory system in response to acoustic stimuli; voltages in response to sound are generated in the brainstem and are referred to as ABRs (Mooney et al. 2012).

Procedures on odontocetes are generally minimally invasive and can be conducted in short time frames. An animal may be resting at the surface or on the beach or may be physically restrained (held by researchers) during the procedure. Standard electroencephalogram (i.e., EEG) gel is used on the electrodes to establish an electrical connection between the electrode and the skin. Sounds may be presented through a jawphone attached to the lower jaw via suction cup, or may be played in the water. A reference electrode is attached near the dorsal fin and a recording electrode is attached about five centimeters behind the blowhole. The electrodes are on the surface of the skin and are connected to an amplifier via wires. The suction cups can easily be removed if there is any difficulty with the procedure. Evoked potentials are recorded from the electrodes. Frequencies used for testing range from one to 160 kHz (the range of frequencies that many odontocetes hear) and the maximum sound pressure level is less than 160 decibels re μPa. Auditory Evoked Potential procedures may also be conducted on mysticetes using a three sensor configuration. Suction cup electrodes will be attempted first; if unsuccessful, subcutaneous pin electrodes will be placed into the blubber layer (if use of surface electrodes is unsuccessful). Prior to placing the pin electrodes, the surface of the skin will be treated with standard prophylactic procedures (betadine and alcohol scrubs). Mysticete AEP will be performed in cooperation with Dr. Dorian Houser, National Marine Mammal Foundation, who is separately permitted for this activity (Permit No. 16599).

Pinniped audiometric testing may be conducted while individuals undergo scheduled sedation and/or anesthesia for necessary medical procedures during rehabilitation. Subcutaneous electrodes would be used to obtain electrophysiological recordings from pinnipeds and are harmless to the animals. The electrodes are sterile 27 gauge x 10 millimeter needles that are placed subcutaneously beneath the skin on the animal’s head. One or two electrodes record AEPs and the other is a reference or ground electrode, which subtracts the biological sound produced by the animal to enhance the recorded evoked potential responses. Testing will be conducted under the supervision of the rehabilitation facility’s attending veterinarian. Individual animals are not tested more than once and testing sessions do not last longer than 60 minutes, except in cases where the individual will be euthanized upon completion of the anesthetic procedure. Testing time has no impact on animal health or recovery from anesthesia in these individuals. Therefore, in situations where animals require euthanasia upon completion of anesthesia, testing may be allowed to continue for longer intervals at the discretion of the attending veterinarian. This protocol maximizes the amount of information that can be obtained from each subject, improves the quality of the data, and precludes any potential residual impact on anesthetic recovery on the individuals tested.

All AEP procedures performed on stranded and rehabilitating odontocetes and pinnipeds will follow the Permits Division’s policies and protocols. Testing would not delay treatment, movement, or release of a stranded animal nor would it interfere with rehabilitation activities. It is considered best practice to conduct AEP on cetacean release candidates to assess suitability for release, so this would be considered part the diagnostic testing of the animal and not for baseline health research purposes. Testing would be stopped if an animal exhibited any adverse reaction, including abnormal respiration and locomotion, vocalization, vomiting, or other signs of distress.

2.2.3.16 *Active Acoustic Playbacks*

Active acoustic playbacks would be used to expose cetaceans and pinnipeds to playbacks of pre-recorded songs, social sounds, and feeding calls. Playbacks may be used during capture and release activities and during rehabilitation. Sounds and songs would be projected from an underwater speaker hung over the side of a small vessel or in a pool at a volume and quality as close to a real sound/song as possible. The playback system would be calibrated so precise levels of sound can be projected. The physiological and/or physical response of the animals to the sounds and songs would be measured, often through behavioral observation and photographs/video recording of the subject animal(s). Playbacks will be used to determine whether an animal can hear, and to assess how they respond to sounds. Sounds may be of conspecifics, closely related species (e.g., other delphinids), or predators to assess the response to the sound. This information would be used to determine the releasability of a rehabilitated animal. Additional uses of active acoustic playbacks as a hazing or attractant technique are discussed above (Section 2.2.3.4).

2.2.3.17 *Euthanasia*

The Permits Division proposes to permit the MMHSRP to oversee and conduct euthanasia of ESA-listed marine mammals. Euthanasia is defined by the American Veterinary Medical Association as “the use of humane techniques to induce the most rapid and painless and distress-free death possible” (AVMA 2013). Euthanasia of an ESA-listed animal may occur if the release or rehabilitation of a stranded animal is not possible or not judged to be in the best interest of the animal. Euthanasia may occur in the field during response or research or at a rehabilitation facility when an animal has an irreversibly poor condition, when it is judged to be the most humane course of action, or if the animal is deemed non-releasable and cannot be placed in permanent captivity. Specific advice on considerations when determining if euthanasia is the appropriate course of action is presented by the International Whaling Commission (IWC) in 2013 and will be followed. Humane euthanasia will only be carried out by an attending, experienced, and licensed veterinarian or other qualified individual. A review of potential euthanasia techniques for cetaceans can be found in (Barco et al. 2012; IWC 2013). The methods below were judged to be euthanasia as defined by the American Veterinary Medical Association when performed by trained and properly equipped personnel with appropriate mitigation.

Euthanasia may be performed through the use of chemical agents. Sedation may precede the administration of euthanasia drugs. Smaller cetaceans may be euthanized by injecting barbiturates or other lethal agent into a vein of the flippers, dorsal fin, flukes, or caudal peduncle. It may also be injected directly into the heart or abdominal cavity using an in-dwelling catheter. A small cetacean may be sedated before injection occurred. For large cetaceans, a method has been developed and successfully used in four cases to sedate the animal via intramuscular injection and then deliver euthanasia agents via intravenous, pericardiac, or intracardiac routes (Harms et al. 2014). Large cetaceans may be euthanized by lethal injection directly into the heart (injection into a vein of the flippers or flukes would likely be unsuccessful). Pinnipeds are typically euthanized using a lethal injection of barbiturates or other agent normally used to euthanize domestic species, larger pinnipeds are usually sedated prior to administration of euthanasia drugs. In pinnipeds, euthanasia solution may be administered into the extradural sinus, caudal gluteal, subclavian or jugular vein, or by intracardiac or intraperitoneal injections. Carcasses euthanized chemically would be disposed of in an environmentally responsible manner. In the PEIS issued on the MMHSRP, the Preferred Alternative is that the NMFS recommended the removal of chemically euthanized carcasses off-site (out of the natural environment) for disposal by incineration, landfill, or other methods. While the MMHSRP recognizes that this is the ideal that should be accomplished whenever possible, there may be logistical or environmental factors that make a complete removal of euthanized animals impossible.

Stranded marine mammals may also be euthanized by physical means, including ballistics (shooting), explosives (currently used in Australia – see (Coughran et al. 2012)), by exsanguination (Geraci and Lounsbury 2005), or other specialized euthanasia equipment such as sperm whale euthanasia devices, captive bolt, spinal lance, explosive penthrite grenades, etc. (IWC 2013). For pinnipeds and cetaceans with a total length less than 6 meters (excluding sperm whales), ballistics is an acceptable form of euthanasia, provided the safety of responders and onlookers is maintained, the marksman is skilled and the targeted area (as described in (Greer et al. 2001)) is clear. Exsanguination is not a preferred method of euthanasia, but may be the only method available in some circumstances. Given the alternative of a prolonged agonal natural death, exsanguination may be deemed acceptable on a case-by-case basis. Whenever possible, exsanguination will only be conducted on a heavily sedated animal, as the time to death may be prolonged and therefore not humane (IWC 2013). Exsanguination occurs through a deep cut or puncture to a major vein, artery, or the heart.

2.2.3.18 *Placement of Non-Releasable Animals in Permanent Captivity*

For emergency response activities, animals may be removed from the wild for medical intervention, entanglement response, or if they are in a situation that poses risk to the animal or the public (e.g., near an oil spill, out of habitat). It is the goal of the MMHSRP to return animals to the wild following intervention unless it is determined the animal is unlikely to thrive in the wild due to medical status or habituation, or poses a risk to the wild population, such as being a carrier of a novel pathogen.

In the event that an ESA-listed marine mammal is deemed non-releasable and is not humanely euthanized, the animal will be placed in a permanent managed care setting for the remainder of its life. This opinion considers the captive maintenance and associated activities on any ESA-listed marine mammal rehabilitated under the MMHSRP permit and deemed non-releasable to the wild for the entirety of that animal's life in captivity.

Under the proposed permit, research may be conducted on ESA-listed permanently captive animals (those deemed non-releasable under the proposed permit, or those already in permanent captivity) at any facility appropriately licensed by the U.S. Department of Agriculture (Permit No. 18768-01, Appendix 7: Conditions for Research/Enhancement Activities on Permanently Captive Marine Mammals). Research includes procedures described in this opinion for wild animals and vaccination trials. Enhancement includes standard husbandry and veterinary care necessary for captive maintenance and any incidental public display to educate the public on the status of the species.

When animals are deemed non-releasable, they are effectively no longer part of the wild population. No captive marine mammal may be released into the wild unless such a release has been authorized under an amendment to the permit or a separate scientific research permit.

2.2.3.19 *Import and Export Activities*

The Permits Division proposes to authorize the MMHSRP to import and export live marine mammals and marine mammal parts.

The MMHSRP proposes to import or export an unlimited number of live marine mammals (ESA-listed and non-listed) for enhancement purposes. Importation and exportation privileges are necessary to import live animals of both ESA-listed and non-listed species for veterinary care, rehabilitation, or temporary holding. If necessary, Convention on International Trade in Endangered Species of Wild Fauna and Flora import/export/re-export permits will be obtained. The MMHSRP currently has a “master file” for export and re-export and a blanket import Convention on International Trade in Endangered Species of Wild Fauna and Flora permit which would be available to be used by co-investigators authorized under this permit at the discretion of the principle investigator.

While import of live foreign marine mammals is not usual, it may be necessary for enhancement purposes, as in many cases the best available veterinary care and rehabilitation and holding facilities are available in the United States. Such import would typically occur at the request of a foreign government or stranding network. For example, as previously mentioned in Section 1.1, reinitiation for this consultation was triggered by the possibility that the MMHSRP may import vaquita from captive facilities in Mexico. This import would occur at the request of the Mexican government if, for example, vaquita needed veterinary care that could only be received in the U.S. or if a natural disaster such as a hurricane threatened vaquita at their facilities in Mexico. Situations that may warrant exportation of live animals include: animals that were previously imported, animals that stranded in the U.S. but near a foreign country where better facilities/care exist, and animals that stranded within the U.S. but were clearly extralimital and the best release option is determined to be in a foreign country (e.g., artic seals stranding along the U.S. Atlantic coast). As the result of importation and exportation, these marine mammals may experience restraint, handling, transport, temporary holding, and release or euthanasia. These activities would follow those protocols outlined above.

The MMHSRP proposes to import or export an unlimited number of marine mammal (ESA-listed and non-listed) specimens, including cell lines for baseline health research purposes. The MMHSRP requires exportation authorization to provide specimens to the international scientific community for analyses or as control/standard reference materials and to export animals for release. Importation privileges are necessary for the MMHSRP to acquire legally obtained specimens from outside the U.S. for archival in the National Marine Mammal Tissue Bank or for health-related analyses by U.S. experts and laboratories. Specimen materials may include, but are not necessarily limited to: earplugs, teeth, bone, tympanic bullae, ear ossicles, baleen, eyes, muscle, skin, blubber, internal organs and tissues, reproductive organs, mammary glands, milk or colostrum, serum or plasma, urine, tears, blood or blood cells, cells for culture, bile, fetuses, internal and external parasites, stomach/intestines and their contents, feces, flippers, fins, flukes, head and skull, and whole carcasses. Specimens would generally be acquired opportunistically; therefore, specific numbers and kinds of specimens, the countries of exportation, and the countries of origin cannot be predetermined.

As most specimens are acquired opportunistically, the MMHSRP will have minimal control over the age, size, sex, or reproductive condition of any animals that are sampled. Imported specimens will be legally obtained from:

- Animals stranded alive or dead or in rehabilitation abroad;
- Soft parts sloughed, excreted, or discharged by live animals (including blowhole exudate) and collected abroad;
- Animals taken from permitted or legal scientific study, where such taking is humane;
- Any captive marine mammal (public display, research, military, or rehabilitation) sampled during husbandry, including samples beyond the scope of normal husbandry or normal rehabilitation practices;
- Marine mammals taken in legal fisheries targeting marine mammals abroad where such taking is humane;
- Marine mammals killed during legal subsistence harvests by native communities abroad;
- Marine mammals killed incidental to recreational and commercial fishing operations or other human activities abroad; or
- Marine mammals or parts confiscated by law enforcement officials.

2.2.3.20 *Documentation*

The Permits Division proposes to authorize the MMHSRP to document activities through a variety of means, including but not limited to: taking photographs (e.g., photo identification); videos (including remote video); thermal imaging; and audio recordings, both above and below the surface of the water. This documentation would be used to assess the impacts of activities on the animals as well as better understand the health situation of the animal (e.g., better visualize the extent of an entanglement). All documentation will be in support of, or incidental to, other activities, and no additional takes are requested solely for the purpose of photography, videography, or acoustic recordings. Documentation obtained under this permit may be shared for education and outreach purposes after review by the principal investigator. Review of documentation contributes information to the post-action review and may result in future modification of activities.

2.3 Action Area

Action area means all areas affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR 402.02). The action area for baseline health research activities includes the land or water within the U.S. coastal zone of the U.S., its territories, and possessions, and adjacent marine waters. These activities may occur in the marine waters of the U.S. and its territories, including the U.S. exclusive economic zone.

In-water cetacean net captures primarily occur in the Southeast region of the United States. Previous locations for in-water net captures include Brunswick, Georgia, Barataria Bay, Louisiana and Saint Joseph's Bay, Florida. Small cetacean emergency response in-water net captures also most frequently occur in the Southeast region. Pinniped net captures for emergency response have recently been conducted in the Northeast region, in Massachusetts. Pinniped net captures may also occur along the West Coast.

Emergency response activities, including the collection of biological samples, responding to entangled marine mammals, and the import and export of live marine mammals and marine mammal parts could occur in all waters (fresh and marine) or land where marine mammals are found world-wide and in rehabilitation facilities.

2.4 Interrelated and Interdependent Activities

Interrelated actions are those that are part of a larger action and depend on that action for their justification. *Interdependent* actions are those that do not have independent use, apart from the action under consideration. For this consultation, we determined that there are no interrelated or interdependent actions outside the scope of directed research activities described above.

3 Approach to the Assessment

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with the NMFS, to insure that their actions are not likely to jeopardize the continued existence of endangered or threatened species, or adversely modify or destroy their designated critical habitat.

To "jeopardize the continued existence of a listed species" means to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species (50 CFR §402.02). The jeopardy analysis considers both survival and recovery of the species.

3.1 The Assessment Framework

We use the following approach to determine whether the proposed action is likely to jeopardize ESA-listed species or destroy or adversely modify critical habitat:

1) We identify the proposed action and those aspects (or stressors) of the proposed action that are likely to have direct or indirect effects on the physical, chemical, and biotic environment within the action area, including the spatial and temporal extent of those stressors.

2) We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time.

3) We describe the environmental baseline in the action area including: past and present impacts of Federal, state, or private actions and other human activities in the action area; anticipated impacts of proposed Federal projects that have already undergone formal or early section 7 consultation, impacts of state or private actions that are contemporaneous with the consultation in process.

4) We identify the number, age (or life stage), and gender of ESA-listed animals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong. This is our exposure analysis.

5) We evaluate the available evidence to determine how those ESA-listed species are likely to respond given their probable exposure. This is our response analyses.

6) We assess the consequences of these responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. This is our risk analysis.

7) The adverse modification analysis considers the impacts of the proposed action on the critical habitat features and conservation value of designated critical habitat. This opinion relies on the recently updated regulatory definition of “destruction or adverse modification” of critical habitat at 50 CFR §402.02: a direct or indirect alteration that appreciably diminishes the value of critical habitat for the conservation of an ESA-listed species. Such alterations may include, but are not limited to, those that alter the physical or biological features essential to the conservation of a species or that preclude or significantly delay development of such features.

8) We describe any cumulative effects of the proposed action in the action area. Cumulative effects, as defined in our implementing regulations (50 CFR §402.02), are the effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area. Future Federal actions that are unrelated to the proposed action are not considered because they require separate section 7 consultation.

9) We integrate and synthesize the above factors by considering the effects of the action to the environmental baseline and the cumulative effects to determine whether the action could reasonably be expected to:

    a) Reduce appreciably the likelihood of both survival and recovery of the ESA-listed species in the wild by reducing its numbers, reproduction, or distribution; or

    b) Reduce the conservation value of designated or proposed critical habitat. These assessments are made in full consideration of the status of the species and critical habitat.

10) We state our conclusions regarding jeopardy and the destruction or adverse modification of critical habitat.

If, in completing the last step in the analysis, we determine that the action under consultation is likely to jeopardize the continued existence or recovery of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative to the action. The reasonable and prudent alternative must not be likely to jeopardize the continued existence of ESA-listed species nor adversely modify their designated critical habitat and it must meet other regulatory requirements.

3.2 Evidence Available for the Consultation

For this consultation, in order to comply with our obligation to use the best scientific and commercial data available, we used several sources to identify information relevant to the species, the potential stressors associated with the proposed action, and the potential responses of marine mammals to those stressors. We conducted electronic searches, using *google scholar* and the online database *web of science,* and considered all lines of evidence available through published and unpublished sources that represent evidence of adverse consequences or the absence of such consequences. We relied on information submitted by the Permits Division and the MMHSRP (including annual reports), government reports (including previously issued NMFS biological opinions and stock assessment reports), NOAA technical memos, peer-reviewed scientific literature, and other information. We organized the results of electronic searches using commercial bibliographic software. We also consulted with subject matter experts, within the NMFS as well as the academic and scientific community. When the information presented contradictory results, we described all results, evaluated the merits or limitations of each study, and explained how each was similar or dissimilar to the proposed action to come to our own conclusion.

4 Status of Endangered Species Act Protected Resources

This section identifies the ESA-listed species and designated critical habitat that occur within the action area that may be affected by the proposed action. It then summarizes the biology and ecology of those species and what is known about their life histories in the action area. The status is determined by the level of risk that the ESA-listed species and critical habitat face, based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This section also breaks down the species and critical habitats that may be affected by the proposed action, describing whether or not those species and critical habitats are likely to be adversely affected by the proposed action. The species and critical habitats deemed likely to be adversely affected by the proposed action are carried forward through the remainder of this opinion.

This section helps to inform the description of the species' current "reproduction, numbers, or distribution" as described in 50 CFR 402.02. More detailed information on the status and trends of these ESA-listed resources, and their biology and ecology, can be found in the listing regulations and critical habitat designations published in the Federal Register, status reviews, recovery plans, and on the NMFS web site (www.nmfs.noaa.gov/pr/species/).

The species potentially occurring within the action area that may be affected by the proposed action are listed in Table 5 below, along with their regulatory status.

Table 5: ESA-listed species and designated critical habitat that may be affected by the proposed action of permitting and carrying out the marine mammal health and stranding response program.

Species	ESA Status	Critical Habitat	Recovery Plan
Marine Mammals – Cetaceans			
Beluga Whale (*Delphinapterus leucas*) – Cook Inlet DPS	E – 73 FR 62919	76 FR 20179	82 FR 1325
Blue Whale (*Balaenoptera musculus)*	E – 35 FR 18319	-- --	07/1998
Bowhead Whale (*Balaena mysticetes*)	E – 35 FR 18319	-- --	-- --
Chinese River/Baiji Dolphin (*Lipotes vexillifer*)	E – 54 FR 22906	-- --	-- --
False Killer Whale (*Pseudorca crassidens*) – Main Hawaiian Islands Insular DPS	E – 77 FR 70915	-- --	-- --
Fin Whale (*Balaenoptera physalus)*	E – 35 FR 18319	-- --	75 FR 47538
Gray Whale (*Eschrichtius robustus*) Western North Pacific	E – 35 FR 18319	-- --	-- --
Gulf of California Harbor Porpoise/Vaquita (*Phocoena sinus*)	E – 50 FR 1056	-- --	-- --
Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*)	E – 81 FR 88639 (Proposed)	-- --	-- --
Humpback Whale (*Megaptera novaeangliae*) – Arabian Sea DPS	E – 81 FR 62259	-- --	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Cape Verde Islands/Northwest Africa DPS	E – 81 FR 62259	-- --	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Central America DPS	E – 81 FR 62259	-- --	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Mexico DPS	T – 81 FR 62259	-- --	11/1991
Humpback Whale (*Megaptera novaeangliae*) – Western North Pacific DPS	E – 81 FR 62259	-- --	11/1991
Indus River Dolphin (*Platanista minor*)	E – 56 FR 1463	-- --	-- --
Killer Whale (*Orcinus orca*) – Southern Resident DPS	E – 70 FR 69903	71 FR 69054	73 FR 4176
Maui's Dolphin (*Cephalorhynchus hectori maui*)	E – 81 FR 64110 (Proposed)	-- --	-- --
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 FR 12024	59 FR 28805 and 81 FR 4837	70 FR 32293
North Pacific Right Whale (*Eubalaena japonica*)	E – 73 FR 12024	59 FR 28805 and 73 FR 19000	78 FR 34347
Sei Whale (*Balaenoptera borealis*)	E – 35 FR 18319	-- --	12/2011
South Island Hector's Dolphin (*Cephalorhynchus hectori hectori*)	T – 81 FR 64110 (Proposed)	-- --	-- --
Southern Right Whale (*Eubalaena australis*)	E – 35 FR 8491	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	-- --	75 FR 81584
Taiwanese Humpback Dolphin (*Sousa chinensis taiwanensis*)	E – 82 FR 28802 (Proposed)	-- --	-- --
Marine Mammals – Pinnipeds			
Bearded Seal (*Erignathus barbatus*) – Beringia DPS	T – 77 FR 76739	-- --	-- --
Bearded Seal (*Erignathus barbatus*) –Okhotsk DPS	T – 77 FR 76739	-- --	-- --
Guadalupe Fur Seal (*Arctocephalus townsendi*)	T – 50 FR 51252	-- --	-- --
Hawaiian Monk Seal (*Neomonachus schauinslandi*)	E – 41 FR 51611	80 FR 50925, 53 FR 18988, and 51 FR 16047	72 FR 46966
Mediterranean Monk Seal, (*Monachus monachus*)	T – 35 FR 8491	-- --	-- --
Ringed Seal (*Phoca hispida hispida*) –Arctic DPS	T – 77 FR 76706 Listing vacated; pending appeal	79 FR 73010 (Proposed)	-- --
Ringed Seal (*Phoca hispida botnica*) –Baltic DPS	T – 77 FR 76706	-- --	-- --
Ringed Seal (*Phoca hispida ladogensis*) – Ladoga DPS	E – 77 FR 76706	**-- --**	**-- --**
Ringed Seal (*Phoca hispida ochotensis*) – Okhotsk DPS	T – 77 FR 76706	-- --	-- --
Ringed Seal, (*Phoca hispida saimensis*) Saimaa	E – 58 FR 40538	-- --	-- --
Spotted Seal (*Phoca largha*) – Southern DPS	T – 75 FR 65239	-- --	-- --
Steller Sea Lion (*Eumetopias jubatus*) – Western DPS	E – 55 FR 49204 and T – 62 FR 24345	58 FR 45269	73 FR 11872
Marine Reptiles			
Green Turtle (*Chelonia mydas*) – Central North Pacific DPS	T – 81 FR 20057	-- --	63 FR 28359
Green Turtle (*Chelonia mydas*) – Central South Pacific DPS	E – 81 FR 20057	-- --	63 FR 28359
Green Turtle (*Chelonia mydas*) – Central West Pacific DPS	E – 81 FR 20057	-- --	63 FR 28359
Green Turtle (*Chelonia mydas*) – East Pacific DPS	T – 81 FR 20057	-- --	63 FR 28359
Green Turtle (*Chelonia mydas*) – North Atlantic DPS	T – 81 FR 20057	63 FR 46693	10/1991
Hawksbill Turtle (*Eretmochelys imbricata)*	E – 35 FR 8491	63 FR 46693	63 FR 28359 and 57 FR 38818
Kemp's Ridley Turtle (*Lepidochelys kempii*)	E – 35 FR 18319	-- --	9/2011
Leatherback Turtle (*Dermochelys coriacea*)	E – 35 FR 8491	44 FR 17710 and 77 FR 4170	63 FR 28359 and 10/1991
Loggerhead Turtle (*Caretta caretta*) – North Pacific Ocean DPS	E – 76 FR 58868	-- --	63 FR 28359
Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS	T – 76 FR 58868	79 FR 39856	74 FR 2995
Loggerhead Turtle (*Caretta caretta*) – South Pacific Ocean DPS	E – 76 FR 58868	-- --	-- --
Olive Ridley Turtle (*Lepidochelys olivacea*) All Other Areas	T – 43 FR 32800	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Olive Ridley Turtle (*Lepidochelys olivacea*) Mexico's Pacific Coast Breeding Colonies	E – 43 FR 32800	-- --	63 FR 28359
Fishes			
Atlantic Salmon (*Salmo salar*) – Gulf of Maine DPS	E – 74 FR 29344 and 65 FR 69459	74 FR 29300	70 FR 75473 and 81 FR 18639 (Draft)
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS	E – 77 FR 5913	81 FR 36077 and 81 FR 41926 (Proposed)	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Chesapeake DPS	E – 77 FR 5879	81 FR 35701 (Proposed)	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Gulf of Maine DPS	T – 77 FR 5879	81 FR 35701 (Proposed)	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – New York Bight DPS	E – 77 FR 5879	81 FR 35701 (Proposed)	-- --
Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – South Atlantic DPS	E – 77 FR 5913	81 FR 36077 and 81 FR 41926 (Proposed)	-- --
Bocaccio (*Sebastes paucispinis*) – Puget Sound/Georgia Basin DPS	E – 75 FR 22276 and 82 FR 7711	79 FR 68041	81 FR 54556 (Draft)
Chinook Salmon (*Oncorhynchus tshawytscha)* – California Coastal ESU	T – 70 FR 37160	70 FR 52488	81 FR 70666
Chinook Salmon (*Oncorhynchus tshawytscha)* – Central Valley Spring-Run ESU	T – 70 FR 37160	70 FR 52488	79 FR 42504
Chinook Salmon (*Oncorhynchus tshawytscha)* – Lower Columbia River ESU	T – 70 FR 37160	70 FR 52629	78 FR 41911
Chinook Salmon (*Oncorhynchus tshawytscha)* – Puget Sound ESU	T – 70 FR 37160	70 FR 52629	72 FR 2493
Chinook Salmon (*Oncorhynchus tshawytscha)* – Sacramento River Winter-Run ESU	E – 70 FR 37160	58 FR 33212	79 FR 42504
Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Fall-Run ESU	T – 70 FR 37160	58 FR 68543	80 FR 67386 (Draft)
Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Spring/Summer Run ESU	T – 70 FR 37160	64 FR 57399	81 FR 74770 (Draft)
Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Columbia River Spring-Run ESU	E – 70 FR 37160	70 FR 52629	72 FR 57303
Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Willamette River ESU	T – 70 FR 37160	70 FR 52629	76 FR 52317
Chum Salmon (*Oncorhynchus keta*) –Columbia River ESU	T – 70 FR 37160	70 FR 52629	78 FR 41911
Chum Salmon (*Oncorhynchus keta*) –Hood Canal Summer-Run ESU	T – 70 FR 37160	70 FR 52629	72 FR 29121
Coho Salmon (*Oncorhynchus kisutch*) – Central California Coast ESU	E – 70 FR 37160	64 FR 24049	77 FR 54565
Coho Salmon (*Oncorhynchus kisutch*) –Lower Columbia River ESU	T – 70 FR 37160	81 FR 9251	78 FR 41911
Coho Salmon (*Oncorhynchus kisutch*) – Oregon Coast ESU	T – 73 FR 7816	73 FR 7816	81 FR 90780
Coho Salmon (*Oncorhynchus kisutch*) – Southern Oregon and Northern California Coasts ESU	T – 70 FR 37160	64 FR 24049	79 FR 58750
Eulachon (*Thaleichthys pacificus*) –Southern DPS	T – 75 FR 13012	76 FR 65323	81 FR 72572 (Draft)
Giant Manta Ray (*Manta birostris*)	T -- 82 FR 3694 (Proposed)	-- --	-- --

Species	ESA Status	Critical Habitat	Recovery Plan
Green Sturgeon (*Acipenser medirostris*) – Southern DPS	T – 71 FR 17757	74 FR 52300	-- --
Gulf Grouper (*Mycteroperca jordani*)	E – 81 FR 72545	-- --	-- --
Gulf Sturgeon (*Acipenser oxyrinchus desotoi*)	T – 56 FR 49653	68 FR 13370	09/1995
Nassau Grouper (*Epinephelus striatus*)	T – 81 FR 42268	-- --	-- --
Oceanic Whitetip Shark (*Carcharhinus longimanus*)	T – 81 FR 96304 (Proposed)	-- --	-- --
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Central and Southwest Atlantic DPS	T – 79 FR 38213	-- --	-- --
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Eastern Pacific DPS	E – 79 FR 38213	-- --	-- --
Scalloped Hammerhead Shark (*Sphyrna lewini*) – Indo-West Pacific DPS	T – 79 FR 38213	-- --	-- --
Shortnose Sturgeon (*Acipenser brevirostrum*)	E – 32 FR 4001	-- --	63 FR 69613
Smalltooth Sawfish (*Pristis pectinata*) – U.S. portion of range DPS	E – 68 FR 15674	74 FR 45353	74 FR 3566
Sockeye Salmon (*Oncorhynchus nerka*) – Ozette Lake ESU	T – 70 FR 37160	70 FR 52630	74 FR 25706
Sockeye Salmon (*Oncorhynchus nerka*) – Snake River ESU	E – 70 FR 37160	58 FR 68543	80 FR 32365
Steelhead Trout (*Oncorhynchus mykiss*) – California Central Valley DPS	T – 71 FR 834	70 FR 52487	79 FR 42504
Steelhead Trout (*Oncorhynchus mykiss*) – Central California Coast DPS	T – 71 FR 834	70 FR 52487	81 FR 70666
Steelhead Trout (*Oncorhynchus mykiss*) – Lower Columbia River DPS	T – 71 FR 834	70 FR 52629	78 FR 41911
Steelhead Trout (*Oncorhynchus mykiss*) – Middle Columbia River DPS	T – 71 FR 834	70 FR 52629	74 FR 50165
Steelhead Trout (*Oncorhynchus mykiss*) – Northern California DPS	T – 71 FR 834	70 FR 52487	81 FR 70666
Steelhead Trout (*Oncorhynchus mykiss*) – Puget Sound DPS	T – 72 FR 26722	81 FR 9251	-- --
Steelhead Trout, (*Oncorhynchus mykiss*) – Snake River Basin DPS	T – 71 FR 834	70 FR 52629	81 FR 74770 (Draft)
Steelhead Trout (*Oncorhynchus mykiss*) – South-Central California Coast DPS	T – 71 FR 834	70 FR 52487	78 FR 77430
Steelhead Trout (*Oncorhynchus mykiss*) – Southern California DPS	E – 71 FR 834	70 FR 52487	77 FR 1669
Steelhead Trout (*Oncorhynchus mykiss*) – Upper Columbia River DPS	T – 71 FR 834	70 FR 52629	72 FR 57303
Steelhead Trout (*Oncorhynchus mykiss*) – Upper Willamette River DPS	T – 71 FR 834	70 FR 52629	76 FR 52317
Yelloweye Rockfish (*Sebastes rubberimus*) – Puget Sound/Georgia Basin DPS	T – 75 FR 22276 and 82 FR 7711	79 FR 68041	81 FR 54556 (Draft)
Marine Invertebrates			
Johnson's Seagrass (Halophila johnsonii)	T – 63 FR 49035	65 FR 17786	67 FR 62230

4.1 Species and Critical Habitat Not Likely to be Adversely Affected

The proposed action is not likely to adversely affect some ESA-listed species and designated critical habitats that occur in the action area because the anticipated effects on those species and habitats are expected to be either insignificant or discountable. “Insignificant” effects relate to the size of impact and do not result in take. “Discountable” effects are those that we consider unlikely to occur.

4.1.1 Fishes

The proposed action overlaps spatially with the ranges of several ESA-listed (or proposed) marine fishes that may be affected by the proposed action, but are not likely to be adversely affected. These include: Atlantic salmon, bocaccio, Chinook salmon (all ESUs), coho salmon (all ESUs), chum salmon (all ESUs), eulachon, giant manta ray, Gulf grouper, Nassau grouper, oceanic whitetip shark, scalloped hammer head shark (Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific DPSs), sockeye salmon (all ESUs), steelhead trout (all DPSs), and yelloweye rockfish. Interactions with these fish species during an enhancement activity is not expected to occur because MMHSRP enhancement activities are in response to marine mammal in distress that would not involve fishes (i.e., response would be to a stranded, entangled, sick marine mammal). Baseline health research activities that have potential to interact with these species would include netting of marine mammals. The coastal and marine habitat use of these fishes is expected to be offshore and deeper than where netting activities would occur. If one of these ESA-listed fish species were near a netting activity, we would expect them to evade interactions with MMHSRP personnel and equipment. Therefore, we find that effects on these ESA-listed fishes are extremely unlikely to occur, and thus discountable. We conclude that the issuance of Permit No. 18786-01 and the MMHSRP are not likely to adversely affect the above fish species, and we will not discuss these species further in this opinion.

4.1.2 Designated and Proposed Critical Habitat

Critical habitat has been designated or proposed for a number of the species listed in Table 5. Activities of the MMHSRP would rarely occur in freshwater where designated critical habitat is for salmon and sturgeon species is located. Even if a marine mammal enters freshwater and needs to be rescued, the rescue procedures would not affect the essential features of designated critical habitat such as water quantity and quality, and prey availability. The essential features for marine fish species designated critical habitat include quantity, quality, and availability of prey species, water quality and sufficient levels of dissolved oxygen to support growth, survival, reproduction, and feeding opportunities; and the type and amount of structure and rugosity that supports feeding opportunities and predator avoidance. None of the MMHSRP activities would have a measureable impact on these features. Thus, the quantity, quality, or availability of the essential physical or biological features of these critical habitats would not be destroyed or adversely modified.

Further, the MMHSRP activities would not have a measurable impact on the essential features of any sea turtle designated critical habitat such as Sargassum, prey availability, or convergence zones. Hence the quantity, quality, or availability of the essential physical or biological features would not be destroyed or adversely modified.

As determined in the original biological opinion for Permit No. 18786 (NMFS 2015a), and our previous opinion on the modified Permit No. 18786-01 (NMFS 2016a), the MMHSRP activities would not have a measurable impact on the essential features of any marine mammal designated critical habitat such as passable waters of appropriate depth which are free of toxins, and have minimal noise pollution and abundant prey to support growth and reproduction. Hence the quantity, quality, or availability of the essential physical or biological features of designated marine mammal critical habitat would not be destroyed or adversely modified.

Therefore, we conclude that the proposed action is not likely to destroy or adversely modify designated critical habitats for ESA-listed sea turtles, marine or anadromous fishes, and marine mammals and we will not discuss these designated or proposed critical habitats further in this opinion.

For Johnson's seagrass, the MMHSRP may walk on, or deploy netting over areas of Johnson's seagrass. We do not expect this to have a measurable impact to the quantity, quality, or availability of the essential physical or biological features such as adequate water quality, salinity levels, and water transparency from the proposed action. We would expect an unmeasurable level of disturbance to the seagrass and sediments from MMHSRP activities if they overlap with Johnson's seagrass and its designated critical habitat. We would anticipate those effects to be temporary and minimal because the activity would be short-term (hours) and localized (small area). Therefore, we find that the action is not likely to destroy or adversely modify Johnson's seagrass critical habitat and Johnson's seagrass itself is not likely to be adversely affected. As such, we will not discuss Johnson's seagrass or its critical habitat further in this opinion.

4.2 Species Likely to Be Adversely Affected

The proposed action is likely to adversely affect some ESA-listed species. These species and critical habitat are described below, and the effects of the proposed action on these species are analyzed in the remainder of this opinion.

4.2.1 Beluga Whale (Cook Inlet Distinct Population Segment)

Cook Inlet beluga whales reside in Cook Inlet (Figure 2) year-round, which makes them geographically and genetically isolated from other beluga whale stocks in Alaska (Allen et al. 2011). Within Cook Inlet, they generally occur in shallow, coastal waters, often in water barely deep enough to cover their bodies (Harrison and Ridgway 1981).

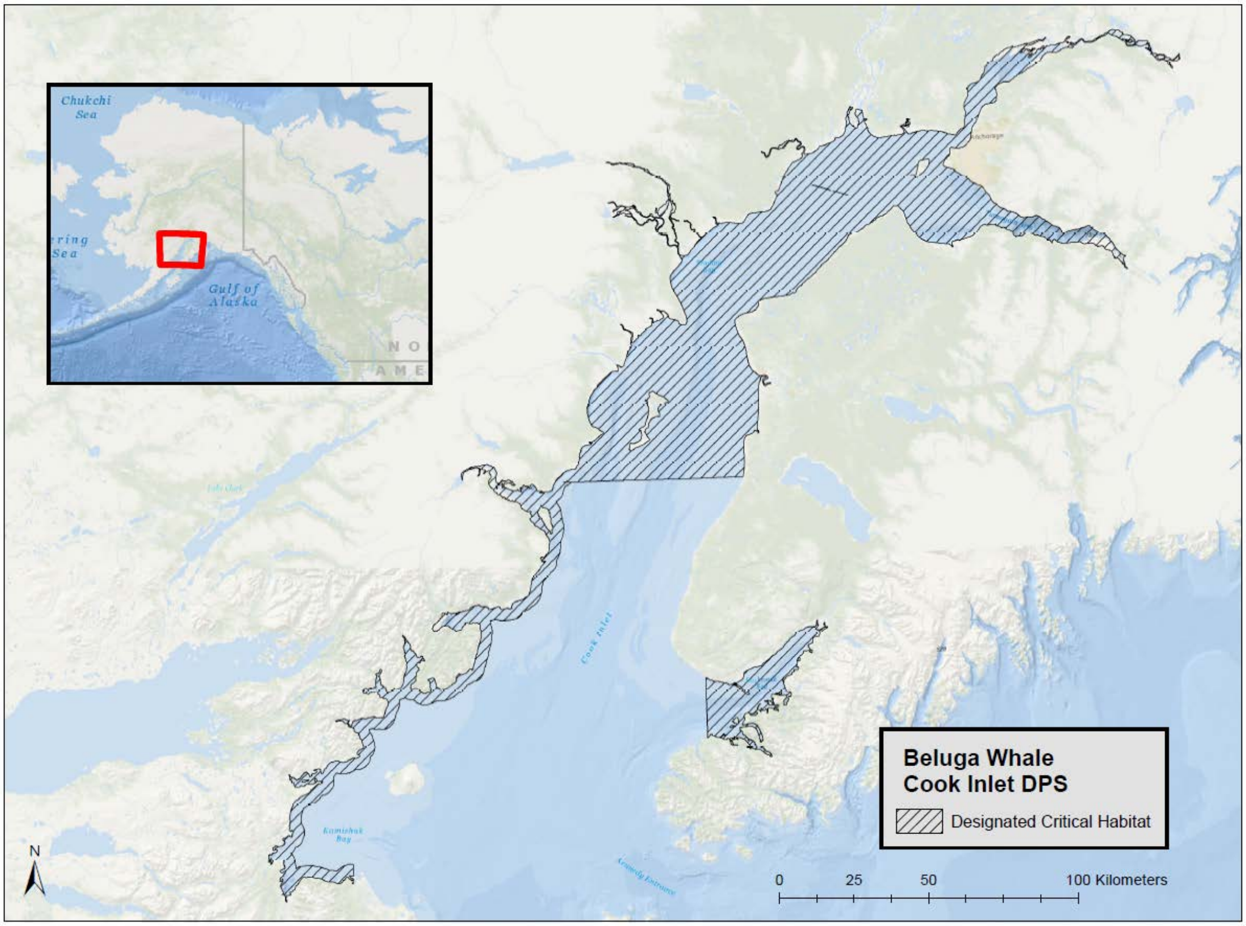

Figure 2. Beluga Whale Cook Inlet distinct population segment general range and designated critical habitat.

The beluga, or "white whale," is a small, white odontocete. Belugas have a stocky body, flexible neck, small rounded head, short beak, and conical teeth (Figure 3). The flippers are relatively small but broad and spatulate, with edges that tend to curl with age. Their flukes are broad and notched with convex trailing edges (NMFS 2016e). The Cook Inlet DPS of beluga whales was listed as endangered under the ESA effective October 22, 2008 (Table 6).

Figure 3: Beluga whale. Photo: National Oceanic and Atmospheric Administration

Table 6: Cook Inlet beluga whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segments	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Delphinapterus leucas	Beluga Whale	Cook Inlet	Endangered	2017	73 FR 62919	2017	76 FR 20180

Information available from the recovery plan (NMFS 2016e), recent stock assessment reports (Carretta et al. 2016), and the status review (NMFS 2017) were used to summarize the life history, population dynamics and status of the species as follows.

4.2.1.1 *Life history*

Belugas are long-lived (60 to 70 years) and have a relatively slow reproductive cycle; sexual maturity is believed to be attained at four to 10 years for females and at eight to 15 for males (Nowak 1991; Suydam et al. 1999). Females typically produce a single calf every two to three years following a 14-month gestation. Most calving in Cook Inlet is assumed to occur from mid-May to mid-July (Calkins 1984).Young beluga whales are nursed for two years and may continue to associate with their mothers for a considerable time thereafter (Reeves et al. 2002).

Belugas in Cook Inlet appear to feed extensively on concentrations of spawning eulachon in the spring and then shift to foraging on salmon species as eulachon runs diminish and salmon return to spawning streams. In winter, Cook Inlet belugas forage opportunistically on benthic and pelagic species including octopi, squids, crabs, shrimps, clams, mussels, snails, sandworms, and a variety of fishes including eulachon and salmon (NMFS 2016e).

4.2.1.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Cook Inlet beluga whale.

The best available historical abundance estimate of 1,293 Cook Inlet beluga whales was obtained from an aerial survey conducted in 1979 (Calkins 1989). NMFS has adopted 1,300 as the value for the carrying capacity to be used for management purposes. Cook Inlet belugas experienced a decline in abundance of nearly 50 percent between 1994 and 1998, from an estimate of 653 whales to 347 whales. This period of rapid decline was associated with a substantial, unregulated subsistence hunt. With the regulation of hunting beginning in 1999 (a total of five whales hunted from 1999 to 2014, 16 years), NMFS anticipated that the population would begin to increase at a growth rate of between two and six percent per year (NMFS 2016e). The 2014 abundance estimate was 340 belugas, with a declining trend for both the most recent 10-year time period (–0.4 percent per year; standard error = 1.3 percent) and since the hunt was managed in 1999 (–1.3 percent per year, standard error = 0.7 percent) (Shelden et al. 2015). Thus, the population is not growing as expected despite the regulation of the subsistence harvest.

The degree of genetic differentiation between the Cook Inlet DPS and the other four Alaska beluga stocks indicates the Cook Inlet DPS is the most isolated (O'Corry-Crowe et al. 2002). This suggests that the Alaska Peninsula has long been an effective physical barrier to genetic exchange and that migration of whales into Cook Inlet from other stocks is unlikely. NMFS concluded that the Allee effect is not a relevant concern for Cook Inlet belugas unless the population size is smaller than 50 animals (Hobbs et al. 2008). Similarly, inbreeding depression and loss of genetic diversity do not pose a significant risk to Cook Inlet belugas unless the population is reduced to fewer than 200 whales (Hobbs et al. 2008).

Multiple data sources indicate that belugas exhibit seasonal shifts in distribution and habitat use within Cook Inlet; however, belugas in Cook Inlet do not migrate out of Cook Inlet. Generally, Cook Inlet belugas spend the ice-free months in the upper Inlet (often at discrete high-use areas), then expand their distribution south and into more offshore waters of the middle Inlet in winter (Hobbs et al. 2008), although they may be found throughout the Inlet at any time of year. The summer distribution of beluga whales in Cook Inlet has experienced a significant contraction since the 1970s (Hobbs et al. 2008; Rugh et al. 2010; Speckman and Piatt 2000). While the exact reasons for the contraction remain unknown, the reduction in range has resulted in belugas in close proximity to Anchorage during summer months, where there is an increased potential for disturbance from human activities (NMFS 2016e).

4.2.1.3 *Acoustics*

Beluga whales have a well-developed sense of hearing and echolocation. They hear over a large range of frequencies, from about 40 Hz to 100 kHz, although their hearing is most acute from 10 to 75 kHz (Richardson et al. 1995a). They call at frequencies of 0.26 to 20 kHz and echolocate at frequencies of 40 to 60 kHz and 100 to 120 kHz (Blackwell and Greene 2002).

4.2.1.4 *Status*

Cook Inlet beluga whales experienced a decline in abundance of nearly 50 percent between 1994 and 1998. Although this rapid decline stopped after hunting was regulated in 1998, beluga numbers have not increased (Hobbs et al. 2008). In the past, there have been both natural and anthropogenic sources of mortality or injury of Cook Inlet belugas. Although the cause of death for most Cook Inlet belugas remains unknown, natural sources include predation by “transient” killer whales, live strandings, and potentially disease; anthropogenic sources include subsistence harvest, poaching or intentional harassment, and mortalities or injuries incidental to other human activities. Climate change has also been identified as a potential threat to Cook Inlet beluga recovery (NMFS 2016e).

4.2.1.5 *Critical Habitat*

NMFS designated critical habitat for the Cook Inlet beluga whale on April 11, 2011. Two specific areas were designated comprising 7,809 square kilometers of marine habitat (Figure 2). Area 1 encompasses 1,918 square kilometers of Cook Inlet northeast of a line from the mouth of Threemile Creek to Point Possession. This area contains shallow tidal flats, river mouths or estuarine areas and is important as foraging and calving habitats. Area 1 has the highest concentrations of beluga whales in the spring through fall as well as the greatest potential for adverse impact from anthropogenic threats. Area 2 includes near and offshore areas of the mid and upper Inlet, and nearshore areas of the lower Inlet. Area 2 includes Tuxedni, Chinitna, and Kamishak Bays on the west coast and a portion of Kachemak Bay of the east coast. Dive studies indicate that beluga whales in this area dive to deeper depths and are at the surface less frequently than they are when they inhabit Area 1.

The physical and biological features (formerly called primary constituent elements) essential to the conservation of Cook Inlet beluga whales found in these areas include: (1) intertidal and subtidal waters of Cook Inlet with depths less than 30 feet (mean lower low water) and within five miles of high and medium flow accumulation anadromous fish streams; (2) primary prey species consisting of four species of Pacific salmon (Chinook, coho, sockeye, and chum salmon), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole; (3) the absence of toxins or other agents of a type or amount harmful to beluga whales; (4) unrestricted passage within or between the critical habitat areas; and (5) absence of in-water noise at levels result in the abandonment of habitat by Cook Inlet beluga whales.

4.2.1.6 *Recovery Goals*

The 2016 Cook Inlet Beluga recovery plan (NMFS 2016e) contains complete demographic and threat-based downlisting and delisting criteria. A general summary of the criteria is provided in Table 7 below.

Table 7: Criteria for considering reclassification (from endangered to threatened, or from threatened to not listed) for Cook Inlet beluga whales.

Status	Demographic criteria		Threats-Based criteria
Reclassified from Endangered to Threatened (i.e., downlisted)	The abundance estimate for CI belugas is greater than or equal to 520 individuals, and there is a 95 percent or greater probability that the most recent 25-year population abundance trend (where 25 years represents one full generation) is positive.	AND	The 10 downlisting threats-based criteria are satisfied.
Reclassified to Recovered (i.e., delisted)	The abundance estimate for CI belugas is greater than or equal to 780 individuals, and there is a 95 percent or greater probability that the most recent 25-year population abundance trend (where 25 years represents one full generation) is positive.	AND	The 10 downlisting and nine delisting threats-based criteria are satisfied

4.2.2 Blue Whale

The blue whale is a widely distributed baleen whale found in all major oceans (Figure 4).

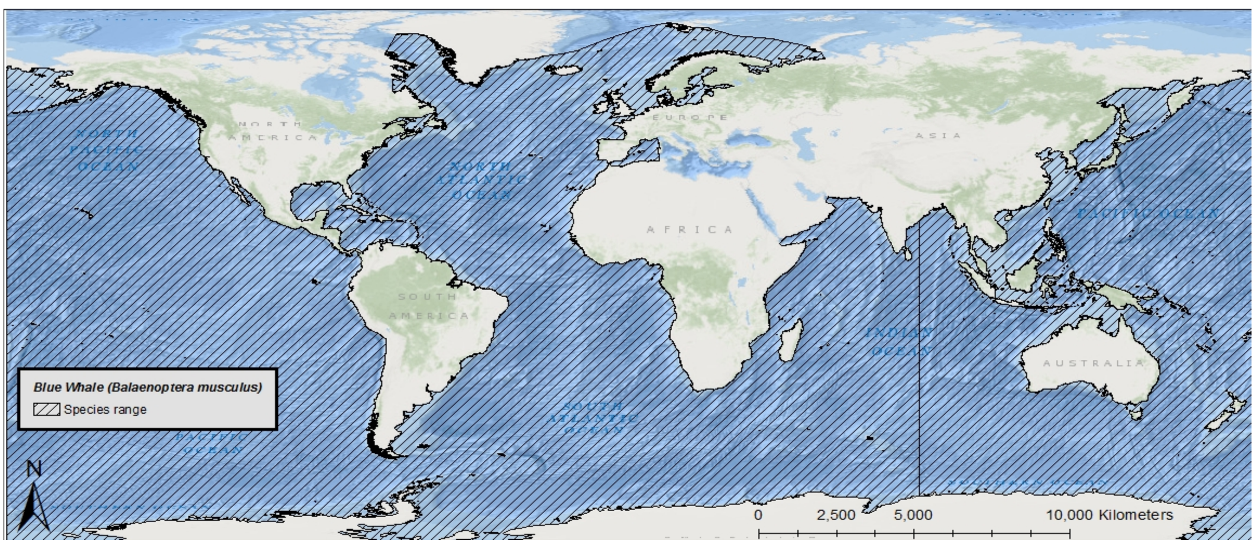

Figure 4: Map identifying the range of the blue whale.

Blue whales are the largest animal on earth and distinguishable from other whales by a long-body and comparatively slender shape, a broad, flat "rostrum" when viewed from above, a proportionally smaller dorsal fin, and a mottled gray coloration that appears light blue when seen through the water (Figure 5). Most experts recognize at least three subspecies of blue whale, *B. m. musculus*, which occurs in the Northern Hemisphere, *B. m. intermedia* or Antarctic blue whales, which occurs in the Southern Ocean, and *B. m. brevicauda*, a pygmy species found in the Indian Ocean and South Pacific. The blue whale was originally listed as endangered on December 2, 1970 (Table 8).

Figure 5: Blue whale. Photo: National Oceanic and Atmospheric Administration

Table 8: Blue whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera musculus	Blue whale	None	Endangered	None	35 FR 18319	1998 Intent to update (77 FR 22760)	None Designated

Information available from the recovery plan (NMFS 1998b), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016a), and the status review (COSEWIC 2002) were used to summarize the life history, population dynamics and status of the species as follows.

4.2.2.1 *Life History*

The average life span of blue whales is eighty to ninety years. They have a gestation period of ten to twelve months, and calves nurse for six to seven months. Blue whales reach sexual maturity between five and fifteen years of age with an average calving interval of two to three years. They winter at low latitudes, where they mate, calve and nurse, and summer at high latitudes, where they feed. Blue whales forage almost exclusively on krill and can eat approximately 3,600 kilograms daily. Feeding aggregations are often found at the continental shelf edge, where upwelling produces concentrations of krill at depths of 90 to 120 meters.

4.2.2.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the blue whale.

The global, pre-exploitation estimate for blue whales is approximately 181,200 (IWC 2007). Current estimates indicate approximately 5,000 to 12,000 blue whales globally (IWC 2007). Blue whales are separated into populations by ocean basin in the North Atlantic, North Pacific, and Southern Hemisphere. There are three stocks of blue whales designated in U.S. waters: the Eastern North Pacific [current best estimate N = 1,647, N_{min} = 1,551; (Mann 1999)] Central North Pacific (N = 81 N_{min} = 38), and Western North Atlantic (N = 400 to 600 N_{min} = 440). In the southern hemisphere, the latest abundance estimate for Antarctic blue whales is 2,280 individuals in 1997/1998 (95 percent confidence intervals 1,160-4,500) (Branch 2007). While no range-wide estimate for pygmy blue whales exists (Thomas et al. 2016), the latest estimate for pygmy blue whales off the west coast of Australia is 662 to 1,559 individuals based on passive acoustics (McCauley and Jenner 2010), or 712 to 1,754 individuals based on photographic mark-recapture (Jenner et al. 2008).

Current estimates indicate a growth rate of just under three percent per year for the eastern North Pacific stock (Calambokidis et al. 2009). An overall population growth rate for the species or growth rates for the two other individual U.S. stocks are not available at this time. In the southern hemisphere, population growth estimates are available only for Antarctic blue whales, which estimate a population growth rate of 8.2 percent per year (95 percent confidence interval 1.6–14.8 percent) (Branch 2007).

Little genetic data exist on blue whales globally. Data from Australia indicates that at least populations in this region experienced a recent genetic bottleneck, likely the result of commercial whaling, although genetic diversity levels appear to be similar to other, non-threatened mammal species (Attard et al. 2010). Consistent with this, data from Antarctica also demonstrate this bottleneck but high haplotype diversity, which may be a consequence of the recent timing of the bottleneck and blue whales long lifespan (Sremba et al. 2012). Data on genetic diversity of blue whales in the Northern Hemisphere are currently unavailable. However, genetic diversity information for similar cetacean population sizes can be applied. Stocks that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Stocks that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Stock populations at low densities (less than 100) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density.

In general, blue whale distribution is driven largely by food requirements; blue whales are more likely to occur in waters with dense concentrations of their primary food source, krill. While they can be found in coastal waters, they are thought to prefer waters further offshore (Figure 4). In the North Atlantic Ocean, the blue whale range extends from the subtropics to the Greenland Sea. They are most frequently sighted in waters off eastern Canada with a majority of sightings taking place in the Gulf of St. Lawrence. In the North Pacific Ocean, blue whales range from Kamchatka to southern Japan in the west and from the Gulf of Alaska and California to Costa Rica in the east. They primarily occur off the Aleutian Islands and the Bering Sea. In the northern Indian Ocean, there is a "resident" population of blue whales with sightings being reported from the Gulf of Aden, Persian Gulf, Arabian Sea, and across the Bay of Bengal to Burma and the Strait of Malacca. In the Southern Hemisphere, distributions of subspecies (*B. m. intermedia* and *B. m. brevicauda*) seem to be segregated. The subspecies *B. m. intermedia* occurs in relatively high latitudes south of the "Antarctic Convergence" (located between 48° South and 61° South latitude) and close to the ice edge. The subspecies *B. m. brevicauda* is typically distributed north of the Antarctic Convergence.

4.2.2.3 *Acoustics*

Blue whales produce prolonged low-frequency vocalizations that include moans in the range from 12.5 to 400 Hz, with dominant frequencies from 16 to 25 Hz, and songs that span frequencies from 16 to 60 Hz that last up to 36 seconds repeated every one to two minutes (see McDonald et al. 1995). Berchok et al. (2006) examined vocalizations of St. Lawrence blue whales and found mean peak frequencies ranging from 17 to 78.7 Hz. Reported source levels are 180 to 188 dB re: 1 µPa at 1 m (rms), but may reach dB re: 1 µPa at 1 m (rms) (Aburto et al. 1997; Clark and Gagnon 2004; Ketten 1998; McDonald et al. 2001a). Samaran et al. (2010) estimated Antarctic blue whale calls in the Indian Ocean at 179 ± 5 dB re: 1 µPa at 1 m (rms) in the 17 to 30 Hz range and pygmy blue whale calls at 175 ± 1 dB re: 1 µPa at 1 m (rms) in the 17 to 50 Hz range.

As with other baleen whale vocalizations, blue whale vocalization function is unknown, although numerous hypotheses exist (maintaining spacing between individuals, recognition, socialization, navigation, contextual information transmission, and location of prey resources) (Edds-Walton 1997; Payne and Webb 1971; Thompson et al. 1992). Intense bouts of long, patterned sounds are common from fall through spring in low latitudes, but these also occur less frequently while in summer high-latitude feeding areas. Short, rapid sequences of 30 to 90 Hz calls are associated with socialization and may be displays by males based upon call seasonality and structure. The low frequency sounds produced by blue whales can, in theory, travel long distances, and it is possible that such long distance communication occurs (Edds-Walton 1997; Payne and Webb 1971). The long-range sounds may also be used for echolocation in orientation or navigation (Tyack 1999).

Cetaceans have an auditory anatomy that follows the basic mammalian pattern, with some modifications to adapt to the demands of hearing in the sea. The typical mammalian ear is divided into the outer ear, middle ear, and inner ear. The outer ear is separated from the inner ear by the tympanic membrane, or eardrum. In terrestrial mammals, the outer ear, eardrum, and middle ear function to transmit airborne sound to the inner ear, where the sound is detected in a fluid. Since cetaceans already live in a fluid medium, they do not require this matching, and thus do not have an air-filled external ear canal. The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low frequency hearing. In a study of the morphology of the mysticete auditory apparatus, Ketten (1997) hypothesized that large mysticetes have acute infrasonic hearing.

Blue whale vocalizations tend to be long (greater than 20 seconds), low frequency (less than 100 Hz) signals (Thomson and Richardson 1995b), with a range of 12 to 400 Hz and dominant energy in the infrasonic range of 12 to 25 Hz (Ketten 1998; McDonald et al. 2001b; Mellinger and Clark 2003). Vocalizations are predominantly songs and calls. Blue whale calls have high acoustic energy, with reports of 186 to 188 dB re: 1 µPa (rms) at 1 m (Cummings and Thompson 1971b; McDonald et al. 2001b) and 195 dB re: 1 µPa (rms) at 1 m (Aburto et al. 1997) source levels. Calls are short-duration sounds (two to five seconds) that are transient and frequency-modulated, having a higher frequency range and shorter duration than song units and often sweeping down in frequency (80 to 30 Hz), with seasonally variable occurrence.

Blue whale songs consist of repetitively patterned vocalizations produced over time spans of minutes to hours or even days (Cummings and Thompson 1971b; McDonald et al. 2001b). The songs are divided into pulsed/tonal units, which are continuous segments of sound, and phrases, repeated in combinations of one to five units (Mellinger and Clark 2003; Payne and McVay 1971). Songs can be detected for hundreds, and even thousands of kilometers (Stafford et al. 1998), and have only been attributed to males (McDonald et al. 2001b; Oleson et al. 2007b). Worldwide, songs are showing a downward shift in frequency (Mcdonald et al. 2009). For example, a comparison of recording from November 2003 and November 1964 and 1965 reveals a long-term shift in the frequency of blue whale calling near San Nicolas Island. In 2003, the spectral energy peak was 16 Hz compared to approximately 22.5 Hz in 1964 and 1965, illustrating a more than 30 percent shift in call frequency over four decades (McDonald et al. 2006). McDonald et al. (2009) observed a 31 percent downward frequency shift in blue whale calls off the coast of California, and also noted lower frequencies in seven of the world’s ten known blue whale songs originating in the Atlantic, Pacific, Southern, and Indian Oceans. Many possible explanations for the shifts exist but none have emerged as the probable cause.

Although general characteristics of blue whale calls are shared in distinct regions (McDonald et al. 2001b; Mellinger and Clark 2003; Rankin et al. 2005; Thompson et al. 1996), some variability appears to exist among different geographic areas (Rivers 1997). Sounds in the North Atlantic Ocean have been confirmed to have different characteristics (i.e., frequency, duration, and repetition) than those recorded in other parts of the world (Berchok et al. 2006; Mellinger and Clark 2003). Clear differences in call structure suggestive of separate populations for the western and eastern regions of the North Pacific Ocean have also been reported (Stafford et al. 2001); however, some overlap in calls from the geographically distinct regions have been observed, indicating that the whales may have the ability to mimic calls (Stafford and Moore 2005).

In Southern California, blue whales produce two predominant call types: Type B and D. B calls are stereotypic of blue whale population found in the eastern North Pacific (McDonald et al. 2006) and are produced exclusively by males and associated with mating behavior (Oleson et al. 2007a). These calls have long durations (20 seconds) and low frequencies (10 to 100 Hz); they are produced either as repetitive sequences (song) or as singular calls. The B call has a set of harmonic tonals, and may be paired with a pulsed Type A call. Blue whale D calls are down-swept in frequency (100 to 40 Hz) with duration of several seconds. These calls are similar worldwide and are associated with feeding animals; they may be produced as call-counter-call between multiple animals (Oleson et al. 2007b). In the Southern California (SOCAL) Range Complex region, D call are produced in highest numbers during the late spring and early summer, and in diminished numbers during the fall, when A-B song dominates blue whale calling (Hildebrand et al. 2011; Hildebrand et al. 2012; Oleson et al. 2007c).

Calling rates of blue whales tend to vary based on feeding behavior. Stafford et al. (2005) recorded the highest calling rates when blue whale prey was closest to the surface during its vertical migration. Wiggins et al. (2005) reported the same trend of reduced vocalization during daytime foraging followed by an increase at dusk as prey moved up into the water column and dispersed. Blue whales make seasonal migrations to areas of high productivity to feed, and vocalize less at the feeding grounds then during migration (Burtenshaw et al. 2004). Oleson et al. (2007c) reported higher calling rates in shallow diving (less than 30 meters [100 feet] whales, while deeper diving whales (greater than 50 meters [165 feet]) were likely feeding and calling less.

Direct studies of blue whale hearing have not been conducted, but it assumed that blue whales can hear the same frequencies that they produce (low frequency) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995a). Based on vocalizations and anatomy, blue whales are assumed to predominantly hear low-frequency sounds below 400 Hz (Croll et al. 2001; Oleson et al. 2007c; Stafford and Moore 2005). In terms of functional hearing capability, blue whales belong to the low frequency group, which have a hearing range of 7 Hz to 22 kHz (NOAA 2016; Southall et al. 2007).

4.2.2.4 *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 nineteenth to mid-twentieth 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 vessel strikes, entanglement in fishing gear, pollution, harassment due to whale watching, and reduced prey abundance and habitat degradation due to climate change. Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, the species has not recovered to pre-exploitation levels.

4.2.2.5 *Critical Habitat*

No critical habitat has been designated for the blue whale.

4.2.2.6 *Recovery Goals*

See the 1998 Final Recovery Plan for the Blue whale for complete down listing/delisting criteria for each of the following recovery goals.

1. Determine stock structure of blue whale populations occurring in U.S. waters and elsewhere
2. Estimate the size and monitor trends in abundance of blue whale populations
3. Identify and protect habitat essential to the survival and recovery of blue whale populations
4. Reduce or eliminate human-caused injury and mortality of blue whales
5. Minimize detrimental effects of directed vessel interactions with blue whales
6. Maximize efforts to acquire scientific information from dead, stranded, and entangled blue whales
7. Coordinate state, federal, and international efforts to implement recovery actions for blue whales
8. Establish criteria for deciding whether to delist or downlist blue whales.

4.2.3 Bowhead Whale

The bowhead whale is a circumpolar baleen whale found throughout high latitudes in the Northern Hemisphere (Figure 6).

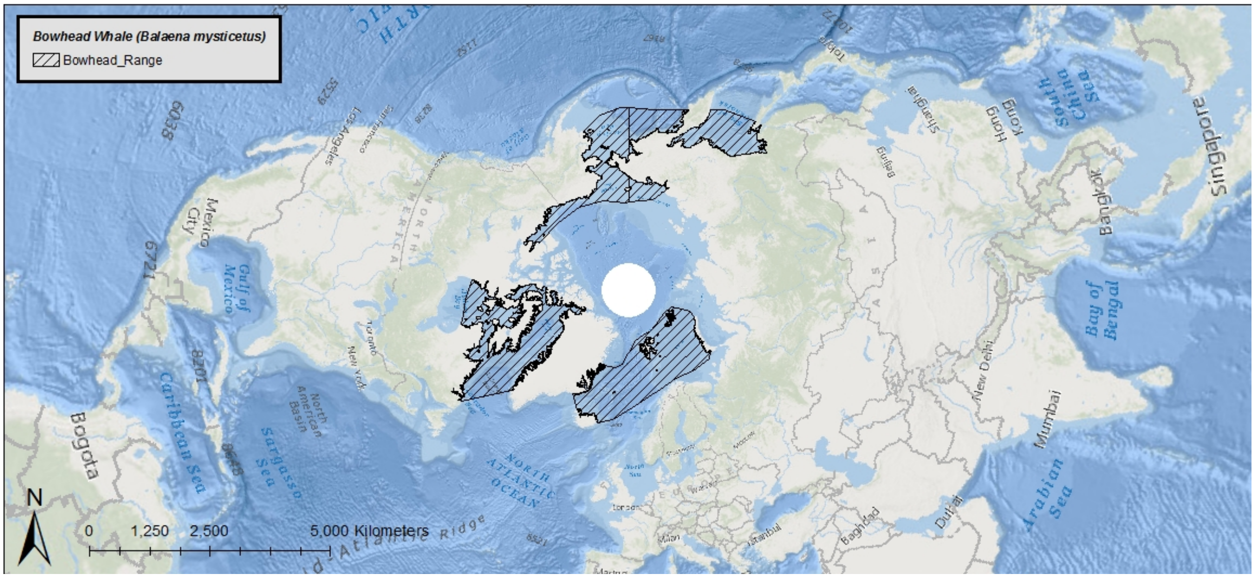

Figure 6: Map identifying the range of bowhead whales.

Bowheads are baleen whales distinguishable from other whales by a dark body with distinctive white chin, no dorsal fin, and a bow-shaped skull that takes up about thirty-five percent of their total body length (Figure 7). The bowhead whale was originally listed as endangered on December 2, 1970 (Table 9).

Figure 7: Bowhead whales. Photo: National Oceanic and Atmospheric Administration

Table 9. Bowhead whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaena mysticetus	Bowhead whale	None	Endangered	1995	35 FR 18319	None	None Designated

Information available from the recent stock assessment report (Muto et al. 2016) and the scientific literature was used to summarize the life history, population dynamics and status of the species as follows.

4.2.3.1 *Life History*

The average lifespan of bowheads is unknown; however, some evidence suggests that they can live for over one hundred years. They have a gestation period of 13 to 14 months and it is unknown how long calves nurse. Sexual maturity is reached around 20 years of age with an average calving interval of three to four years. They spend the winter associated with the southern limit of the pack ice and move north as the sea ice breaks up and recedes during spring. Bowheads use their large skull to break through thick ice and feed on zooplankton (crustaceans like copepods, euphausiids and mysids), other invertebrates and fish.

4.2.3.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the bowhead whale.

The global, pre-exploitation estimate for bowhead whales is 30,000 to 50,000. There are currently four or five recognized stocks of bowheads, the Western Arctic (or Bering-Chukchi-Beaufort) stock, the Okhotsk Sea stock, the Davis Strait and Hudson Bay stock (sometimes considered separate stocks), and the Spitsbergen stock (Rugh and Shelden 2009). The only stock thought to be found within U.S. waters is the Western Arctic stock. The 2011 ice-based abundance estimate puts this stock, the largest remnant stock, at over 16,892 (N_{min}= 16,091) individuals. Prior to commercial whaling, there may have been 10,000 to 23,000 whales in this stock (Rugh and Shelden 2009). Historically the Davis Strait-Hudson Bay stock may have contained over 11,000 individuals, but now it is thought to number around 7,000 bowheads (Cosens et al. 2006). In the Okhotsk Sea, there were originally more than 3,000 bowheads, but now there are only about 300 to 400. The Spitsbergen stock originally had about 24,000 bowheads and supported a huge European fishery, but today is thought to only contain tens of whales (Shelden and Rugh 1995).

Current estimates indicate approximately 16,892 bowhead whales in the Western Arctic stock, with an annual growth rate of 3.7 percent (Givens et al. 2013). While no quantitative estimates exist, the Davis Strait and Hudson Bay stock is also thought to be increasing (COSEWIC 2009). We could find no information on population trends for the Okhotsk Sea stock. Likewise, no information is available on the population trend for the Spitsbergen stock, but it is thought to be nearly extinct.

Genetic studies conducted on the Western Arctic stock of bowhead whales revealed sixty-eight different haplotypes defined by forty-four variable sites (Leduc et al. 2008) making it the most diverse stock of bowheads. These results are consistent with a single stock with genetic heterogeneity related to age cohorts and indicate no historic genetic bottlenecks (Rugh et al. 2003). In the Okhotsk Sea stock, only four to seven mitochondrial DNA (mtDNA) haplotypes have been identified, three of which are shared with the Western Arctic Stock, indicating lower genetic diversity, as might be expected given its much small population size (Alter et al. 2012; LeDuc et al. 2005; MacLean 2002). The Davis Strait-Hudson Bay stock has 23 mtDNA haplotypes, making it more diverse than the Okhotsk but less diverse than the large Western Arctic stock (Alter et al. 2012). Based on historic mtDNA, the Spitsbergen stock previously had at least 58 mtDNA haplotypes, but its current genetic diversity remains unknown (Borge et al. 2007). However, given its near extirpation, it likely has low genetic diversity.

The Western Arctic stock is found in waters around Alaska, the Okhotsk Sea stock in eastern Russia waters, the Davis Strait and Hudson Bay stock in northeastern waters near Canada, and the Spitsbergen stock in the northeastern Atlantic (Rugh and Shelden 2009) (Figure 6).

4.2.3.3 *Acoustics*

Bowhead whales produce songs of an average source level of 185±2 dB re: 1 µPa at 1 m (rms) centered at a frequency of 444±48 Hz (Roulin et al. 2012). Given background noise, this allows bowhead whales an active space of 40 to 130 kilometers (21.6 to 70.2 nautical miles) (Roulin et al. 2012). We are aware of no information directly on the hearing abilities of bowhead whales, but all marine mammals, we presume they hear best in frequency ranges at which they produce sounds (444±48 Hz).

4.2.3.4 *Status*

The bowhead whale is endangered as a result of past commercial whaling. Prior to commercial whaling, thousands of bowhead whales existed. Global abundance declined to 3,000 by the 1920s. Bowhead whales may be killed under "aboriginal subsistence whaling" provisions of the IWC. Additional threats include vessel strikes, fisheries interactions (including entanglement), contaminants, and noise. The species' large population size and increasing trends indicate that it is resilient to current threats.

4.2.3.5 *Critical Habitat*

No critical habitat has been designated for the bowhead whale.

4.2.3.6 *Recovery Goals*

Currently, there is no recovery plan available for the bowhead whale.

4.2.4 Chinese River dolphin

The Chinese river dolphin is a freshwater dolphin, and is one of the most endangered animals on Earth. The Chinese river dolphin has several common names: baiji, Yangtze river dolphin, white-flag dolphin, and white-fin dolphin. It lives exclusively in the Yangtze River in China (Figure 8).

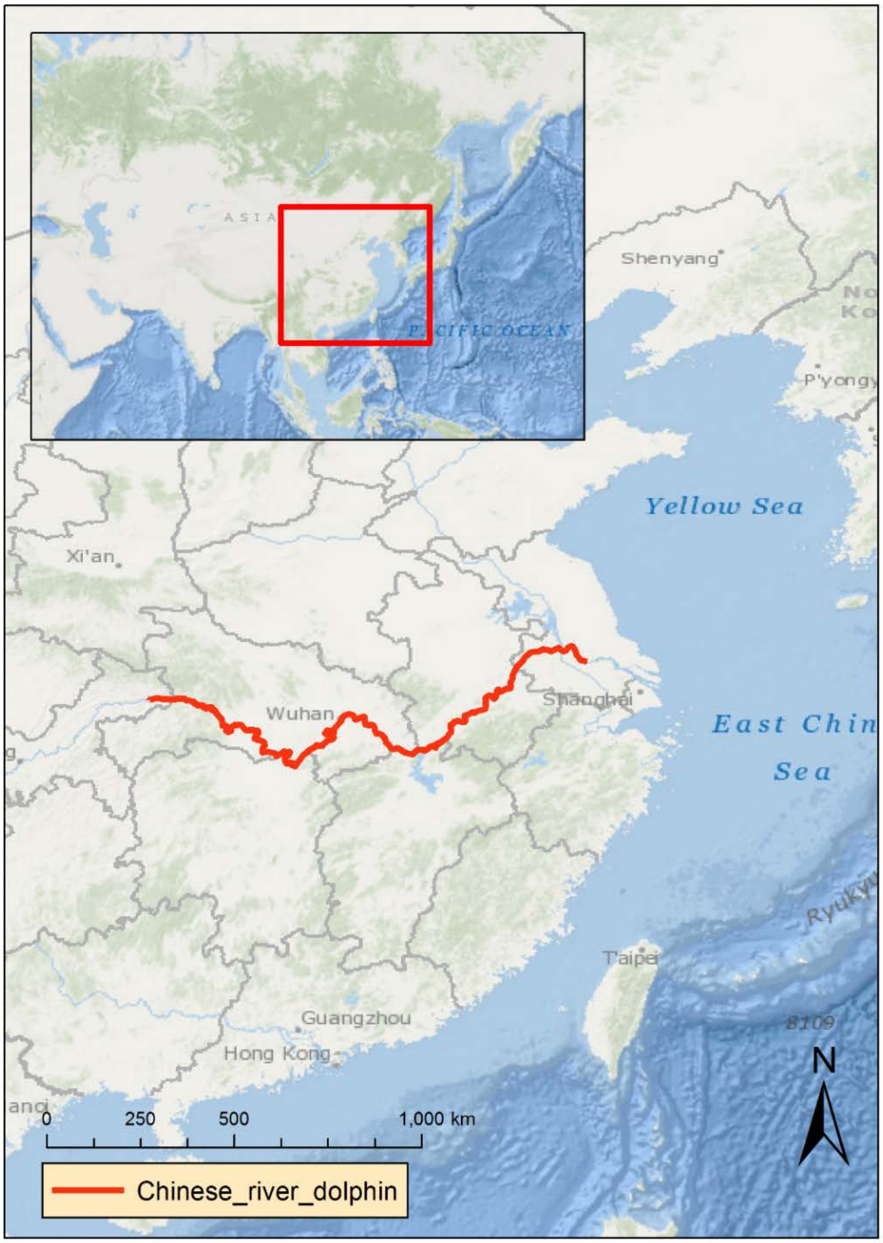

Figure 8. Map identifying the range of the Chinese river dolphin.

Chinese river dolphins are pale blue or gray on the dorsal side, and white on the ventral side (Figure 9). They can grow to 2.5 meters long and weigh up to 220 kilograms. Chinese river dolphins have a long, slightly upturned beak, and a low, triangular dorsal fin. The Chinese river dolphin was originally listed as endangered on May 30, 1989 (Table 10).

Figure 9: Chinese river dolphin. Photo: Whale and Dolphin Conservation, Dr. Henry Genthe.

Table 10: Chinese river dolphin information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Lipotes vexillifer	Chinese river dolphin	None	Endangered	2012	54 FR 22906	None	None Designated

Information available from the five-year status review (NMFS 2012b) was used to summarize the life history, population dynamics, and status of the Chinese river dolphin as follows.

4.2.4.1 *Life History*

Not much is known about the life history of Chinese river dolphins. The lifespan of Chinese river dolphins is thought to be as long as 25 years, based on the lifespan of a captive individual. Gestation lasts between 10 and 11 months. Sexual maturity is reached at between four and six years of age. Chinese river dolphins have smaller eyes than marine dolphins, and rely on echolocation to find prey and navigate the turbid waters of the Yangtze River. They echolocate using clicks and whistles. Chinese river dolphins are usually in small groups of two to four individuals, and occasionally, in groups of as many as 16 individuals. Chinese river dolphins eat a variety of freshwater fishes (NMFS 2012b).

4.2.4.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Chinese river dolphin.

Abundance surveys were first conducted in the late 1970s. Based on data from 1979 to 1981, there were about 400 Chinese river dolphins in the Yangtze River. Surveys continued, and the population estimates varied from 300 individuals in 1985 to 1986, and 100 animals from 1982 to 1986. Surveys of the middle and lower Yangtze River and estuary from 1997 to 1999 indicated that there were 13 Chinese river dolphins remaining. The most recent survey in 2006 did not locate any Chinese river dolphins, leading to conclusions that the species is extinct. There have been a few unconfirmed sightings since the 2006 survey (NMFS 2012b).

There is no range-wide population trend available for the Chinese river dolphin. However, as noted above, the population abundance has steadily and drastically declined since the late 1970s. There is also no information available on the genetic diversity of Chinese river dolphins.

Chinese river dolphins occupy freshwater in the Yangtze River in China, from the mouth of the river at Shanghai to the Three Gorges area (Figure 8). Chinese river dolphins favor calm areas of the river near counter-current eddies around banks and sandbars that help trap fish.

4.2.4.3 *Acoustics*

While we are aware of no hearing data on Chinese river dolphins specifically, data from other river dolphins indicate they are high frequency specialists, with a likely hearing range between 275 Hz to 160 kHz (NOAA 2016). Recordings of a captive and free ranging Chinese river dolphins indicate they produce short echolocation clicks between frequencies of 50 and 120 kHz with source levels between 130 and 150 dB re: 1 µPa at 1 m (rms) (Akamatsu et al. 1998), consistent with them having a high frequency hearing range.

4.2.4.4 *Status*

Fisheries in the Yangtze River are thought to be the principal cause of the Chinese river dolphin's decline, primarily through incidental bycatch in fisheries using rolling hooks, gillnets, fyke nets, and electrofishing (Turvey et al. 2007). China banned the use of rolling hook longlines, fyke nets, and electrofishing, but these measures were not enforced. Overfishing also severely reduced the available prey for Chinese river dolphins. Water pollution also degrades habitat for the Chinese river dolphin. Sources of pollution include billions of tons of untreated wastewater discharged into the Yangtze River annually, as well as nutrients from agricultural runoff. Chinese river dolphins are also at risk of vessel strike and injuries or mortality from propellers due to the high degree of vessel traffic in the Yangtze River (NMFS 2012b). Water development and dam construction are also thought to negatively impacts Chinese river dolphins. Construction of the first dam on the mainstem of the Yangtze River in 1970 blocked dolphin movement in upstream habitat between the dam and the Three Gorges area, affected counter-current below the dam, and reduced fish populations (NMFS 2012b). Subsequent dams, including the large Three Gorges dam completed in 2012, further modified and degraded habitat, as well as increased ship traffic and thus the threat of vessel strikes. Despite efforts to protect it, Chinese river dolphins face numerous threats from overfishing, incidental bycatch, pollution, and dams and habitat degradation; these threats are expected to continue in the future. Due to its dramatic decline in abundance, the inability to locate individuals during surveys or confirm sightings, and ongoing threats, NMFS determined that the Chinese river dolphin became functionally extinct in 2012 (NMFS 2012b).

4.2.4.5 *Critical Habitat*

No critical habitat has been designated for the Chinese river dolphin. NMFS cannot designate critical habitat in foreign waters.

4.2.4.6 *Recovery Goals*

There is currently no Recovery Plan for the Chinese river dolphin. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.5 False Killer Whale (Main Hawaiian Islands Insular Distinct Population Segment)

False killer whales are distributed worldwide in tropical and temperate waters more than 1,000 meters deep. The Main Hawaiian Islands Insular DPS of false killer whales is found in waters around the Main Hawaiian Islands (Figure 10).

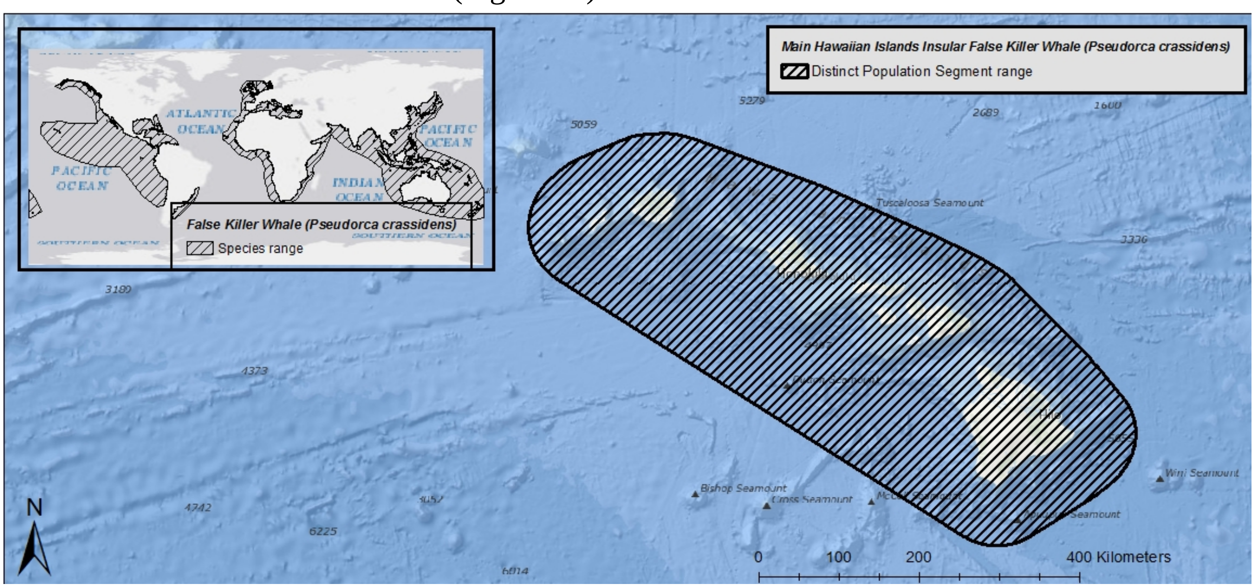

Figure 10: Map identifying the range of false killer whales and the Main Hawaiian Islands Insular distinct population segment of false killer whale.

The false killer whale is a toothed whale and large member of the dolphin family. False killer whales are distinguishable from other whales by having a small conical head without a beak, tall dorsal fin, and a distinctive bulge in the middle of the front edge of their pectoral fins (Figure

11). The Main Hawaiian Islands Insular DPS of false killer whale was originally listed as endangered on November 28, 2012 (Table 11).

Figure 11: False killer whale. Photo: National Oceanic and Atmospheric Administration.

Table 11. Main Hawaiian Islands Insular distinct population segment False killer whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Pseudorca crassidens	False killer whale	Main Hawaiian Islands Insular	Endangered	2010	77 FR 70915	None	None Designated

Information available from the most recent status review (Oleson et al. 2010) and recent stock assessment (Carretta et al. 2011) were used to summarize the status of the species as follows.

4.2.5.1 *Life History*

False killer whales can live, on average, for 60 years. They have a gestation period of 14 to 16 months, and calves nurse for 1.5 to two years. Sexual maturity is reached around 12 years of age with a very low reproduction rate and calving interval of approximately seven years. False killer whales prefer tropical to temperate waters that are deeper than 1,000 meters. They feed during the day and at night on fishes and cephalopods, and are known to attack other marine mammals, indicating they may occasionally feed on them.

4.2.5.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Main Hawaiian Islands Insular DPS of false killer whales.

Recent, unpublished estimates of abundance for two time periods, 2000 to 2004 and 2006 to 2009, were 162 and 151 respectively. The minimum population estimate for the Main Hawaiian Islands Insular DPS of false killer whale is the number of distinct individuals identified during the 2011 to 2014 photo-identification studies, or ninety-two false killer whales (Baird et al. 2015).

A current estimated population growth rate for the Main Hawaiian Islands Insular DPS of false killer whales is not available at this time. Reeves et al. (2009) suggested that the population may have declined during the last two decades, based on sighting data collected near Hawaii using various methods between 1989 and 2007. A modeling exercise conducted by Oleson et al. (2010) evaluated 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 indicating the probability of decline to fewer than 20 animals within 75 years as greater than 20 percent. Although causation was not evaluated, all models indicated current declines at an average rate of negative nine percent since 1989.

The Main Hawaiian Islands Insular DPS of false killer whale is considered resident to the Main Hawaiian Islands and is genetically and behaviorally distinct compared to other stocks. Genetic data suggest little immigration into the Main Hawaiian Islands Insular DPS of false killer whale (Baird et al. 2012a). Genetic analyses indicated restricted gene flow between false killer whales sampled near the Main Hawaiian Islands, the Northwestern Hawaiian Islands, and pelagic waters of the Eastern and Central North Pacific.

NMFS currently recognizes three stocks of false killer whales in Hawaiian waters: the Main Hawaiian Islands Insular, Hawaii pelagic, and the Northwestern Hawaiian Islands. All false killer whales found within forty kilometers of the Main Hawaiian Islands belong to the insular stock and all false killer whales beyond 140 kilometers belong to the pelagic stock. 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 Kauai.

4.2.5.3 *Acoustics*

Functional hearing in mid-frequency cetaceans, including Main Hawaiian Islands Insular DPS of false killer whales, is conservatively estimated to be between approximately 150 Hz and 160 kHz (Southall et al. 2007). There are three categories of sounds that odontocetes make. The first includes echolocation sounds of high intensity, high frequency, high repetition rate, and very short duration (Au et al. 2000b). The second category of odontocete sounds is comprised of pulsed sounds. Burst pulses are generally very complex and fast, with frequency components sometimes above 100 kHz and average repetition rates of 300 per second (Yuen et al. 2007).

The final category of odontocete sounds is the narrowband, low frequency, tonal whistles (Au et al. 2000b; Caldwell et al. 1990). With most of their energy below 20 kHz, whistles have been observed with an extensive variety of frequency patterns, durations, and source levels, each of which can be repeated or combined into more complex phrases (Tyack and Clark 2000; Yuen et al. 2007).

In general, odontocetes produce sounds across the wildest band of frequencies (NOAA 2016). Their social vocalizations range from a few hundreds of Hz to tens of kHz (Southall et al. 2007) with source levels in the range of 100 to 170 dB re: 1 µPa at 1 m (rms) (see (Richardson et al. 1995a)). They also generate specialized clocks used in echolocation at frequencies above 100 kHz that are used to detect, localize and characterize underwater objects such as prey (Au et al. 1993). Echolocation clicks have source levels that can be as high as 229 dB re: 1 µPa at 1 m (rms) peak-to-peak (Au et al. 1974).

Nachtigall and Supin (2008) investigated the signals from an echolocating false killer whale and found that the majority of clicks had a single-lobed structure with peak energy between 20 and 80 kHz false rather than dual-lobed clicks, as has been demonstrated in the bottlenose dolphin. U.S. Navy researchers measured the hearing of a false killer whale and demonstrated the ability of this species to change its hearing during echolocation (Nachtigall and Supin. 2008). They found that there are at least three mechanisms of automatic gain control in odontocete echolocation, suggesting that echolocation and hearing are a very dynamic process (Nachtigall and Supin. 2008). For instance, false killer whales change the focus of the echolocation beam based on the difficulty of the task and the distance to the target. The echo from an outgoing signal can change by as much as 40 dB, but the departing and returning signal are the same strength entering the brain (Nachtigall and Supin. 2008). The U.S. Navy demonstrated that with a warning signal, the false killer whale can adjust hearing by 15 dB prior to sound exposure (Nachtigall and Supin. 2008).

4.2.5.4 *Status*

The exact causes for the decline in the Main Hawaiian Islands Insular DPS of the false killer whale are not specifically known, but multiple factors have threatened and continue to threaten the population. Threats to the DPS include small population size, including inbreeding depression and Allee effects, exposure to environmental contaminants, competition for food with commercial fisheries, and hooking, entanglement, or intentional harm by fishermen. Recent photographic evidence of dorsal fin disfigurements and mouthline injuries suggest a high rate of fisheries interactions for this population compared to others in Hawaiian waters (Baird et al. 2015).

4.2.5.5 *Critical Habitat*

No critical habitat has been designated for the Main Hawaiian Islands Insular DPS of the false killer whale.

4.2.5.6 *Recovery Goals*

There is currently no Recovery Plan available for the Main Hawaiian Islands Insular DPS of the false killer whale.

4.2.6 Fin Whale

The fin whale is a large, widely distributed baleen whale found in all major oceans and comprised of three subspecies: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere (Figure 12).

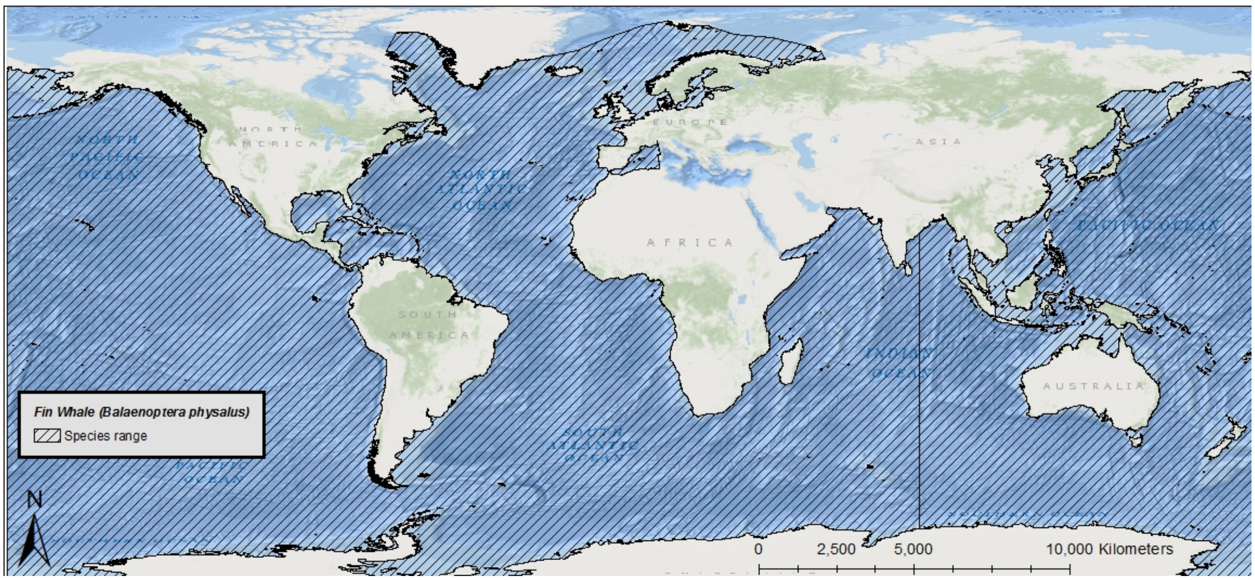

Figure 12: Map identifying the range of the fin whale.

Fin whales are distinguishable from other whales by a sleek, streamlined body with a V-shaped head, a tall, falcate dorsal fin, and a distinctive color pattern of a black or dark brownish-gray body and sides with a white ventral surface (Figure 13). The fin whale was originally listed as endangered on December 2, 1970 (Table 12).

Figure 13: Fin whale. Photo: National Oceanic and Atmospheric Administration

Table 12: Fin whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera physalus	Fin whale	None	Endangered	2011	35 FR 18319	2010	None Designated

Information available from the recovery plan (NMFS 2010d), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016a), and the status review (NMFS 2011b) were used to summarize the life history, population dynamics and status of the species as follows.

4.2.6.1 *Life History*

Fin whales can live, on average, eighty to ninety years. They have a gestation period of less than one year, and calves nurse for six to seven months. Sexual maturity is reached between six and ten years of age with an average calving interval of two to three years. They mostly inhabit deep, offshore waters of all major oceans. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed, although some fin whales appear to be residential to certain areas. Fin whales eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lice.

4.2.6.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the fin whale.

The pre-exploitation estimate for the fin whale population in the North Pacific was 42,000 to 45,000 (Ohsumi and Wada 1974). In the North Pacific, at least 74,000 whales were killed between 1910 and 1975. In the North Atlantic, at least 55,000 fin whales were killed between 1910 and 1989. Approximately 704,000 whales were killed in the Southern Hemisphere from 1904 to 1975. Of the three to seven stocks in the North Atlantic (approximately 50,000 individuals), one occurs in U.S. waters, where the best estimate of abundance is 1,618 individuals (N_{min}=1,234); however, this may be an underrepresentation as the entire range of stock was not surveyed (Palka 2012). There are three stocks in U.S. Pacific waters: Northeast Pacific [minimum 1,368 individuals], Hawaii [approximately 58 individuals (N_{min}=27)] and California/Oregon/Washington [approximately 9,029 (N_{min}=8,127 individuals), (Nadeem et al. 2016)]. The IWC also recognizes the China Sea stock of fin whales, found in the Northwest Pacific, which currently lacks and abundance estimate (Reilly et al. 2013). Abundance data for the Southern Hemisphere stock are limited; however, there were assumed to be somewhat more than 15,000 in 1983 (Thomas et al. 2016).

Current estimates indicate approximately 10,000 fin whales in U.S. Pacific Ocean waters, with an annual growth rate of 4.8 percent in the Northeast Pacific stock and a stable population abundance in the California/Oregon/Washington stock (Nadeem et al. 2016). Overall population growth rates and total abundance estimates for the Hawaii stock, China Sea stock, western north Atlantic stock, and southern hemisphere fin whales are not available at this time.

Archer et al. (2013) recently examined the genetic structure and diversity of fin whales globally. Full sequencing of mtDNA genome for 154 fin whales sampled in the North Atlantic, North Pacific, and Southern Hemisphere, resulted in 136 haplotypes, none of which were shared among ocean basins suggesting differentiation at least at this geographic scale. However, North Atlantic fin whales appear to be more closely related to the Southern Hemisphere population, as compared to fin whales in the North Pacific, which may indicate a revision of the subspecies delineations is warranted. Generally speaking, haplotype diversity was found to be high both within ocean basins, and across. Such high genetic diversity and lack of differentiation within ocean basins may indicate that despite some population's having small abundance estimates, the species may persist long-term and be somewhat protected from substantial environmental variance and catastrophes.

There are over 100,000 fin whales worldwide, occurring primarily in the North Atlantic, North Pacific, and Southern Hemisphere (Figure 12), where they appear to be reproductively isolated. The availability of prey, sand lice in particular, is thought to have a strong influence on the distribution and movements of fin whales.

4.2.6.3 *Acoustics*

Fin whales produce a variety of low frequency sounds in the 10 to 200 Hz range (Edds 1988; Thompson et al. 1992; Watkins 1981; Watkins et al. 1987). Typical vocalization are long, patterned pulses of short duration (0.5 to 2 seconds) in the 18 to 35 Hz range, but only males are known to produce these (Clark et al. 2002; Patterson and Hamilton 1964). Richardson et al. (1995a) reported the most common sound as a one second vocalization of about 20 Hz, occurring in short series during spring, summer, and fall, and in repeated stereotyped patterns in winter. Au (Au and Green 2000) reported monas of 14 to 118 Hz, with a dominant frequency of 20 Hz, tonal vocalizations of 34 to 150 Hz, and songs of 17 to 25 Hz (Cummings and Thompson 1994; Edds 1988; Watkins 1981). Source levels for fin whale vocalizations are 140 to 200 dB re: 1 µPa at 1 m (rms) (see also Clark and Gagnon 2004; as compiled by Erbe 2002b). The source depth of calling fin whales has been reported to be about 50 m (164 feet) (Watkins et al. 1987).

Although their function is still in doubt, low frequency fin whale vocalizations travel over long distances and may aid in long distance communication (Edds-Walton 1997; Payne and Webb 1971). During the breeding season, fin whales produce pulses in a regular repeating pattern, which have been proposed to be mating displays similar to those of humpback whales (Croll et al. 2002). These vocal bouts last for a day or longer (Tyack 1999).

The inner ear is where sound energy is converted into neural signals that are transmitted to the central nervous system via the auditory nerve. Acoustic energy causes the basilar membrane in the cochlea to vibrate. Sensory cells at different positions along the basilar membrane are excited by different frequencies of sound (Tyack 1999). Baleen whales have inner ears that appear to be specialized for low frequency hearing. In a study of the morphology of the mysticete auditory apparatus, Ketten (1997) hypothesized that large mysticetes have acute infrasonic hearing. In a study using computer tomography scans of a calf fin whale skull, Cranford and Krysl (2015) found sensitivity to a broad range of frequencies between ten and 12 kHz and a maximum sensitivity to sounds in the one to two kHz range.

Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995a).

Fin whales produce a variety of low frequency (less than 1 kHz) sounds, but the most typically recorded is a 20 Hz pulse lasting about one second, and reaching source levels of 189 ± 4 dB re: 1 µPa at 1 m (rms) (Charif et al. 2002; Clark et al. 2002; Edds 1988; Richardson et al. 1995a; Sirovic et al. 2007; Watkins 1981; Watkins et al. 1987). These pulses frequently occur in long sequenced patterns, are down swept (e.g., 23 to 18 Hz), and can be repeated over the course of many hours (Watkins et al. 1987). In temperate waters, intense bouts of these patterned sounds are very common from fall through spring, but also occur to a lesser extent during the summer in high latitude feeding areas (Clarke and Charif 1998). The seasonality and stereotype nature of these vocal sequences suggest that they are male reproductive displays (Watkins 1981; Watkins et al. 1987); a notion further supported by recent data linking these vocalizations to male fin whales only (Croll et al. 2002). In Southern California, the 20 Hz pulses are the dominant fin whale call type associated both with call-counter-call between multiple animals and with singing (Navy 2010; Navy 2012). An additional fin whale sound, the 40 Hz call described by Watkins (1981), was also frequently recorded, although these calls are not as common as the 20 Hz fin whale pulses. Seasonality of the 40 Hz calls differed from the 20 Hz calls, since 40 Hz calls were more prominent in the spring, as observed at other sites across the northeast Pacific Ocean (Sirovic et al. 2012). Source levels of Eastern Pacific Ocean fin whale 20 Hz calls has been reported as 189 ± 5.8 dB re: 1 μPa at 1 m (rms) (Weirathmueller et al. 2013). Although acoustic recordings of fin whales from many diverse regions show close adherence to the typical 20 Hz bandwidth and sequencing when performing these vocalizations, there have been slight differences in the pulse patterns, indicative of some geographic variation (Thompson et al. 1992; Watkins et al. 1987).

Responses to conspecific sounds have been demonstrated in a number of mysticetes, and there is no reason to believe that fin whales do not communicate similarly (Edds-Walton 1997). The low frequency sounds produced by fin whales have the potential to travel over long distances, and it is possible that long distance communication occurs in fin whales (Edds-Walton 1997; Payne and Webb 1971). Also, there is speculation that the sounds may function for long range echolocation of large-scale geographic targets such as seamounts, which might be used for orientation and navigation (Tyack 1999).

Although no studies have directly measured the sound sensitivity of fin whales, experts assume that fin whales are able to receive sound signals in roughly the same frequencies as the signals they produce. This suggests fin whales, like other baleen whales, are more likely to have their best hearing capacities at low frequencies, including frequencies lower than those of normal human hearing, rather than mid- to high-frequencies (Ketten 1997). Several fin whales were tagged during the Southern California Behavioral Response Study (SOCAL BRS) 2010 and no obvious responses to a mid-frequency sound source were detected by the visual observers or in the initial tag analysis (Southall et al. 2011a). Results of studies on blue whales (Goldbogen et al. 2013; Southall et al. 2011a), which have similar auditory physiology compared to fin whales, indicate that some individuals hear some sounds in the mid-frequency range and exhibit behavioral responses to sounds in this range depending on received level and context, In terms of functional hearing capability fin whales belong to the low-frequency group, which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007).

4.2.6.4 *Status*

The fin whale is endangered as a result of past commercial whaling. Prior to commercial whaling, hundreds of thousands of fin whales existed. Fin whales may be killed under “aboriginal subsistence whaling” in Greenland, under Japan’s scientific whaling program, and Iceland’s formal objection to the IWC ban on commercial whaling. Additional threats include vessel strikes, reduced prey availability due to overfishing or climate change, and noise. The species' overall large population size may provide some resilience to current threats, but trends are largely unknown.

4.2.6.5 *Critical Habitat*

No critical habitat has been designated for the fin whale.

4.2.6.6 *Recovery Goals*

See the 2010 Final Recovery Plan for the fin whale for complete down listing/delisting criteria for both of the following recovery goals.

1. Achieve sufficient and viable population in all ocean basins.
2. Ensure significant threats are addressed.

4.2.7 Gray Whale (Western North Pacific Distinct Population Segment)

The gray whale is a baleen whale and the only species in the family Eschrichtiidae. There are two isolated geographic distributions of gray whales in the North Pacific Ocean: the Eastern North Pacific stock, found along the west coast of North America, and the Western North Pacific or "Korean" stock, found along the coast of eastern Asia (Figure 14).

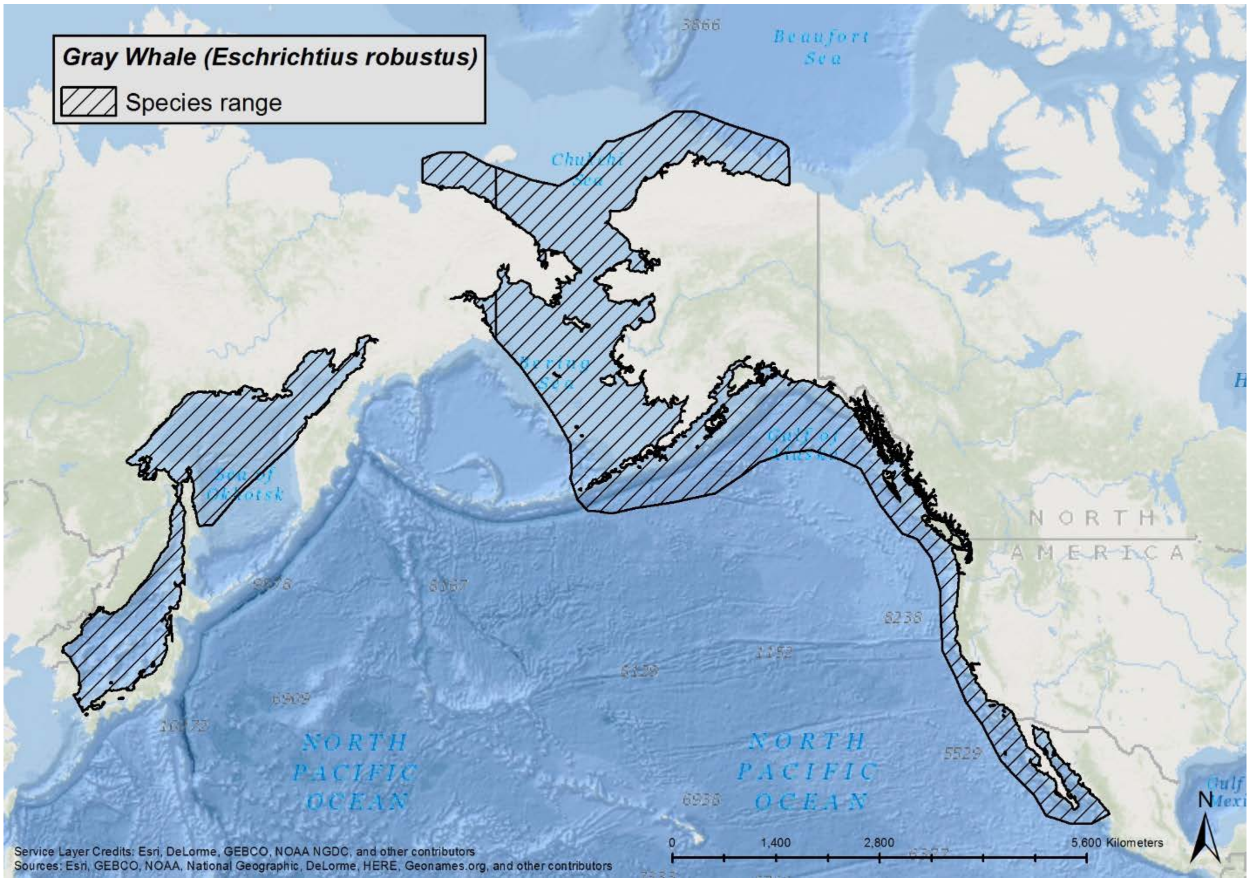

Figure 14: Map identifying the range of the gray whales.

Gray whales are distinguishable from other whales by a mottled gray body, small eyes located near the corners of their mouth, no dorsal fin, broad, paddle-shaped pectoral fins and a dorsal hump with a series of eight to fourteen small bumps known as "knuckles" (Figure 15). The gray whale was originally listed as endangered on December 2, 1970. The Eastern North Pacific stock was officially delisted on June 16, 1994 when it reached pre-exploitation numbers. The Western North Pacific population of gray whales remained listed as endangered (Table 13).

Figure 15: Gray whale. Photo: National Oceanic and Atmospheric Administration.

Table 13. Gray whale **i**nformation bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Eschrichtius robustus	Gray whale	Western North Pacific Population	Endangered	None	35 FR 18319	None	None Designated

Information available from the recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016b) were used to summarize the life history, population dynamics and status of the species as follows.

4.2.7.1 *Life History*

The average life span of gray whales is unknown, but it is thought to be as long as eighty years. They have a gestation period of twelve to thirteen months, and calves nurse for seven to eight months. Sexual maturity is reached between six and twelve years of age with an average calving interval of two to four years (Weller et al. 2009). Gray whales mostly inhabit shallow coastal waters in the North Pacific Ocean. Some Western North Pacific gray whales winter on the west coast of North America while others migrate south to winter in waters off Japan and China, and summer in the Okhotsk Sea off northeast Sakhalin Island, Russia, and off southeastern Kamchatka in the Bering Sea (Burdin et al. 2013). Gray whales travel alone or in small, unstable groups and are known as bottom feeders that eat "benthic" amphipods.

4.2.7.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the gray whale.

Photo-identification data collected between 1994 and 2011 on the Western North Pacific gray whale summer feeding ground off Sakhalin Island were used to calculate an abundance estimate of 140 whales for the non-calf population size in 2012 (Cooke et al. 2013). The minimum population estimate for the Western North Pacific stock is 135 individual gray whales on the summer feeding ground off Sakhalin Island.

The current best growth rate estimate for the Western North Pacific gray whale stock is 3.3 percent annually.

There are often observed movements between individuals from the Eastern North Pacific stock and Western North Pacific stock; however, genetic comparisons show significant mitochondrial and nuclear genetic differences between whales sampled from each stock indicating genetically distinct populations (Leduc et al. 2002). A study conducted between 1995 and 1999 using biopsy samples found that Western North Pacific gray whales have retained a relatively high number of mtDNA haplotypes for such a small population. Although the number of haplotypes currently found in the Western North Pacific stock is higher than might be expected, this pattern may not persist into the future. Populations reduced to small sizes, such as the Western North Pacific stock, can suffer from a loss of genetic diversity, which in turn may compromise their ability to respond to changing environmental conditions (Willi et al. 2006) and negatively influence long-term viability (Frankham 2005; Spielman et al. 2004).

Gray whales in the Western North Pacific population are thought to feed in the summer and fall in the Okhotsk Sea, primarily off Sakhalin Island, Russia and the Kamchatka peninsula in the Bering Sea, and winter in the South China Sea (Figure 14). However, tagging, photo-identification, and genetic studies have shown that some whales identified as members of the Western North Pacific stock have been observed in the Eastern North Pacific, which may indicate that not all gray whales share the same migratory patterns.

4.2.7.3 *Acoustics*

No data are available regarding Western North Pacific population gray whale hearing or communication. We assume that Eastern North Pacific population gray whale communication is representative of the Western North Pacific population and present information stemming from this population. Individuals produce broadband sounds within the 100 Hz to 12 kHz range (Dahlheim et al. 1984; Jones and Swartz 2002; Thompson et al. 1979). The most common sounds encountered are on feeding and breeding grounds, where "knocks" of roughly 142 dB re: 1 µPa at 1 m (rms) (source level) have been recorded (Cummings et al. 1968; Jones and Swartz 2002; Thomson and Richardson 1995a). However, other sounds have also been recorded in Russian foraging areas, including rattles, clicks, chirps, squeaks, snorts, thumps, knocks, bellows, and sharp blasts at frequencies of 400 Hz to 5 kHz (Petrochenko et al. 1991). Estimated source levels for these sounds ranged from 167 to 188 dB re: 1 µPa at 1 m (rms) (Petrochenko et al. 1991). Low frequency (less than 1.5 kHz) "bangs" and "moans" are most often recorded during migration and during ice-entrapment (Carroll et al. 1989; Crane and Lashkari. 1996). Sounds vary by social context and may be associated with startle responses (Rohrkasse-Charles et al. 2011). Calves exhibit the greatest variation in frequency range used, while adults are narrowest; groups with calves were never silent while in calving grounds (Rohrkasse-Charles et al. 2011). Based upon a single captive calf, moans were more frequent when the calf was less than a year old, but after a year, croaks were the predominant call type (Wisdom et al. 1999).

Auditory structure suggests hearing is attuned to low frequencies (Ketten 1992a; Ketten 1992b). Responses of free-ranging and captive individuals to playbacks in the 160 Hz to 2 kHz range demonstrate the ability of individuals to hear within this range (Buck and Tyack 2000; Cummings and Thompson 1971a; Dahlheim and Ljungblad 1990; Moore and Clark 2002; Wisdom et al. 2001). Responses to low-frequency sounds stemming from oil and gas activities also support low-frequency hearing (Malme et al. 1986; Moore and Clark 2002).

4.2.7.4 *Status*

The Western North Pacific gray whale is endangered as a result of past commercial whaling and may still be hunted under "aboriginal subsistence whaling" provisions of the IWC Commission. Current threats include ship strikes, fisheries interactions (including entanglement), habitat degradation, harassment from whale watching, illegal whaling or resumed legal whaling, and noise.

4.2.7.5 *Critical Habitat*

No critical habitat has been designated for the Western North Pacific gray whale. NMFS cannot designate critical habitat in foreign waters.

4.2.7.6 *Recovery Goals*

There is currently no Recovery Plan for the Western North Pacific gray whale. In general, listed species, which occur entirely outside U.S. jurisdiction, are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.8 Gulf of Califronia Harbor Porpoise/Vaquita

The vaquita, or Gulf of California harbor porpoise, is the smallest of all porpoise species and can only be found in the upper Gulf of California (Figure 16).

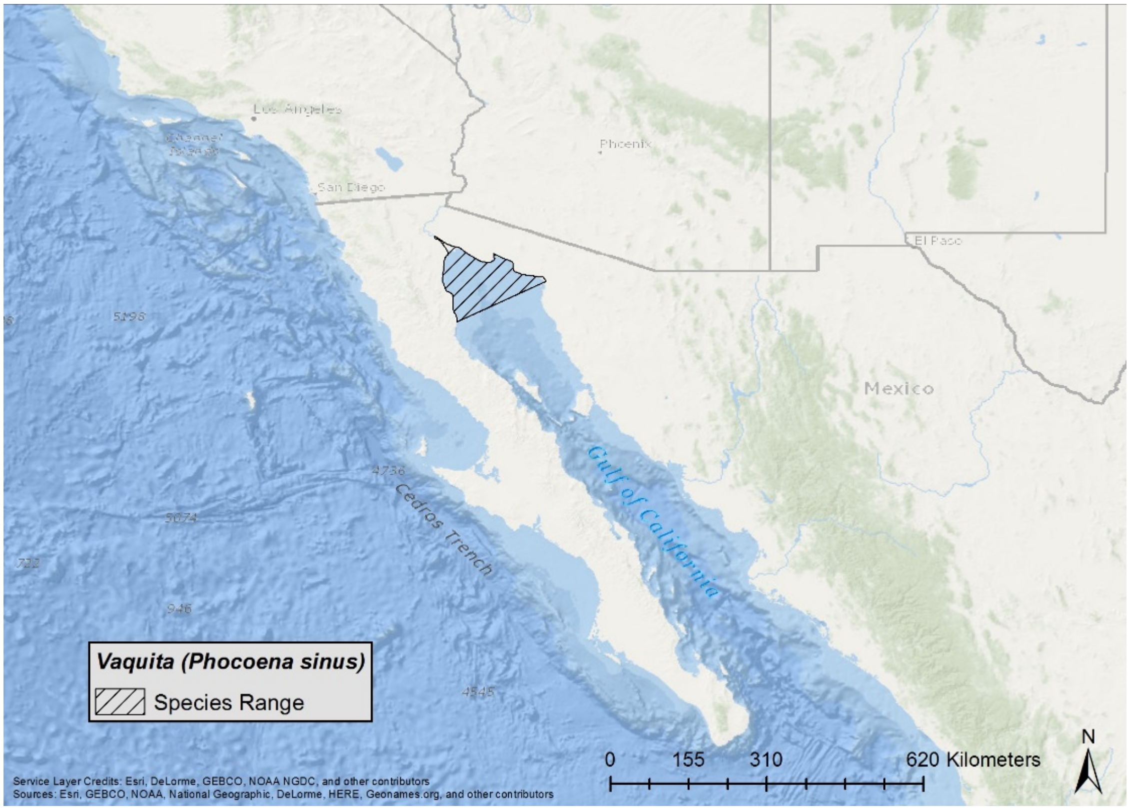

Figure 16. Map identifying the range of Vaquita in the upper Gulf of California.

Vaquita are one the world's smallest cetacean species, with males being slightly smaller (approximately 1.3 meters) than females (approximately 1.4 meters) (Rojas-Bracho and Jaramillo-Legoretta 2009). Compared to other porpoises, vaquita have proportionally larger flippers and a more falcate dorsal fin. They are further distinguished by their unique black eye rings and lip patches (Figure 17). The vaquita was listed as endangered under the ESA in 1985 (Table 14).

Figure 17: Vaquita. Photo: National Oceanic and Atmospheric Administration, Paula Olson.

Table 14. Vaquita information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Phocoena sinus	Vaquita/Gulf of California Harbor Porpoise	None	Endangered	None	50 FR 1056	None	None Designated

Information available from reports and the peer-reviewed literature were used to summarize the life history, population dynamics and status of the species as follows.

4.2.8.1 *Life History*

The age at maturity for male vaquita is unknown. Female vaquita reach sexual maturity between three and six years of age, have a gestation of 10 to 11 months, and reproduce seasonally with the greatest number of births occurring in March. However, unlike other harbor porpoises, female vaquita likely do not reproduce annually (Rojas-Bracho and Jaramillo-Legoretta 2009). The maximum life expectancy is estimated to be around 21 years of age, but few animals appear to live into their twenties (Rojas-Bracho and Jaramillo-Legoretta 2009). Vaquita are year-round residents of the upper Gulf of California and feed on a variety of prey species, including squid, crustaceans, and a variety of demersal and benthic fish species(Rojas-Bracho and Jaramillo-Legoretta 2009).

4.2.8.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to vaquita.

Vaquita were only discovered in the late 1950s, and it wasn't until 1997 that data were available for abundance estimates, which produced estimates ranging from 224 to 885 depending on the methods used, for periods between 1986 and 1993 (Barlow et al. 1997). For this period between 1986 and 1993, the population was estimated to have experienced a drastic decline of 17.7 percent per year (95 percent confidence intervals -43.2 percent to +19.3 percent). Dedicated vaquita vessel surveys in 1997 produced a more robust population estimate of 567 individuals (95 percent confidence intervals 177 to 1,073) (Jaramillo-Legorreta et al. 1999). In 2008, combined vessel transect and passive acoustic data produced an estimate of 245 individuals (95 percent confidence intervals 68 to 884) (Gerrodette et al. 2011). This estimate indicated more than a 50 percent reduction as compared to the 1997 estimate, with an average rate of decline of 7.6 percent per year. To examine the likelihood of decline, Gerrodette et al. (2011) conducted a Bayesian analyses, which estimated an 89 percent probability of decline between 1997 and 2008. In more recent years the population has only continued to decline, as indicated primarily by acoustic data (Jaramillo-Legorreta et al. 2017). The most recent published population abundance estimate is for the fall of 2015, at which point there were estimated to be only 59 individuals remaining (95 percent Bayesian Credible Interval 22 to 145) based on both line transect survey and acoustic data (Taylor et al. 2016). However, the Comité Internacional para la Recuperación de la Vaquita (CIRVA) recently estimated that only about 30 individuals remain as of November 2016 (CIRVA 2016), and at least six individuals have died since this time putting the population below 30 individuals (CIRVA 2017). During recent efforts between March 6 to April 17, 2017, only two encounters with vaquita were recorded (CIRVA 2017).

Not surprisingly given their low abundance, vaquita have low genetic diversity. Genetic analysis of 43 individuals sampled between 1985 and 1993, revealed a complete lack of variability in a 400 to 600 base pair control region of mtDNA (Rosel and Rojas-Bracho 1999). However, low genetic diversity and inbreeding is not considered a major threat to the species as its effective population size and, thus, genetic diversity, appears to have always been low (Rojas-Bracho and Taylor 1999; Taylor and Rojas-Bracho 1999). Nonetheless, vaquita appear to also have low variability at two major histocompatibility complex class II loci, suggesting the species may have high susceptibility to novel pathogens and diseases (Munguia-Vega et al. 2007).

Vaquita are endemic to the Gulf of California, specifically the upper Gulf of California between 30°45' North and west of 114°20' West, with the year-round core range consisting of a 2,235 square kilometer area around the Rocas Consag archipelago, approximately 40 kilometers east of San Felipe, Baja California, Mexico (Rojas-Bracho et al. 2006; Silber 1991b).

4.2.8.3 *Acoustics*

Vaquita are porpoises and as such, are expected to be high frequency specialists (NOAA 2016). Consistent with this, recordings of free ranging vaquita documented sharp, intense, and narrow-band echolocation clicks between 122.2 and 146.9 kHz, with dominant frequencies ranging between 128 and 139 kHz (Silber 1991a). Like other phocoenids, vaquita do not appear to produce whistles (Silber 1991a). Based on these vocalizations and data from related harbor porpoises (*Phocoena phocoena*), vaquita are expected to have a hearing range between 275 Hz to 160 kHz (NOAA 2016).

4.2.8.4 *Status*

The abundance of vaquita has likely always been low but has drastically declined since its discovery in the late 1960s, when the populated was estimated to consist of 200 to 800 individuals, down to less than 30 individuals now. This decline is attributed almost exclusively to bycatch from gill net and shrimp fisheries, especially illegal gill net fisheries targeting totoaba (*Totoaba macdonaldi*) (Rojas-Bracho et al. 2006). While additional threats such as indirect effects of trawling on vaquita prey, dam construction on the Colorado River, and subsequent loss of fresh water input to the Gulf of California are possible, but not immediate or well understood (Rojas-Bracho et al. 2006). Between 1993 and 1994 estimate rates of bycatch ranged between 39 and 84 animals per year, but actual rates could be as high as 155 animals per year, and perhaps even higher (Rojas-Bracho et al. 2006). This is well above rates the small population can withstand.

Given this high rate of bycatch, the Mexican government enacted an emergency two year gill-net ban within the vaquita’s range starting in May of 2015. Despite this, vaquita have still been subject to bycatch from illegal gill netting (CIRVA 2016; CIRVA 2017). Unless the use of gillnets is permanently banned within the region, the species is likely to be functionally extinct (less than 10 individuals) by 2022 and completely gone by 2026 (Taylor et al. 2016). Recently the Mexican government announced that the gill net ban, which was set to expire in June of 2017, would become permanent, although exceptions are made for the corvina (*Cynoscion othonopterus*) fishery (CIRVA 2017). However, it may already be too late to save the vaquita from extinction in the wild given its low population size and the continued bycatch in illegal fisheries. As a result, the scientific community is currently organizing efforts to capture several vaquita in hopes of breeding them in captivity, for eventual release once more protective measures can be put in place in the natural habitat (CIRVA 2016; CIRVA 2017; Morell 2017).

4.2.8.5 *Critical Habitat*

No critical habitat has been designated for vaquita. NMFS cannot designate critical habitat in foreign waters.

4.2.8.6 *Recovery Goals*

NMFS has not prepared a recovery plan for vaquita. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.9 Gulf of Mexico Bryde's Whale

The Bryde's whale is a widely distributed baleen whale found in tropical and subtropical oceans. The Gulf of Mexico subspecies of Bryde's whale is found in the northeastern Gulf of Mexico near De Soto Canyon (Figure 18). From historical whaling records and several recent sightings, there some evidence of a former distribution of these whales in waters of north-central and southern Gulf of Mexico.

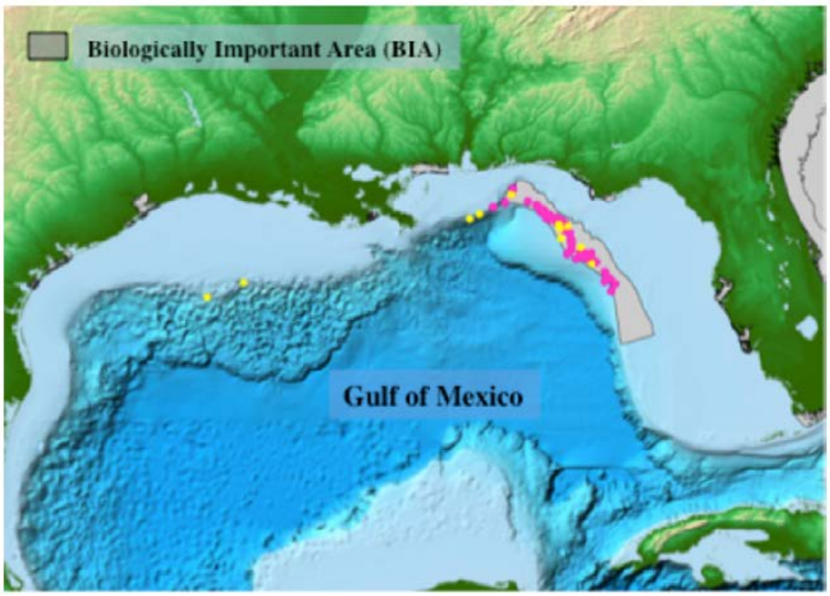

Figure 18: Map identifying the biologically important area and known range of Gulf of Mexico Bryde's whales. From (Rosel et al. 2016).

Bryde's whales are baleen whales that grow to lengths of 13 to 16.5 meters. Bryde's whales in the Gulf of Mexico are a taxonomically distinct subspecies. Gulf of Mexico Bryde's whales have a gray dorsal surface, streamlined body, and pointed, flat rostrum with three prominent ridges (Figure 19). The Gulf of Mexico stock of Bryde's whale was proposed for listing under the ESA as endangered on December 8, 2016 (Table 15).

Figure 19: Bryde's whale surfacing in the Gulf of Mexico. Photo: National Oceanic and Atmospheric Administration.

Table 15: Gulf of Mexico Bryde's whale information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera edeni	Gulf of Mexico Bryde's whale	N/A	Endangered	2016	81 FR 88639 (Proposed)	N/A	None Designated

Information available from the status review (Rosel et al. 2016), the proposed listing, and available literature were used to summarize the life history, population dynamics, and status of the species as follows.

4.2.9.1 *Life History*

The life expectancy of Gulf of Mexico Bryde's whales is unknown. They have a gestation period of 11 to 12 months, give birth to a single calf, which is nursed for six to 12 months. Age of sexual maturity is not known for Gulf of Mexico Bryde's whales specifically, but Bryde's whales are thought to be sexually mature at eight to 13 years. Peak breeding and calving probably occurs in the fall. Females breed every second year. Gulf of Mexico Bryde's whales exhibit a typical diel dive pattern, with deep dives in the daytime, and shallow dives at night.

Bryde's whales generally feed on schooling fishes (e.g., anchovy, sardine, mackerel, and herring) and small crustaceans (Rosel et al. 2016).

4.2.9.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Gulf of Mexico Bryde's whale.

The Gulf of Mexico Bryde's whale population is very small; the most recent estimate from 2009 places the population size at 33 individuals. A second estimate incorporating visual survey data from 1992 to 2009 estimated 44 individuals (Rosel et al. 2016). There is no population trend information available for the Gulf of Mexico Bryde's whale.

Genetic diversity within the Gulf of Mexico Bryde's whale population is very low, with genetic analyses indicating only two mtDNA haplotypes (compared to five haplotypes for North Atlantic right whales and 51 in fin whales across the same control region sequence) (Rosel and Wilcox 2014). Examination of 42 nuclear microsatellite loci found that 60 percent were monomorphic, meaning no genetic variability was seen for the 21 Gulf of Mexico Bryde's whales sampled (Rosel et al. 2016).

The range of Gulf of Mexico Bryde's whales is primarily in a small, biologically important area in the northeastern Gulf of Mexico near De Soto Canyon, in waters 100 to 400 meters deep along the continental shelf break (Figure 18). It inhabits the Gulf of Mexico year round, but its distribution outside of this biologically important area is unknown.

4.2.9.3 *Acoustics*

Bryde's whales produce low-frequency tonal and broadband calls for communication, navigation, and reproduction (Richardson et al. 1995a). Like other balaenopterids, Bryde's whales have distinctive calls depending on geographic regions (Figueiredo 2014; Rosel et al. 2016; Širović et al. 2014). In areas of the Gulf of Mexico where Bryde's whales are thought to be the main baleen whale present, a variety of vocalizations consistent with Bryde's whale vocalizations from other locations have been recorded ranging in frequency from 43 to 208 Hertz (Rice et al. 2014). While no data exist on the hearing abilities of Bryde's whale, as with other marine mammals we assume they hear best in the frequency range in which they produce calls.

4.2.9.4 *Status*

Historically, commercial whaling did occur in the Gulf of Mexico, but the area was not considered prime whaling grounds. Bryde's whales were not specifically targeted by commercial whalers, but the "finback whales" which were caught between the mid-1700s and late 1800s were likely Bryde's whales (Reeves et al. 2011). Noise from shipping traffic and seismic surveys in the region may impact Gulf of Mexico Bryde's whales' ability to communicate. Vessel traffic from commercial shipping and the oil and gas industry also poses a risk of vessel strike for Gulf of Mexico Bryde's whales. Entanglement from fishing gear is also a threat, and several fisheries operate within the range of the species. The Deepwater Horizon oil spill severely impacted Bryde's whales in the Gulf of Mexico, with an estimated 17 percent of the population killed, 22 percent of females exhibiting reproductive failure, and 18 percent of the population suffering adverse health effects (DWHTrustees 2016). Because the Gulf of Mexico Bryde's whale population is so small size and has low genetic diversity, it is highly susceptible to further perturbations.

4.2.9.5 *Critical Habitat*

No critical habitat has been designated for Gulf of Mexico Bryde's whales as the species is currently proposed for listing under the ESA.

4.2.9.6 *Recovery Goals*

No Recovery Plan has been prepared for Gulf of Mexico Bryde's whales as the species is currently proposed for listing under the ESA.

4.2.10 Humpback Whale (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific Distinct Population Segments)

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 20).

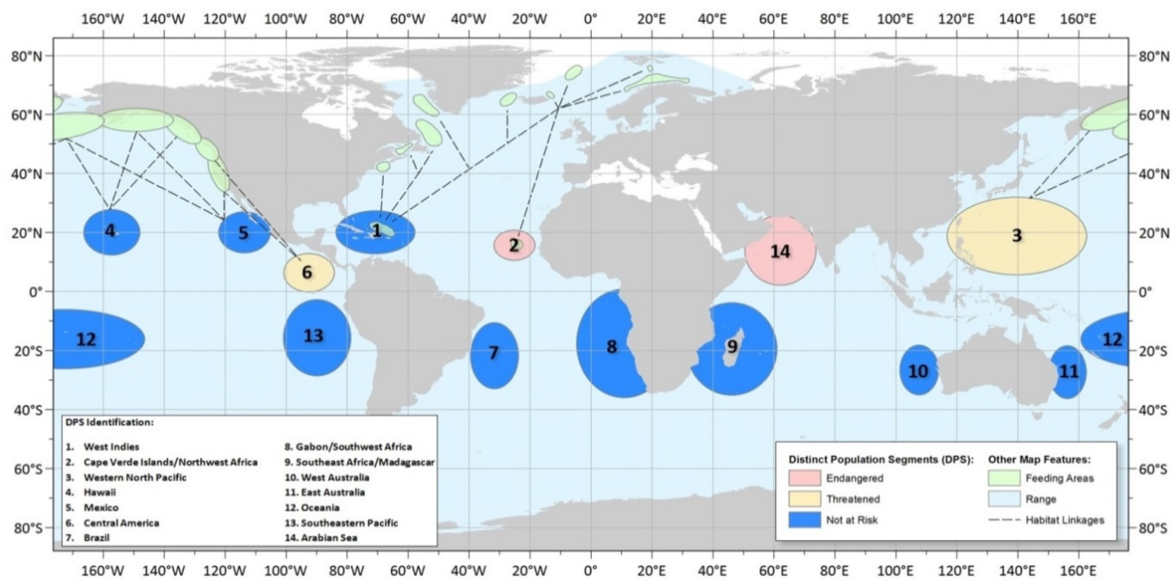

Figure 20: Map identifying 14 distinct population segments with 1 threatened and 4 endangered, based on primary breeding location of the humpback whale, their range, and feeding areas (Bettridge et al. 2015).

Humpbacks are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white (Figure 21). The humpback whale was originally listed as endangered on December 2, 1970. Since then, NMFS has designated 14 distinct population segments (DPSs) with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one as threatened (Mexico) (Table 16).

Figure 21: Humpback whale. Photo: National Oceanic and Atmospheric Administration

Table 16. Humpback whale information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Megaptera novaeangliae	Humpback whale	Cape Verde Islands/Northwest Africa	Endangered	2015	81 FR 62259	1991	None Designated
		Arabian Sea	Endangered				
		Western North Pacific	Endangered				
		Central America	Endangered				
		Mexico	Threatened				

Information available from the recovery plan (NMFS 1991), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

4.2.10.1 *Life History*

Humpbacks can live, on average, fifty years. They have a gestation period of eleven to twelve months, and calves nurse for one year. Sexual maturity is reached between five to eleven years of age with an average calving interval of two to three years. Humpbacks mostly inhabit coastal and continental shelf waters. They winter at low latitudes, where they calve 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.

4.2.10.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the humpback whale.

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The abundance and population trends of ESA-listed humpback whale DPSs is summarized in Table 17. Population growth rates are currently unavailable for all ESA-listed humpback whale DPSs (Table 17).

Table 17: Abundance and population trend estimates for humpback whale distinct population segments as listed under the Endangered Species Act.

Distinct Population Segment	ESA Status	Abundance	Population Trend
Cape Verde Islands/Northwest Africa	Endangered	Unknown	Unknown
Arabian Sea	Endangered	82	Unknown
Western North Pacific	Endangered	1,059	Unknown
Central America	Endangered	411	Unknown
Mexico	Threatened	3,264	Unknown

For humpback whales, distinct population segments that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Populations at low densities (less than 100) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density.

The Mexico DPS is estimated to have more than 2,000 individuals and should have enough genetic diversity for long-term persistence and protection from substantial environmental variance and catastrophes. The Central America DPS has just below 500 individuals and so may be subject to genetic risks due to inbreeding and moderate environmental variance. The Western North Pacific DPS has less than 2,000 individuals total and is made up of two subpopulations, Okinawa/Philippines and the Second West Pacific. Thus, while its genetic diversity may be protected from moderate environmental variance, it could be subject to extinction due to genetic risks due to low abundance. The population size of the Cape Verde Islands/Northwest Africa DPS is unknown at this time and therefore evidence of genetic diversity (or lack of) cannot be determined. The entire range of the Arabian Sea DPS has not been surveyed, but the most recent estimate abundance is less than 100 individuals, putting it at high risk of extinction due to lack of genetic diversity. The low abundance of this DPS suggests the population has reached a genetic bottleneck and is at an increased risk to impacts from inbreeding, such as reduced genetic fitness and susceptibility to disease.

The Western North Pacific DPS consists of humpback whales breeding/wintering in the area of Okinawa and the Philippines, another unidentified breeding area (inferred from sightings of whales in the Aleutian Islands area feeding grounds) and those transiting from the Ogasawara area. These whales migrate to feeding grounds in the northern Pacific, primarily off the Russian coast (Figure 20).

The Cape Verde Islands/Northwest Africa DPS consists of humpback whales whose breeding range includes waters surrounding the Cape Verde Islands as well as an undetermined breeding area in the eastern tropical Atlantic, and possibly the Caribbean. Its feeding range includes primarily Iceland and Norway (Figure 20).

The Mexico DPS consists of humpback whales that breed along the Pacific coast of mainland Mexico, and the Revillagigedos Islands and transit through the Baja California Peninsula coast. The DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington – southern British Columbia, northern and western Gulf of Alaska and Bering Sea feeding grounds (Figure 20).

The Central America DPS is composed of humpback whales that breed along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras and Nicaragua. This DPS feeds almost exclusively offshore of California and Oregon in the eastern Pacific, with only a few individuals identified at the northern Washington – southern British Columbia feeding grounds (Figure 20).

The Arabian Sea DPS includes those humpback whales that are currently known to breed and feed along the coast of Oman. However, historical records from the eastern Arabian Sea along the coasts of Pakistan and India indicate its range may also include these areas (Figure 20).

4.2.10.3 *Acoustics*

Humpback whale vocalization is much better understood than is hearing. Different sounds are produced that correspond to different functions: feeding, breeding, and other social calls (Dunlop et al. 2008). Males sing complex sounds while in low-latitude breeding areas in a frequency range of 20 Hz to 4 kHz with estimated source levels from 144 to 174 dB (Au et al. 2006a; Au et al. 2000b; Frazer and Mercado III 2000; Richardson et al. 1995a; Winn et al. 1970a). Males also produce sounds associated with aggression, which are generally characterized by frequencies between 50 Hz to 10 kHz with most energy below 3 kHz (Silber 1986a; Tyack 1983a). Such sounds can be heard up to 9 kilometers (4.9 nautical miles) away (Tyack 1983a). Other social sounds from 50 Hz to 10 kHz (most energy below 3 kHz) are also produced in breeding areas (Richardson et al. 1995a; Tyack 1983b). While in northern feeding areas, both sexes vocalize in grunts (25 Hz to 1.9 kHz), pulses (25 to 89 Hz) and songs (ranging from 30 Hz to 8 kHz but dominant frequencies of 120 Hz to 4 kHz), which can be very loud (175 to 192 dB re: 1 µPa at 1 m [rms]) (Au et al. 2000b; Erbe 2002a; Payne 1985; Richardson et al. 1995c; Thompson et al. 1986). However, humpback whales tend to be less vocal in northern feeding areas than in southern breeding areas (Richardson et al. 1995c). NMFS classified humpback whales in the low-frequency cetacean (i.e., baleen whale) functional hearing group. As a group, it is estimated that baleen whales can hear frequencies between 0.007 and 30 Hz (NOAA 2013). Houser et al. (2001) produced a mathematical model of humpback whale hearing sensitivity based on the anatomy of the humpback whale ear. Based on the model, they concluded that humpback whales would be sensitive to sound in frequencies ranging from 0.7 to 10 kHz, with a maximum sensitivity between 2 to 6 kHz.

Humpback whales are known to produce three classes of vocalizations: (1) “songs” in the late fall, winter, and spring by solitary males; (2) social sounds made by calves (Zoidis et al. 2008) or within groups on the wintering (calving) grounds; and (3) social sounds made on the feeding grounds (Thomson and Richardson 1995a). The best-known types of sounds produced by humpback whales are songs, which are thought to be reproductive displays used on breeding grounds and sung only by adult males (Clark and Clapham 2004; Gabriele and Frankel. 2002; Helweg et al. 1992; Schevill et al. 1964; Smith et al. 2008). Singing is most common on breeding grounds during the winter and spring months but is occasionally heard in other regions and seasons (Clark and Clapham 2004; Gabriele and Frankel. 2002; McSweeney et al. 1989). Au et al. (2000a) noted that humpback whales off Hawaii tended to sing louder at night compared to the day. There is a geographical variation in humpback whale song, with different populations singing a basic form of a song that is unique to their own group. However, the song evolves over the course of a breeding season but remains nearly unchanged from the end of one season to the start of the next (Payne et al. 1983). The song is an elaborate series of patterned vocalizations that are hierarchical in nature, with a series of songs (‘song sessions’) sometimes lasting for hours (Payne and McVay 1971). Components of the song range from below 20 Hz up to 4 kHz, with source levels measured between 151 and 189 dB re: 1 µPa at 1 m (rms) and high frequency harmonics extending beyond 24 kHz (Au et al. 2006b; Winn et al. 1970b).

Social calls range from 20 Hz to 10 kHz, with dominant frequencies below 3 kHz (D'Vincent et al. 1985; Dunlop et al. 2008; Silber 1986b; Simao and Moreira 2005). Female vocalizations appear to be simple; Simao and Moreira (2005) noted little complexity.

“Feeding” calls, unlike song and social sounds are a highly stereotyped series of narrow-band trumpeting calls. These calls are 20 Hz to 2 kHz, less than one second in duration, and have source levels of 162 to 192 dB re: 1 µPa at 1 m (rms) (D'Vincent et al. 1985; Thompson et al. 1986). The fundamental frequency of feeding calls is approximately 500 Hz (D'Vincent et al.

1985; Thompson et al. 1986). The acoustics and dive profiles associated with humpback whale feeding behavior in the northwest Atlantic Ocean has been documented with Digital Acoustic Recording Tags[3] (DTAGs) (Stimpert et al. 2007). Underwater lunge behavior was associated with nocturnal feeding at depth and with multiple boats of broadband click trains that were acoustically different from toothed whale echolocation: Stimpert et al. (Stimpert et al. 2007) termed these sounds "mega-clicks" which showed relatively low received levels at the DTAGs (143 to 154 dB re: 1 µPa at 1 m [rms]), with the majority of acoustic energy below 2 kHz.

In terms of functional hearing capability, humpback whales belong to low frequency cetaceans which have a hearing range of 7 Hz to 22 kHz (Southall et al. 2007). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hz to 10 kHz, with maximum relative sensitivity between 2 kHz and 6 kHz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006a) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kHz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kHz may have been demonstrated in a play back study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kHz at 219 dB re: 1 µPa at 1 m (rms) or frequency sweep of 3.1 to 3.6 kHz. In addition, the system had some low frequency components (below 1 kHz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

4.2.10.4 *Status*

Humpback whales were originally listed as endangered as a result of past commercial whaling, and the five DPSs that remain listed (Cape Verde Islands/Northwest Africa, Western North Pacific, Central American, and Arabian Sea and Mexico) have likely not yet recovered from this. 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 (IUCN 2012). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the IWC. Additional threats include ship strikes, fisheries interactions (including entanglement), energy development, harassment from whale watching,

[3] *DTAG is a novel archival tag, developed to monitor the behavior of marine mammals, and their response to sound, continuously throughout the dive cycle. The tag contains a large array of solid-state memory and records continuously from a built-in hydrophone and suite of sensors. The sensors sample the orientation of the animal in three dimensions with sufficient speed and resolution to capture individual fluke strokes. Audio and sensor recording is synchronous so the relative timing of sounds and motion can be determined precisely (Johnson and Tyack 2003)*

and noise. The species' large population size and increasing trends indicate that it is resilient to current threats, but individual DPSs face varying risks of extinction.

4.2.10.5 *Critical Habitat*

No critical habitat has been designated for the humpback whale.

4.2.10.6 *Recovery Goals*

See the 1991 Final Recovery Plan for the Humpback whale for complete down listing/delisting criteria for each of the four following recovery goals.

1. Maintain and enhance habitats used by humpback whales currently or historically.
2. Identify and reduce direct human-related injury and mortality.
3. Measure and monitor key population parameters.
4. Improve administration and coordination of recovery program for humpback whales.

4.2.11 Indus River dolphin

The Indus River dolphin is a subspecies of the Ganges river dolphin. It lives exclusively in the Indus River system in Pakistan and India (Figure 22).

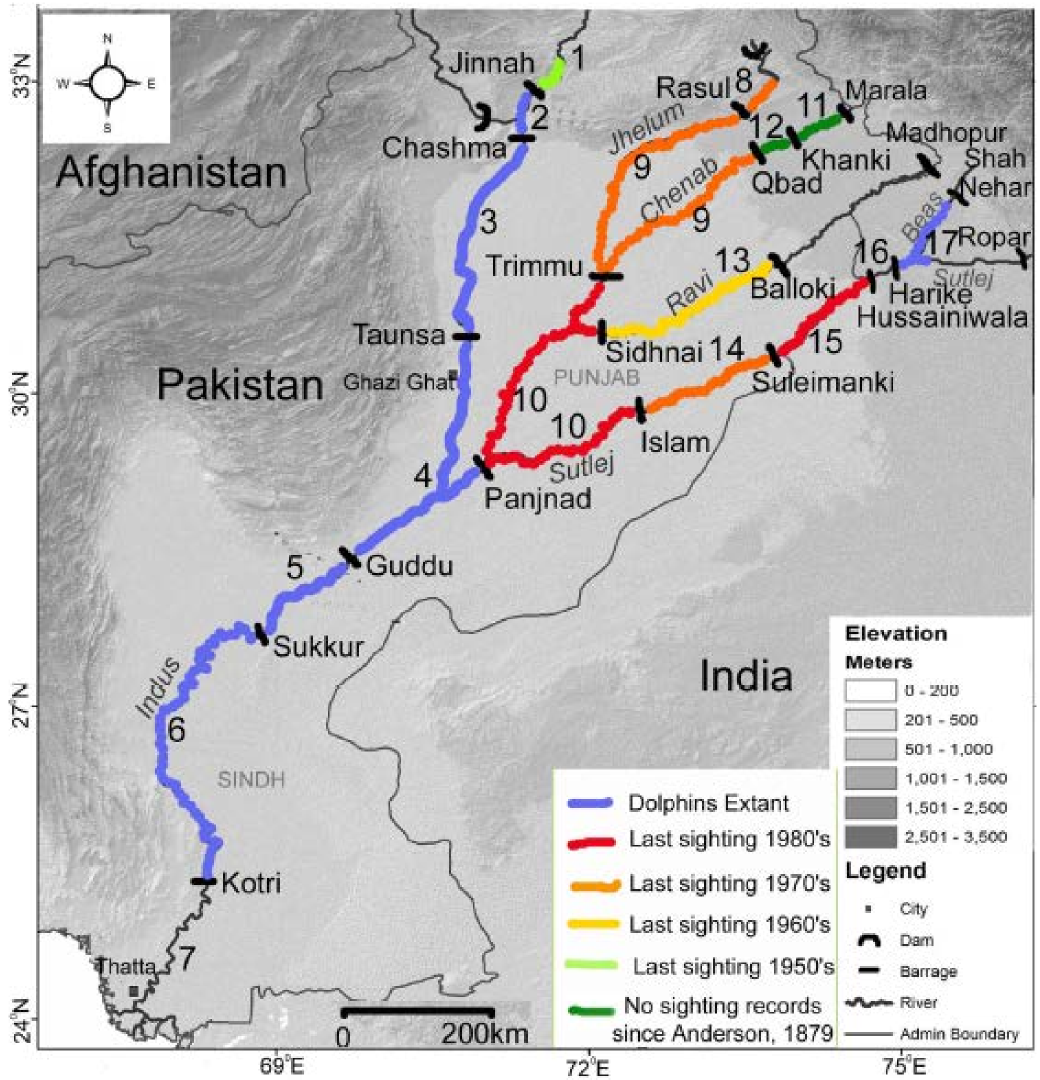

Figure 22. Map identifying the range of the Indus River dolphin subpopulations. From (Braulik et al. 2014).

Indus River dolphins have rounded stocky bodies and a long narrow beak (Figure 23). They can grow to 2.6 meters long and weigh 70 to 90 kilograms. Indus River dolphins have very small eyes and are functionally blind. The Indus River dolphin was originally listed as endangered on January 14, 1991 (Table 18).

Figure 23: Indus River dolphin. Photo: River Dolphin Trust.

Table 18: Indus River dolphin information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Platanista gangetica minor	Indus River dolphin	None	Endangered	2016	56 FR 1463	None	None Designated

Information available from the five-year status review (NMFS 2016d) and available literature were used to summarize the life history, population dynamics and status of the Indus River dolphin as follows.

4.2.11.1 *Life History*

The average life span of Indus River dolphins is thought to be between 30 and 35 years. Gestation period is unknown, but could be between 10 and 11 months; females may give birth to up to 11 calves in their lifetime. Calves are weaned a few months after birth. Sexual maturity for both sexes is reached at between seven and 10 years of age. The calving interval is probably every year or every other year. Indus river dolphins are functionally blind, and rely on echolocation to navigate and find prey. The echolocate almost continuously (between 20 to 50 clicks per second), and produce clicks, but not whistles, at frequencies between 50 and 80 kHz (Braulik et al. 2015b). Indus River dolphins are usually sighted alone or in small groups, and less frequently, in aggregations of 20 to 30 individuals. Indus River dolphins primarily eat a variety of benthic fishes like catfish and carp, as well as prawns (Braulik et al. 2015b).

4.2.11.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Indus River dolphin.

The minimum population estimate for the Indus River dolphin was 1,452 in 2011 (Braulik et al. 2015b; NMFS 2016d). The Indus River dolphin is composed of six extant subpopulations, described as those individuals residing in sections of the Indus River defined by barrages, or dams used for irrigation, as dividing points for the subpopulations (Figure 22). The three largest subpopulations—between the Chashma and Taunsa Barrages, between the Taunsa and Guddu Barrages, and between the Guddu and Sukkur Barrages—make up approximately 99 percent of the total population, occurring in about 690 kilometers of the Indus River. The remaining three subpopulations are comparatively small (Table 19).

Table 19: Abundance estimates for Indus River dolphin subpopulations.

Subpopulation	Number of Individuals	Source
Beas River	35 ±19	(Khan 2016)
Chasma and Jinnah	1-2	(Braulik et al. 2012)
Chasma and Taunsa	84	(Braulik 2006)
Taunsa and Guddu	259	(Braulik 2006)
Guddu and Sukkur	602	(Braulik 2006)
Sukkur and Kotri	4-34	Noureen 2013 in (Braulik et al. 2015b)

There is no range-wide population trend available for the Indus River dolphin. There is some evidence that the Guddu and Sukkur subpopulation has increased 5.6 percent annually from 1974 to 2008. This increase would coincide with the establishment of a dolphin preserve in the area and enforcement of a hunting ban. However, that increase may also be due to differences in survey methods, and not a true trend.

The Indus River dolphin exhibits low genetic diversity, and has likely gone through a genetic bottleneck in the past (Braulik et al. 2015a; NMFS 2016d). The barrages on the Indus River limit Indus River dolphins from mixing with individuals from other subpopulations. It is possible that Indus River dolphins will move through the barrages when they are open, but the high flow and turbulent water during these times make it unlikely that dolphins regularly move from one stretch of river to another (Braulik et al. 2015b).

Indus River dolphins inhabit freshwater in the Indus River and its tributaries (Figure 22). They seem to prefer areas of the river with depths between 2.4 and 5.1 meters, and widths of 0.5 to 2 kilometers (NMFS 2016d). Additionally, Indus River dolphins favor confluence areas in the river, with counter-current eddies that help trap fish and provide a resting area where they are not continuously swimming against the downstream current.

4.2.11.3 *Acoustics*

We are aware of no hearing data on Indus river dolphins specifically, but data from other river dolphins indicate they are high frequency specialists, with a likely hearing range between 275 Hz to 160 kHz (NOAA 2016). Recordings of a captive and wild Indus river dolphins have documented that they echolocate almost continuously (between 20 to 50 clicks per second), and produce clicks, but not whistles, at frequencies primarily between 50 and 80 kHz, with a second peak between 160 and 200 kHz (Braulik et al. 2015b). These data are consistent with them having a high frequency hearing range.

4.2.11.4 *Status*

The range of the Indus River dolphin has shrunk over 80 percent in the last one hundred years (NMFS 2016d). Indus River dolphins were hunted for food by indigenous peoples in the region for centuries. Hunting continued until 1972, when it was banned. A dolphin reserve was established in the early 1970s between the Guddu and Sukkur barrages. The subpopulation there started increasing. Dolphin hunting ceased in the Sindh province once the ban was enforced, but poaching still occurred in other areas of the Indus River until at least the early 1980s. Incidental capture in fishing nets is a concern for the species. Indus River dolphins can become trapped in irrigation canals which are heavily fished and thus be at risk for capture. However, Indus River dolphins are more frequently found in the main channel of the river, where there is less fishing pressure. Entrapment in canals is a threat for Indus River dolphins because they can become stranded when the canal is drained for maintenance. A dolphin rescue program was instituted in 1992, and it has saved over one hundred dolphins between 1992 and 2014. Pollution is a growing concern as Pakistan becomes more industrialized, and insecticide dumping in the Indus River has been responsible for at least six dolphin deaths. The Indus River is an important source of water for the region, and the river has a system of barrages and canals that are used for irrigation for agriculture. These barrages serve as barriers for the Indus River dolphins, fragmenting the populations and the available habitat. In addition, water extraction causes habitat degradation by reducing the physical space dolphins can inhabit, changing water flow and depth, and increasing water temperature. Climate change may affect water availability in the region, but it is unclear whether water in the Indus River will increase or decrease under different climate change scenarios (Braulik et al. 2015b). Although the population is no longer subject to hunting pressure, Indus River dolphins face numerous threats from habitat degradation and pollution; these threats are expected to continue in the future. Due to its small population size, low genetic diversity, and ongoing threats, the Indus River dolphin is not resilient to future perturbations.

4.2.11.5 *Critical Habitat*

No critical habitat has been designated for the Indus River dolphin. NMFS cannot designate critical habitat in foreign waters.

4.2.11.6 *Recovery Goals*

There is currently no Recovery Plan for the Indus River dolphin. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.12 Killer Whale (Southern Resident Distinct Population Segment)

Killer whales are distributed worldwide, but populations are isolated by region and ecotype. Killer whales have been divided into DPSs on the basis of differences in genetics, ecology, morphology and behavior. The Southern Resident killer whale DPS can be found along the Pacific Coast of the United States and Canada, and in the Salish Sea, Strait of Juan de Fuca and Puget Sound (Figure 24).

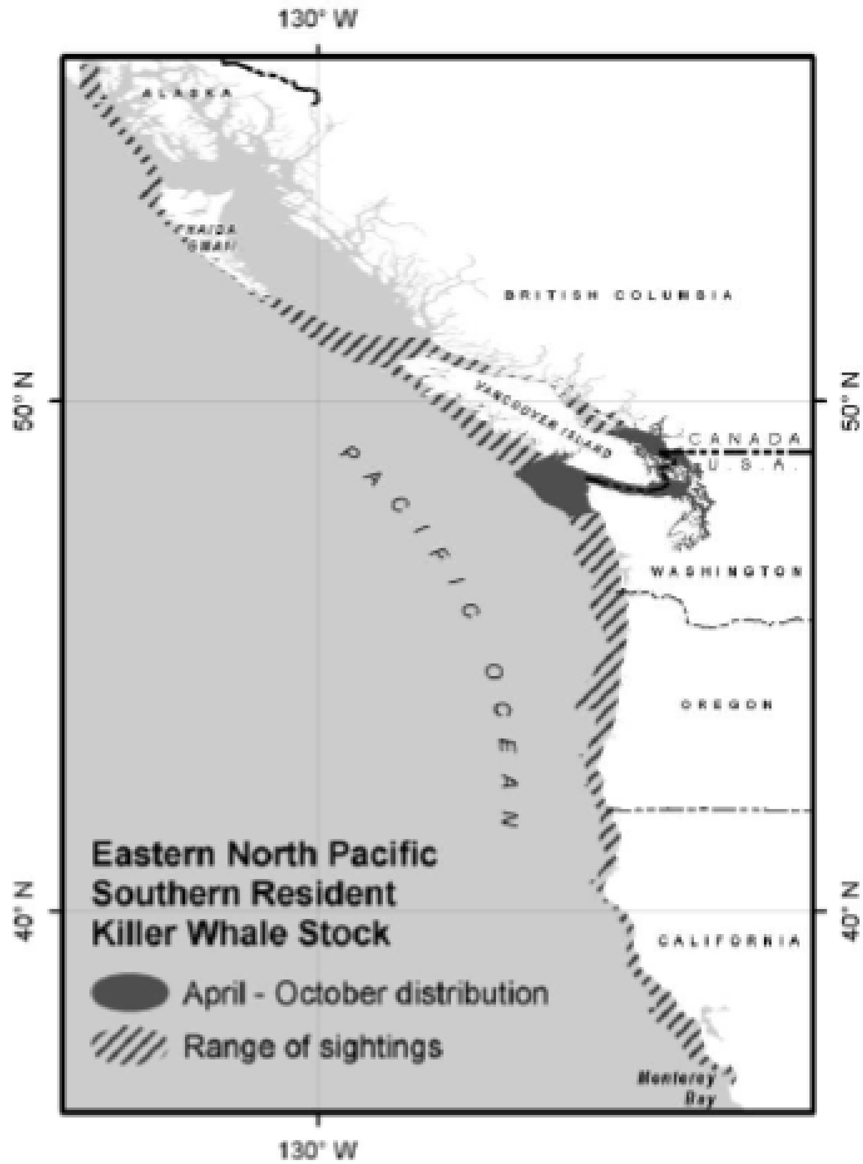

Figure 24. Map identifying the range of the Southern resident killer whale. Approximate April to October distribution of the Southern Resident killer whale (shaded area) and range of sightings (diagonal lines) (Carretta et al. 2016).

Killer whales are odontocetes and the largest delphinid species with black coloration on their dorsal side and white undersides and patches near the eyes. They also have a highly variable gray or white saddle behind the dorsal fin (Figure 25). The Southern Resident DPS of killer whales was listed as endangered under the ESA on November 18, 2005 (Table 20).

Figure 25: Southern Resident killer whales. Photo: National Oceanic and Atmospheric Administration

Table 20. Southern Resident killer whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Orcinus orca	Killer Whale	Southern Resident	Endangered	2016	70 FR 69903	73 FR 4176	71 FR 69054

We used information available in the final rule, the Recovery Plan (NMFS 2008a), the 2016 Status Review (NMFS 2016g) and the 2015 Stock Assessment Report (Carretta et al. 2016) to summarize the life history, population dynamics and status of this species, as follows.

4.2.12.1 *Life History*

Southern Resident killer whales are geographically, matrilineally, and behaviorally distinct from other killer whale populations. 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 ten to seventeen years of age. Females reach maturity at twelve to sixteen 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).

4.2.12.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Southern Resident killer whale.

The most recent abundance estimate for the Southern Resident DPS is eighty whales in 2016[4]. This represents a decline from just a few years ago, when in 2012, there were 85 whales. Population abundance has fluctuated over time with a maximum of approximately 100 whales in 1995 (Carretta et al. 2016), with an increase between 1974 and 1993, from 76 to 93 individuals. As compared to stable or growing populations, the DPS reflects lower fecundity and has demonstrated little to no growth in recent decades (NMFS 2016g).

For the period between 1974 and the mid-90s, when the population increased from 76 to 93 animals, the population growth rate was 1.8 percent (Ford et al. 1994). More recent data indicate the population is now in decline (Carretta et al. 2016).

After thorough genetic study, the Biological Review Team concluded that Southern Resident killer whales were discrete from other killer whale groups (NMFS 2008). Despite the fact that their ranges overlap, Southern Resident killer whales do not intermix with Northern Resident killer whales. Southern Resident killer whales consist of three pods, called J, K, and L. Low genetic diversity within a population is believed to be in part due to the matrilineal social structure (NMFS 2008).

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 (Figure 24).

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[4] *http://www.orcanetwork.org/Main/index.php?categories_file=Births%20and%20Deaths; accessed 11/15/2016*

4.2.12.3 *Acoustics*

Killer whales have advanced vocal communication and also use vocalizations to aid in navigation and foraging (NMFS 2008a). Their vocalizations typically have both a low frequency component (250 to 1,500 Hz) and a high frequency component (five to 12 kHz) (NMFS 2008a). Killer whale vocalizations consist of three main types, echolocation clicks, which are primarily used for navigation and foraging, and tonal whistles and plus calls, which are thought to be used for communication (NMFS 2008a). Individual Southern Resident pods have distinct call repertoires, with each pod being recognizable by its acoustic dialect (NMFS 2008a). Killer whale hearing is one of the most sensitive of any odontocete, with a hearing range of one to 120 kHz, with the most sensitive range being between 18 and 42 kHz range (Szymanski et al. 1999).

4.2.12.4 *Status*

The Southern Resident killer whale DPS was listed as endangered in 2005 in response to the population decline from 1996 to 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. These contaminants become concentrated at higher trophic levels and may lead to immune suppression or reproductive impairment. 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. The recent decline, unstable population status, and population structure (e.g., few reproductive age males and non-calving adult females) continue to be causes for concern. The relatively low number of individuals in this population makes it difficult to resist or recover from natural spikes in mortality, including disease and fluctuations in prey availability.

4.2.12.5 *Critical Habitat*

On November 29, 2006, NMFS designated critical habitat for the Southern Resident killer whale. The critical habitat consists of approximately 6,630 square kilometers 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 (Figure 26). It provides the following physical and biological features essential to the conservation of Southern Resident killer whales: 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.

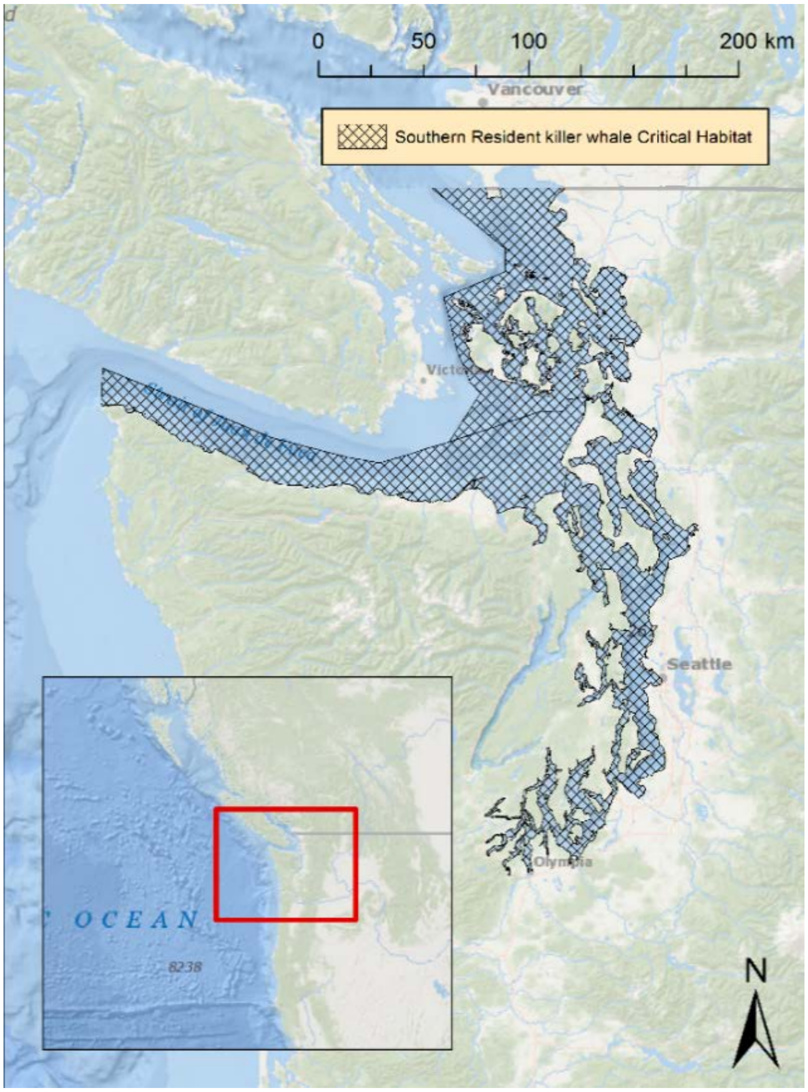

Figure 26: Map depicting designated critical habitat for the Southern Resident killer whale.

4.2.12.6 *Recovery Goals*

See the 2008 Final Recovery Plan for the Southern Resident killer whale for complete down listing/delisting criteria for each of the following recovery goals.

1. Prey Availability: Support salmon restoration efforts in the region including habitat, harvest and hatchery management considerations and continued use of existing NMFS authorities under the ESA and Magnuson-Stevens Fishery Conservation and Management Act to ensure an adequate prey base
2. Pollution/Contamination: Clean up existing contaminated sites, minimize continuing inputs of contaminants harmful to killer whales, and monitor emerging contaminants.
3. Vessel Effects: Continue with evaluation and improvement of guidelines for vessel activity near Southern Resident killer whales and evaluate the need for regulations or protected areas.

4. Oil Spills: Prevent oil spills and improve response preparation to minimize effects on Southern Residents and their habitat in the event of a spill.
5. Acoustic Effects: Continue agency coordination and use of existing ESA and MMPA mechanisms to minimize potential impacts from anthropogenic sound.
6. Education and Outreach: Enhance public awareness, educate the public on actions they can participate in to conserve killer whales and improve reporting of Southern Resident killer whale sightings and strandings.
7. Response to Sick, Stranded, Injured Killer Whales: Improve responses to live and dead killer whales to implement rescues, conduct health assessments, and determine causes of death to learn more about threats and guide overall conservation efforts.
8. Transboundary and Interagency Coordination: Coordinate monitoring, research, enforcement, and complementary recovery planning with Canadian agencies, and Federal and State partners.
9. Research and Monitoring: Conduct research to facilitate and enhance conservation efforts. Continue the annual census to monitor trends in the population, identify individual animals, and track demographic parameters.

4.2.13 Maui’s and South Island Hector’s dolphins

The Hector’s dolphin is a small delphinid species found only in coastal waters off New Zealand. Two subspecies of Hector’s dolphin are recognized based on genetic and morphological data, the Maui’s dolphin occurring off the North Island of New Zealand, and the South Island Hector’s dolphin occurring off the South Island of New Zealand (Figure 27).

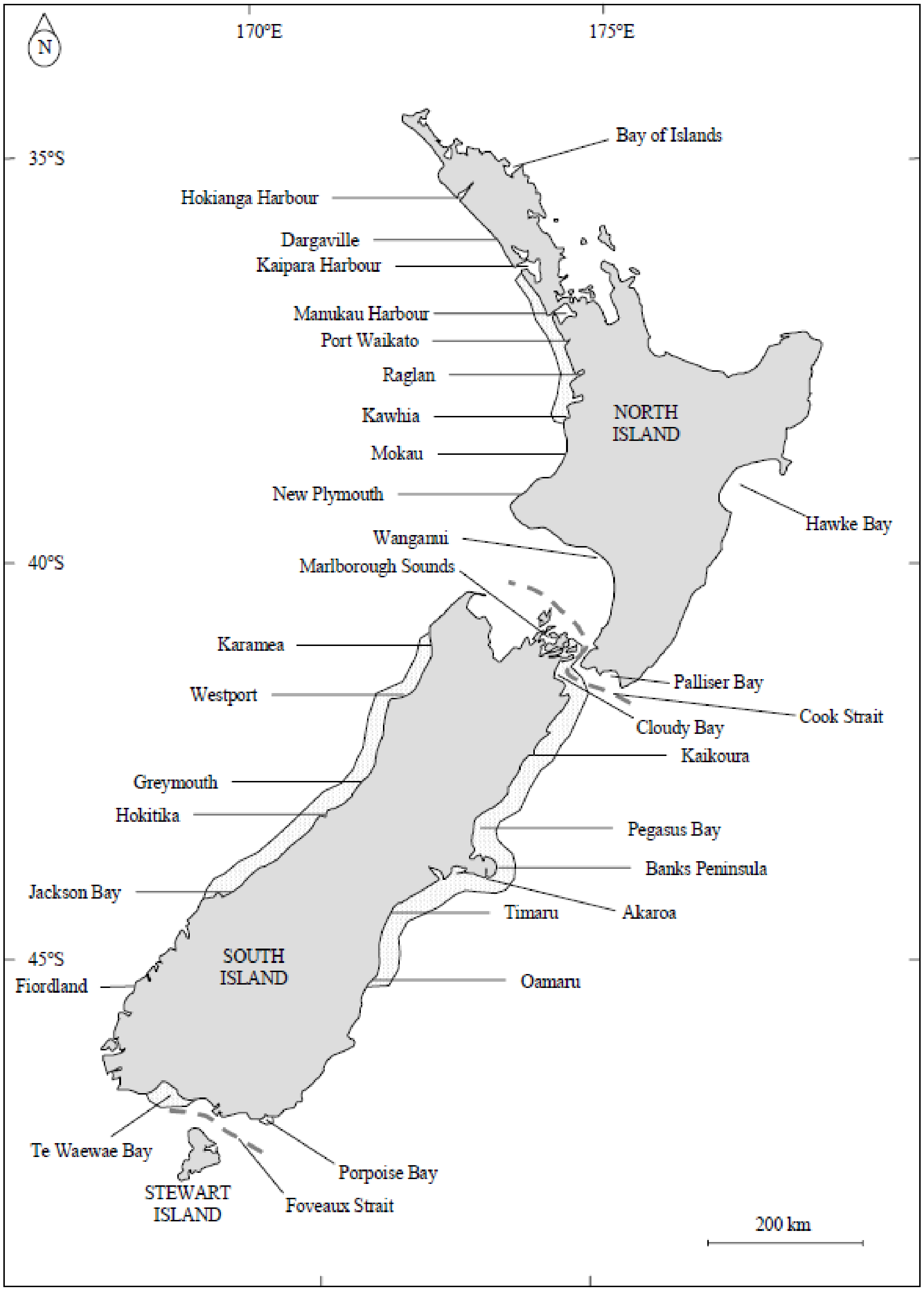

Figure 27. Map identifying the ranges (shaded coastlines) of the Maui's dolphin (North Island) and South Island Hector's dolphin (South Island) off the coast of New Zealand. Taken from (Pichler 2002).

Hector's dolphins are small (up to 1.2 meters or four feet), have a short and stocky body, no external beak, a rounded dorsal fin and rounded pectoral fins, and relatively large flukes (Manning and Grantz. 2016). They have a distinctive and complex black and white coloration pattern (Figure 28). Both the Maui's and South Island subspecies of Hector's dolphin were proposed for listing under the ESA on September 19, 2016, with the Maui's dolphin being proposed as endangered and the South Island Hector's dolphin being proposed as threatened (Table 21).

Figure 28: Hector's dolphin. Photo: National Oceanic and Atmospheric Administration

Table 21. Hector's dolphin information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Cephalorhynchus hectori maui	Maui's Dolphin	None	Endangered	2016 (Draft)	81 FR 64110 (Proposed)	None	None Designated
Cephalorhynchus hectori hectori	South Island Hector's Dolphin	None	Threatened	2016 (Draft)	81 FR 64110 (Proposed)	None	None Designated

Information available from the draft status review (Manning and Grantz. 2016), listing documents, and the peer-reviewed literature were used to summarize the life history, population dynamics, and status of the species as follows.

4.2.13.1 *Life History*

Female Hector's dolphins reach sexual maturity between seven and nine years of age, males mature slightly earlier between six and nine years, and both sexes can live into their twenties

(Slooten 1991). Breeding typically occurs in the austral fall and winter, with most females giving birth to a single calf every two to four years during the austral spring and summer (Slooten and Dawson 1994). Calves remain with their mother until weaning between one and two years of age (Slooten and Dawson 1994). Evidence indicates some Hector’s dolphins appear to migrate from inshore waters during the summer, to offshore waters during the winter, which may be related to shifts in prey distribution or reproductive behavior. Hector’s dolphins feed on a wide variety of prey species including cephalopods, crustaceans, and small fishes, but focus on mid-water and demersal prey species (Miller et al. 2012a).

4.2.13.2 *Population Dynamics*

The following is a discussion of the species’ population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to Hector’s dolphins.

The earliest reliable population abundance estimate for Maui’s dolphins is from 1984/1985, with an estimated 134 individuals (Dawson and Slooten 1988). More advanced methodologies in the 1990s and 2000s produced several abundance estimates for Maui’s dolphins ranging from 75 to 111 individuals (Manning and Grantz. 2016). For 2010/2011, the abundance estimate for Maui’s dolphins appeared to decline to 55 dolphins (95 percent confidence intervals between 48 and 69) (Hamner et al. 2014), but the most recent estimate for 2015/2016 increased to 63 dolphins (95 percent confidence intervals between 57 and 75) (Baker et al. 2016). Two recent studies have examined population trends in Maui’s dolphins, with one indicating a three percent decline from 2001 to 2010 (95 percent confidence intervals between -11 and 6 percent) (Hamner et al. 2012a), and the other a sharper decline of 13 percent per year from 2001 to 2007 (95 percent confidence intervals between -40 and 14 percent) (Baker et al. 2013). While neither of these studies could confirm a population decline given the large confidence intervals, a meta-analysis of multiple studies on Maui’s dolphins found significant declining trend of 3.2 percent (90 percent confidence intervals between -5.7 and -0.6 percent) between 1985 and 2011 (Wade et al. 2012).

The earliest reliable population abundance for South Island Hector’s dolphins comes from the same study mentioned above for Maui’s dolphins, with an estimated 3,274 South Island Hector’s dolphins from 1984/1985 (Dawson and Slooten 1988). Between 1997 and 2001, more advanced methods produced a much larger estimate of 7,270 individuals (95 percent confidence intervals between 5,303 and 9,966) (Slooten et al. 2004), and a more recent study produced an even larger estimate of 14,849 individuals (95 percent confidence intervals between 11,923 and 18,492) (MacKenzie and Clement 2016). The first population trend estimate for South Island Hector’s dolphins comes from data collected from 1984 to 1988 around Banks Peninsula, which resulted in an estimated five percent decline per year (Slooten et al. 1992). Following the establishment of a Marine Mammal Sanctuary around Banks Peninsula in 1988, the population of South Island Hector’s dolphins in this area appeared to improve with a six percent increase in population growth rate (Gormley et al. 2012). Despite this, the population in this area still appears to be in decline at a rate of 0.5 percent per year (Gormley et al. 2012). Range-wide, both a stochastic

Schaefer (1954) and Bayesian model suggest substantial declines in South Island Hector's dolphins since the 1970s and predict continued declines over the next 50 years (Slooten and Davies 2011).

Maui's and South Island Hector's dolphins are genetically distinct based on both mitochondrial and nuclear DNA analyses (Manning and Grantz. 2016). Within subspecies, Maui's dolphins show extremely limited genetic diversity, and South Island Hector's dolphins exhibit higher, but still low genetic diversity. Maui's dolphins exhibit low nuclear DNA heterozygosity and are all of a single mtDNA haplotype and, thus, represent a single maternal lineage (Pichler 2002). South Island Hector's dolphins show greater genetic diversity, and exhibit regional population structure with an east coast, west coast, and south coast population all being genetically differentiated. Across populations, South Island Hector's dolphins exhibit at least 20 different mtDNA haplotypes, with each regional population having different predominant haplotypes and exhibiting significant genetic differentiation based on 13-locus microsatellite genotypes (Hamner et al. 2012b). There is even some evidence of genetic differentiation within these regional populations (Hamner et al. 2016). While South Island Hector's dolphins have higher genetic diversity than Maui's dolphins, they still have relatively low genetic diversity compared to more abundant odontocetes (Manning and Grantz. 2016).

Hector's dolphins are only found in coastal waters off New Zealand, inhabiting nearshore environments, typically within five nautical miles of shore, although South Island Hector's dolphins may be found in waters out to 20 nautical miles off shore. Historically, Hector's dolphins are thought to have ranged along entire coastline of both the North and South Island of New Zealand. Today, Maui's dolphins are found primarily along the northwest coast of the North Island, and South Island Hector's dolphins are found along the east, west, and south coasts of the South Island. Seasonal distribution changes have been documented in some areas. While across seasons Hector's dolphins are most abundant close to shore, during winter some dolphins migrate further offshore resulting in a more even distribution of dolphins with respect to distance from shore. This change in distribution may be a response to changes in prey density, or the consequence of females seeking warmer shallower waters to give birth in the summer.

4.2.13.3 *Acoustics*

South Island Hector's dolphins produce high frequency clicks ranging between 112 and 130 kHz with maximum source levels of 163 dB re 1μPa (Dawson 1988; Dawson and Thorpe 1990). Unlike most delphinids, they do not appear to produce whistles although they do occasionally produce rapid click pulses that generate an audible "cry" or "squeal" sound (Dawson 1988). Based on the characteristics of their vocalizations, it is thought that South Island Hector's dolphins use sound primarily for foraging, communication, and fine scale navigation but not large-scale navigation (Dawson 1988). We are aware of no information on the hearing range of

South Island Hector's dolphins, but assume they hear best in the frequency range at which they produce sound (112 and 130 kHz).

4.2.13.4 *Status*

Both subspecies of Hector's dolphin show evidence of population declines, which is thought to be primarily due to bycatch in commercial and recreational gillnets and trawls (Manning and Grantz. 2016). While changes in the management of New Zealand fisheries appear to have reduced some of the impacts from this threat, both subspecies are expected to continue to decline as a result of bycatch (Manning and Grantz. 2016). Habitat modification and degradation due to development and industrial activities, and disease and tourism also pose a threat to both subspecies (Manning and Grantz. 2016). Given the small size, low genetic diversity, and limited range of Maui's dolphins, the species is at very high risk for extinction and is proposed for listing as endangered under the ESA (Manning and Grantz. 2016). The more abundant and wider ranging South Island Hector's dolphin fairs better but still is at moderate risk of extinction and is proposed for listing as threatened under the ESA (Manning and Grantz. 2016).

4.2.13.5 *Critical Habitat*

No critical habitat has been designated for either subspecies of Hector's dolphin. NMFS cannot designate critical habitat in foreign waters.

4.2.13.6 *Recovery Goals*

NMFS has not prepared a recovery plan for either subspecies of Hector's dolphin. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.14 North Atlantic Right Whale

The North Atlantic right whale is a narrowly distributed baleen whale found in temperate and sub-polar latitudes in the North Atlantic Ocean (Figure 29).

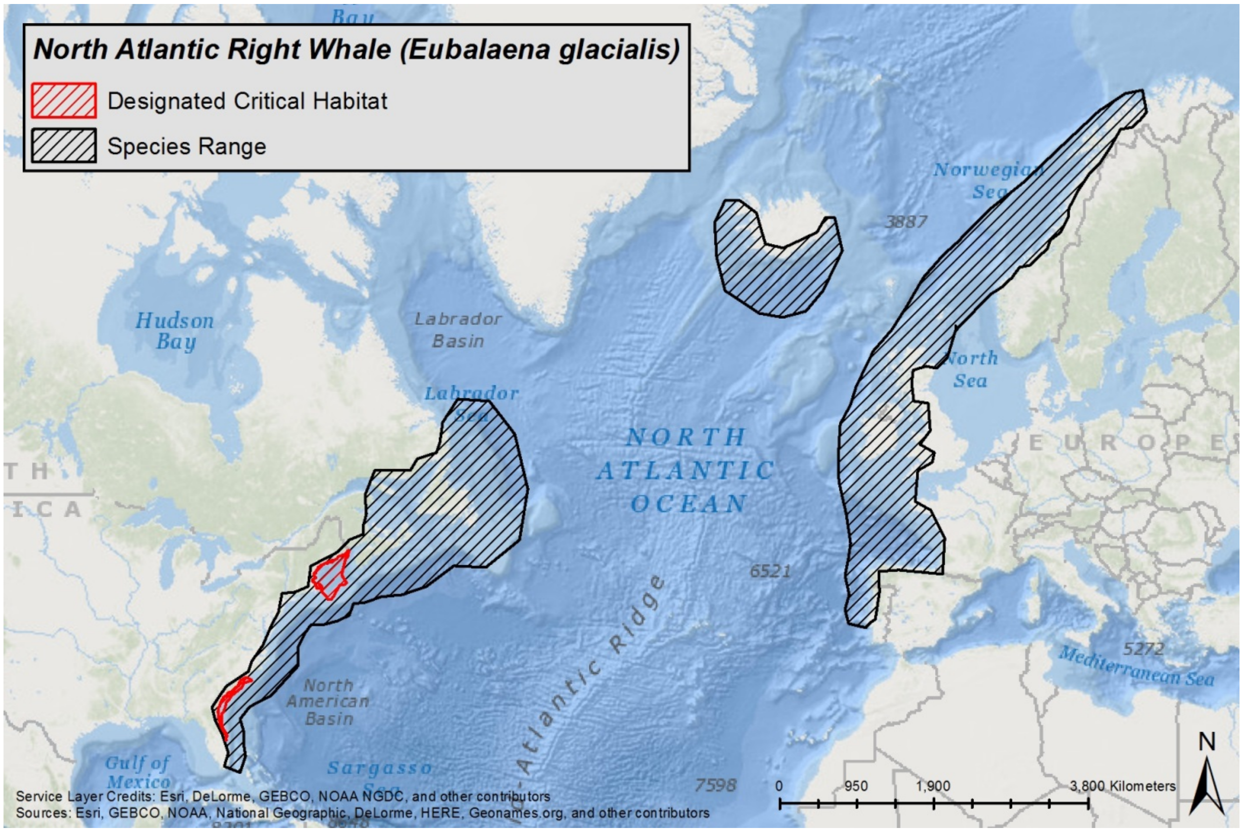

Figure 29: Map identifying range and critical habitat of the North Atlantic right whale.

The North Atlantic right whale is a narrowly distributed baleen whale, distinguished by its stocky body and lack of a dorsal fin (Figure 30). The species was originally listed as endangered on December 2, 1970 (Table 22).

Figure 30: North Atlantic right whale. Photo: National Oceanic and Atmospheric Administration.

Table 22. North Atlantic right whale information bar provides species Latin name, common name, current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Eubalaena glacialis	North Atlantic right whale	None	Endangered	2012	73 FR 12024	2005	81 FR 4837

We used information available in the five-year review (Colligan et al. 2012), the most recent stock assessment report (Waring et al. 2016a), and the scientific literature to summarize the life history, population dynamics and status of the species, as follows.

4.2.14.1 *Life history*

The lifespan of North Atlantic right whales is unknown, but some individuals appear to live to be at least fifty years old (Kenney 2009). Their gestation is twelve to thirteen months, and calves are nursed for eight to seventeen months. The average calving interval is three to five years and they reach sexual maturity at nine years of age. They migrate to low latitudes during the winter to give birth in shallow, coastal waters and in summer, feed on large concentrations of copepods in the high latitudes (Colligan et al. 2012).

4.2.14.2 *Population dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the North Atlantic right whale.

There are currently two recognized populations of North Atlantic right whales, a western and an eastern population. There are at least 465 individuals in the western North Atlantic population (Waring et al. 2016a). This estimate is based on a review of the photo-identification recapture database as it existed in October 2013 and represents a minimum population size. Less than twenty individuals exist in the eastern North Atlantic, and as such, this population may be functionally extinct (Colligan et al. 2012**).** Pre-exploitation abundance is not available for the species. The western population may have numbered fewer than one hundred individuals by 1935 when international protection for right whales came into effect (Kenney et al. 1995). Little is known about the population dynamics of right whales in the intervening years.

In the western North Atlantic, the species demonstrated overall growth rates of 2.6 percent over the period 1990 to 2010, despite two periods of increased mortality during that time span (Waring et al. 2016a). However, in more recent years, photo-id data indicate the population is now in decline (Kraus et al. 2016).

Analysis of mtDNA from North Atlantic right whales has identified seven mtDNA haplotypes in the western North Atlantic. This is significantly less diverse than southern right whales (*Eubalaena australis*) and may indicate inbreeding. While analysis of historic DNA taken from museum specimens indicates that the eastern and western populations were likely not genetically distinct, the lack of recovery of the eastern North Atlantic population indicates at least some level of population segregation. Overall, the species has low genetic diversity as would be expected based on its low abundance (Waring et al. 2016a).

Today, North Atlantic right whales are primarily found in the western North Atlantic, from their breeding grounds in lower latitudes off the coast of the southeastern U.S. to their feeding grounds in higher latitudes off the coast of Nova Scotia (Waring et al. 2016a). Very few, if any, individuals are thought to make up the population in the eastern Atlantic (Waring et al. 2016a). However, in recent years a few known individuals from the western population have been seen in the eastern Atlantic, suggesting some individuals may have wider ranges than previously thought (Kenney 2009).

4.2.14.3 *Acoustics*

Right whales vocalize to communicate over long distances and for social interaction, including communication apparently informing others of prey path presence (Biedron et al. 2005; Tyson and Nowacek 2005). Vocalization patterns amongst all right whale species are generally similar, with six major call types: scream, gunshot, blow, up call, warble, and down call (McDonald and Moore 2002; Parks and Tyack 2005). A large majority of vocalizations occur in the 300 to 600 Hz range with up and down sweeping modulations (Vanderlaan et al. 2003). Vocalizations below

200 Hz and above 900 Hz were rare (Vanderlaan et al. 2003). Calls tend to be clustered, with periods of silence between clusters (Vanderlaan et al. 2003). Gushot bouts last 1.5 hours on average and up to seven hours (Parks et al. 2012a). Blows are associated with ventilation and are generally inaudible underwater (Parks and Clark 2007). Up calls are 100 to 400 Hz (Gillespie and Leaper 2001). Gushots appear to be largely or exclusively male vocalization (Parks et al. 2005b).

Smaller groups vocalize more than larger groups and vocalization is more frequent at night (Matthews et al. 2001b). Moans are usually produced within 10 m (33 feet) of the surface (Matthews et al. 2001b). Up calls were detected year-round in Massachusetts Bay except July and August and peaking in April (Mussoline et al. 2012). Individuals remaining in the Gulf of Maine through winter continue to call, showing a strong diel pattern of up call and gunshot vocalizations from November through January possibly associated with mating (Bort et al. 2011; Morano et al. 2012; Mussoline et al. 2012). Estimated source levels of gunshots in non-surface active groups are 201 dB re: 1 μPa at 1 m (rms) peak-to-peak (Hotchkin et al. 2011). While in surface active groups, females produce scream calls and males produce up calls and gunshot calls as threats to other males; calves (at least female calves) produce warble sounds similar top their mothers' screams (Parks et al. 2003; Parks and Tyack 2005). Source levels for these calls in surface active groups range from 137 to 162 dB re: 1 μPa at 1 m (rms), except for gunshots, which are 174 to 192 dB re: 1 μPa at 1 m (rms) (Parks and Tyack 2005). Up calls may also be used to reunite mothers with calves (Parks and Clark 2007). Atlantic right whales shift calling frequencies, particularly of up calls, as well as increase call amplitude over both long and short term periods due to exposure to vessel noise (Parks and Clark 2007; Parks et al. 2005a; Parks et al. 2007a; Parks et al. 2011; Parks et al. 2010; Parks et al. 2012b; Parks et al. 2006), particularly the peak frequency (Parks et al. 2009). North Atlantic right whales respond to anthropogenic sound designed to alert whales to vessel presence by surfacing (Nowacek et al. 2003; Nowacek et al. 2004).

There is no direct data on the hearing range of North Atlantic right whales. However, based on anatomical modeling, the hearing range for North Atlantic right whales is predicted to be from 10 Hz-22 kHz with functional ranges probably between 15 Hz-18 kHz (Parks et al. 2007b).

4.2.14.4 *Status*

The North Atlantic right whale is listed under the ESA as endangered. With whaling now prohibited, the two major threats to the survival and recovery of the species are ship strikes and entanglement in fishing gear. Substantial progress has been made in mitigating ship strikes by regulating vessel speeds (78 FR 73726) (Conn and Silber 2013; Waring et al. 2016a), but entanglement in fishing gear remains a major threat (Kraus et al. 2016). In addition, while population trends have been positive since its original listing, the species may now be in decline and its resilience to future perturbations is low due to its small population size.

4.2.14.5 *Critical Habitat*

Critical habitat for North Atlantic right whales was designated in 1994 and expanded in 2016. It includes two major units: Unit 1 located in the Gulf of Maine and Georges Bank Region and Unit 2 located off the coast of North Carolina, South Carolina, Georgia, and Florida (Figure 29). Unit 1 consists of important foraging area and contains the following physical and biological features essential to the conservation of the species: the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate the zooplankton species *Calanus finmarchicus* for right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region. Unit 2 consists of an important calving area and contains the following physical and biological features essential to the conservation of the species: sea surface conditions associated with Force 4 or less on the Beaufort Scale, sea surface temperatures of 7 to 17 °Celsius, and water depths of 6 to 28 meters, where these features simultaneously co-occur over contiguous areas of at least 231 nautical square-miles of ocean waters during the months of November through April.

4.2.14.6 *Recovery Goals*

See the 2005 updated Recovery Plan for the North Atlantic right whale for complete down listing criteria for the following recovery goals:

1. The population ecology (range, distribution, age structure, and gender ratios, etc.) and vital rates (age-specific survival, age-specific reproduction, and lifetime reproductive success) of right whales are indicative of an increasing population;
2. The population has increased for a period of thirty-five years at an average rate of increase equal to or greater than two percent per year;
3. None of the known threats to Northern right whales are known to limit the population’s growth rate; and
4. Given current and projected threats and environmental conditions, the right whale population has no more than a one percent chance of quasi-extinction in one hundred years.

4.2.15 North Pacific Right Whale

North Pacific right whales are found in temperate and sub-polar waters of the North Pacific Ocean (Figure 31).

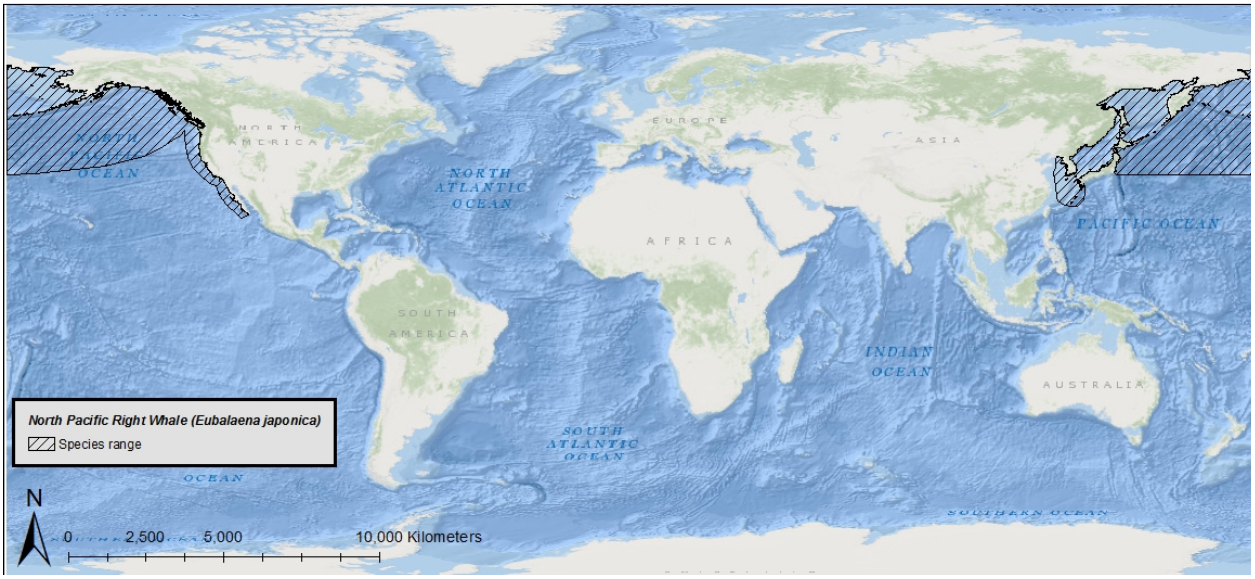

Figure 31: Map identifying the range of the North Pacific right whale.

The North Pacific right whale is a baleen whale found only in the North Pacific Ocean and is distinguishable by a stocky body, lack of dorsal fin, generally black coloration, and callosities on the head region (Figure 32). The species was originally listed with the North Atlantic right whale (i.e., "Northern" right whale) as endangered on December 2, 1970. The North Pacific right whale was listed separately as endangered on March 6, 2008 (Table 23).

Figure 32: North Pacific right whale. Photo: National Oceanic and Atmospheric Administration

Table 23: North Pacific right whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Eubalaena japonica	North Pacific right whale	None	Endangered	2012	73 FR 12024	2013	73 FR 19000

Information available from the recovery plan (NMFS 2013a) recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016a), and status review (NMFS 2012a) were used to summarize the life history, population dynamics and status of the species as follows.

4.2.15.1 *Life History*

North Pacific right whales can live, on average, 50 or more years. They have a gestation period of approximately one year, and calves nurse for approximately one year. Sexual maturity is reached between nine and 10 years of age. The reproduction rate of North Pacific right whales remains unknown. However, it is likely low due to a male-biased sex ratio that may make it difficult for females to find viable mates. North Pacific right whales mostly inhabit coastal and continental shelf waters. Little is known about their migration patterns, but they have been observed in lower latitudes during winter (Japan, California, and Mexico) where they likely calve and nurse. In the summer, they feed on large concentrations of copepods in Alaskan waters. North Pacific right whales are unique compared to other baleen whales in that they are skim feeders meaning they continuously filtering through their baleen while moving through a patch of zooplankton.

4.2.15.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the North Pacific right whale.

The North Pacific right whale remains one of the most endangered whale species in the world. Their abundance likely numbers fewer than 1,000 individuals. There are two currently recognized stocks of North Pacific right whales, a Western North Pacific stock that feeds primarily in the Sea of Okhotsk, and an Eastern North Pacific stock that feeds eastern north Pacific waters off Alaska, Canada, and Russia. Several lines of evidence indicate a total population size of less than 100 for the Eastern North Pacific stock. Based on photo-identification from 1998 to 2013 (Wade et al. 2011) estimated 31 individuals, with a minimum population estimate of 25.7 individuals. Genetic data have identified 23 individuals based on samples collected between 1997 and 2011 (Leduc et al. 2012). The Western North Pacific stock is likely more abundant and was estimated to consist of 922 whales (95 percent confidence intervals 404 to 2,108) based on data collected in 1989, 1990, and 1992 (IWC 2001; Thomas et al. 2016). While there have been several sightings of Western North Pacific right whales in recent years, with one sighting identifying at least 77 individuals, these data have yet to be compiled to provide a more recent abundance estimate (Thomas et al. 2016). There is currently no information on population trends for either stock of North Pacific right whales.

As a result of past commercial whaling, the remnant population of North Pacific right whales has been left vulnerable to genetic drift and inbreeding due to low genetic variability. This low diversity potentially affects individuals by depressing fitness, lowering resistance to disease and parasites, and diminishing the whales' ability to adapt to environmental changes. At the population level, low genetic diversity can lead to slower growth rates, lower resilience, and poorer long-term fitness (Lacy 1997). Marine mammals with an effective population size of a few dozen individuals likely can resist most of the deleterious consequences of inbreeding (Lande 1991). It has also been suggested that if the number of reproductive animals is fewer than fifty, the potential for impacts associated with inbreeding increases substantially. Rosenbaum et al. (2000) found that historic genetic diversity of North Pacific right whales was relatively high compared to North Atlantic right whales, but samples from extant individuals showed very low genetic diversity, with only two matrilineal haplotypes among the five samples in their dataset.

The North Pacific right whale inhabits the Pacific Ocean, particularly between 20° and 60° latitude (Figure 31). Prior to exploitation by commercial whalers, concentrations of right whales in the North Pacific where found in the Gulf of Alaska, Aleutian Islands, south central Bering Sea, Sea of Okhotsk, and Sea of Japan. There has been little recent sighting data of right whales occurring in the central North Pacific and Bering Sea. However, since 1996, North Pacific right whales have been consistently observed in Bristol Bay and the southeastern Bering Sea during summer months. In the Western North Pacific where the population is thought to be somewhat larger, right whales have been sighted in the Sea of Okhotsk and other areas off the coast of Japan, Russia, and South Korea (Thomas et al. 2016). Although North Pacific right whales are typical found in higher latitudes, they are thought to migrate to more temperate waters during winter to reproduce, and have been sighted as far south as Hawaii and Baja California.

4.2.15.3 *Acoustics*

Given their extremely small population size and remote location, little is known about North Pacific right whale vocalizations (Marques et al. 2011). However, data from other right whales is informative. Right whales vocalize to communicate over long distances and for social interaction, including communication apparently informing others of prey path presence (Biedron et al. 2005; Tyson and Nowacek 2005). Vocalization patterns amongst all right whale species are generally similar, with six major call types: scream, gunshot, blow, up call, warble, and down call (McDonald and Moore 2002; Parks and Tyack 2005). A large majority of vocalizations occur in the 300 to 600 Hz range with up and down sweeping modulations (Vanderlaan et al. 2003). Vocalizations below 200 Hz and above 900 Hz were rare (Vanderlaan et al. 2003). Calls tend to be clustered, with periods of silence between clusters (Vanderlaan et al. 2003). Gushot bouts last 1.5 hours on average and up to seven hours (Parks et al. 2012a). Blows are associated with ventilation and are generally inaudible underwater (Parks and Clark 2007). Up calls are 100 to 400 Hz (Gillespie and Leaper 2001). Gushots appear to be largely or exclusively male vocalization (Parks et al. 2005b).

Smaller groups vocalize more than larger groups and vocalization is more frequent at night (Matthews et al. 2001b). Moans are usually produced within 10 m (33 feet) of the surface (Matthews et al. 2001b). Up calls were detected year-round in Massachusetts Bay except July and August and peaking in April (Mussoline et al. 2012). Individuals remaining in the Gulf of Maine through winter continue to call, showing a strong diel pattern of up call and gunshot vocalizations from November through January possibly associated with mating (Bort et al. 2011; Morano et al. 2012; Mussoline et al. 2012). Estimated source levels of gunshots in non-surface active groups are 201 dB re: 1 μPa at 1 m (rms) peak-to-peak (Hotchkin et al. 2011). While in surface active groups, females produce scream calls and males produce up calls and gunshot calls as threats to other males; calves (at least female calves) produce warble sounds similar top their mothers' screams (Parks et al. 2003; Parks and Tyack 2005). Source levels for these calls in surface active groups range from 137 to 162 dB re: 1 μPa at 1 m (rms), except for gunshots, which are 174 to 192 dB re: 1 μPa at 1 m (rms) (Parks and Tyack 2005). Up calls may also be used to reunite mothers with calves (Parks and Clark 2007). Atlantic right whales shift calling frequencies, particularly of up calls, as well as increase call amplitude over both long and short term periods due to exposure to vessel noise (Parks and Clark 2007; Parks et al. 2005a; Parks et al. 2007a; Parks et al. 2011; Parks et al. 2010; Parks et al. 2012b; Parks et al. 2006), particularly the peak frequency (Parks et al. 2009). North Atlantic right whales respond to anthropogenic sound designed to alert whales to vessel presence by surfacing (Nowacek et al. 2003; Nowacek et al. 2004).

There is no direct data on the hearing range of North Pacific right whales. However, based on anatomical modeling, the hearing range for North Atlantic right whales is predicted to be from 10 Hz-22 kHz with functional ranges probably between 15 Hz-18 kHz (Parks et al. 2007b).

4.2.15.4 *Status*

The North Pacific right whale is endangered as a result of past commercial whaling. Prior to commercial whaling, abundance has been estimated to have been more than 11,000 individuals. Current threats to the survival of this species include hunting, vessel strikes, climate change, and fisheries interactions (including entanglement). The resilience of North Pacific right whales to future perturbations is low due to its small population size and continued threats. Recovery is not anticipated in the foreseeable future (several decades to a century or more) due to small population size and lack of available current information.

4.2.15.5 *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 (Figure 33). 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 physical and biological features (previously referred to as primary constituent elements), which include: nutrients, physical oceanographic processes, certain species of zooplankton, and a long photoperiod due to the high latitude. Consistent North Pacific right whale sightings are a proxy for locating these elements.

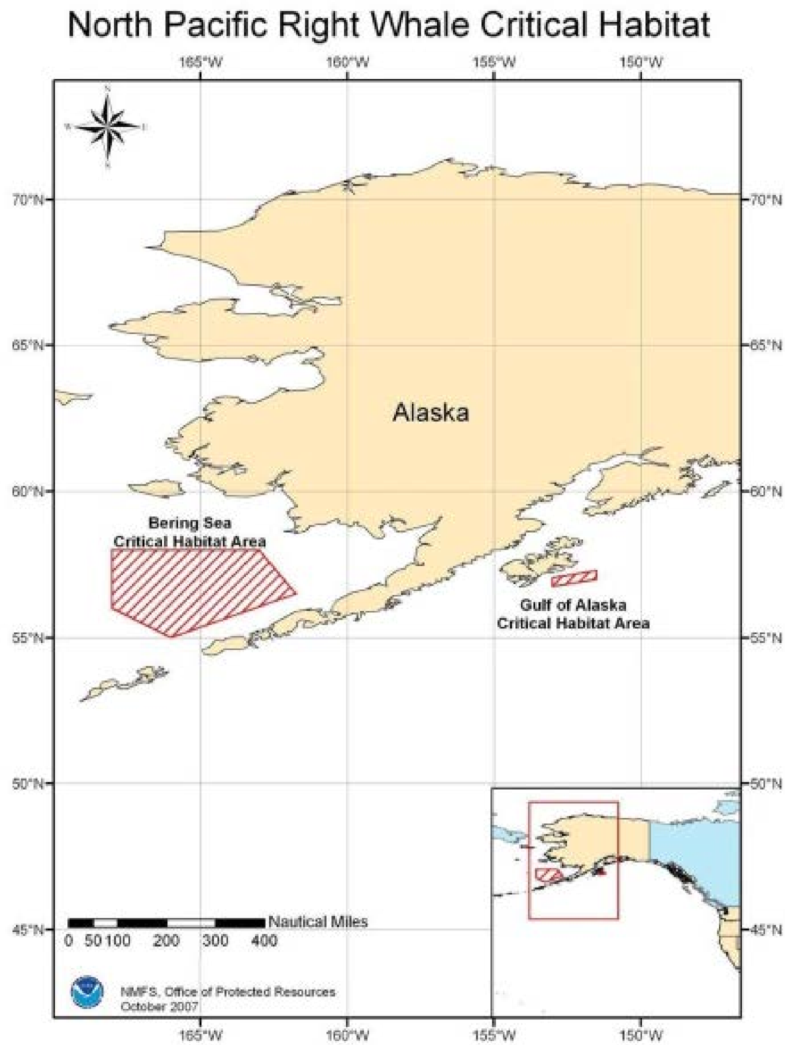

Figure 33: Map identifying designated critical habitat for the North Pacific right whale in the Southeast Bering Sea and south of Kodiak Island in the Gulf of Alaska.

4.2.15.6 *Recovery Goals*

See the 2013 Final Recovery Plan for the North Pacific right whale for complete down listing/delisting criteria for both of the following recovery goals.

1. Achieve sufficient and viable populations in all ocean basins.
2. Ensure significant threats are addressed.

4.2.16 Sei Whale

The sei whale is a widely distributed baleen whale found in all major oceans (Figure 34).

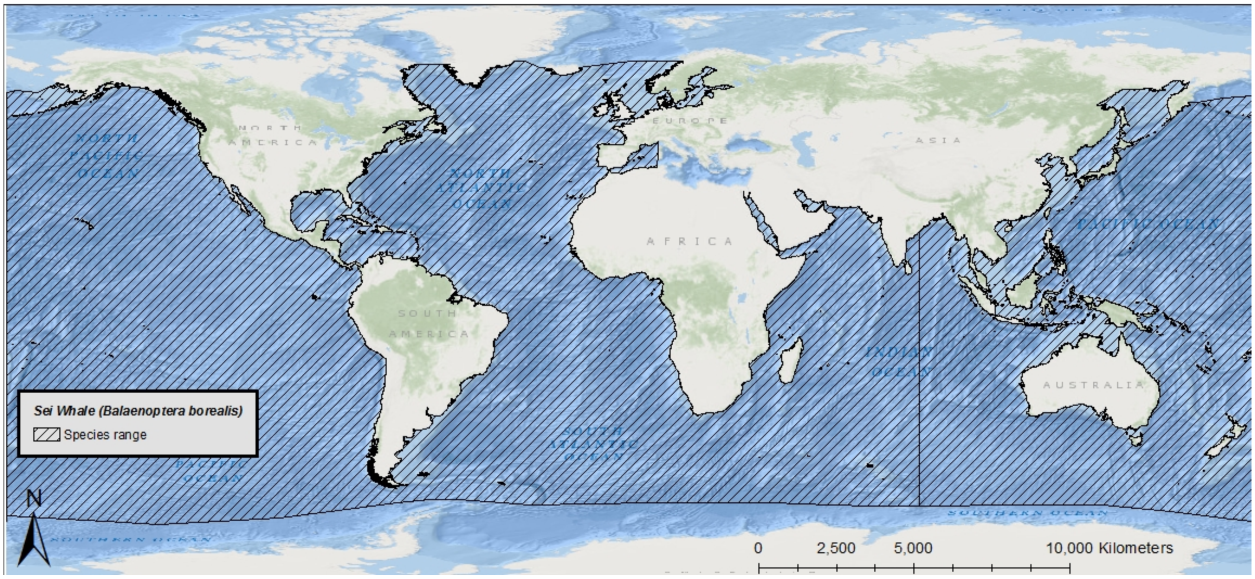

Figure 34: Map showing the range of the sei whale.

Sei whales are distinguishable from other whales by a long, sleek body that is dark bluish-gray to black in color and pale underneath, and a single ridge located on their rostrum (Figure 35). The sei whale was originally listed as endangered on December 2, 1970 (Table 24). Information available from the recovery plan (NMFS 2011c), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016a), and status review (NMFS 2012e) were used to summarize the status of the species as follows.

Figure 35: Sei whale. Photo: National Oceanic and Atmospheric Administration

Table 24: Sei whale information bar provides species Latin name, common name, Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan for sei whale.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Balaenoptera borealis	Sei whale	None	Endangered	2012	35 FR 18319	2011	None Designated

4.2.16.1 *Life History*

Sei whales can live, on average, between 50 to 70 years. They have a gestation period of 10 to 12 months, and calves nurse for six to nine months. Sexual maturity is reached between six and 12 years of age with an average calving interval of two to three years. Sei whales mostly inhabit continental shelf and slope waters far from the coastline. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed on a range of prey types, including zooplankton (copepods and krill), small schooling fishes, and cephalopods.

4.2.16.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the sei whale.

Two subspecies of sei whale are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere. There are no estimates of pre-exploitation abundance for sei whales in the North Atlantic. Models indicate that total abundance declined from 42,000 to 8,600 between 1963 and 1974 in the North Pacific. More recently, the North Pacific population was estimated to be 29,632 (95 percent confidence intervals 18,576 to 47,267) between 2010 and 2012 (IWC 2016; Thomas et al. 2016). In the Southern Hemisphere, pre-exploitation abundance is estimated at 65,000 whales, with recent abundance estimated ranging from 9,800 to 12,000. Three relatively small stocks occur in U.S. waters: Nova Scotia (N=357, N_{min}=236), Hawaii (N=178, N_{min}=93), and Eastern North Pacific (N=126, N_{min}=83). Population growth rates for sei whales are not available at this time as there are little to no systematic survey efforts to study sei whales.

While some genetic data exist sei whales, current samples sizes are small limiting our confidence in their estimates of genetic diversity (NMFS 2011c). However, genetic diversity information for similar cetacean population sizes can be applied. Stocks that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Stocks that have a total population 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Stock populations at low densities (less than 100) are more likely to suffer from the 'Allee' effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. All stocks of sei whales within U.S. waters are estimated to be below 500 individuals indicating they may be at risk of extinction due to inbreeding.

Sei whales are distributed worldwide, occurring in the North Atlantic, North Pacific, and Southern Hemisphere (Figure 34).

4.2.16.3 *Acoustics*

Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100 to 600 Hz range with 1.5 second duration and tonal and upsweep calls in the 200 to 600 Hz range of one to three second durations (McDonald et al. 2005). Vocalizations from the North Atlantic consisted of paired sequences (0.5 to 0.8 seconds, separated by 0.4 to 1.0 seconds) of 10 to 20 short (4 milliseconds) FM sweeps between 1.5 and 3.5 kHz (Thomson and Richardson 1995b). Source levels of 189 ±5.8 dB re: 1 μPa at 1 m (rms) have been established for sei whales in the northeastern Pacific (Weirathmueller et al. 2013). It is presumed sei whales hear in the same frequencies bands in which they vocalize, and are likely most sensitive to sounds in this frequency range.

4.2.16.4 *Status*

The sei whale is endangered as a result of past commercial whaling. Now, only a few individuals are taken each year by Japan; however, Iceland has expressed an interest in targeting sei whales. Current threats include vessel strikes, fisheries interactions (including entanglement), climate change (habitat loss and reduced prey availability), and anthropogenic sound. Given the species' overall abundance, they may be somewhat resilience to current threats. However, trends are largely unknown, especially for individual stocks, many of which have relatively low abundance estimates.

4.2.16.5 *Critical Habitat*

No critical habitat has been designated for the sei whale.

4.2.16.6 *Recovery Goals*

See the 2011 Final Recovery Plan for the sei whale for complete down listing/delisting criteria for both of the following recovery goals:

1. Achieve sufficient and viable populations in all ocean basins.
2. Ensure significant threats are addressed.

4.2.17 Southern Right Whale

Southern right whales are a large baleen whale species distributed in the Southern Hemisphere worldwide form 20° to 60° South (Figure 36).

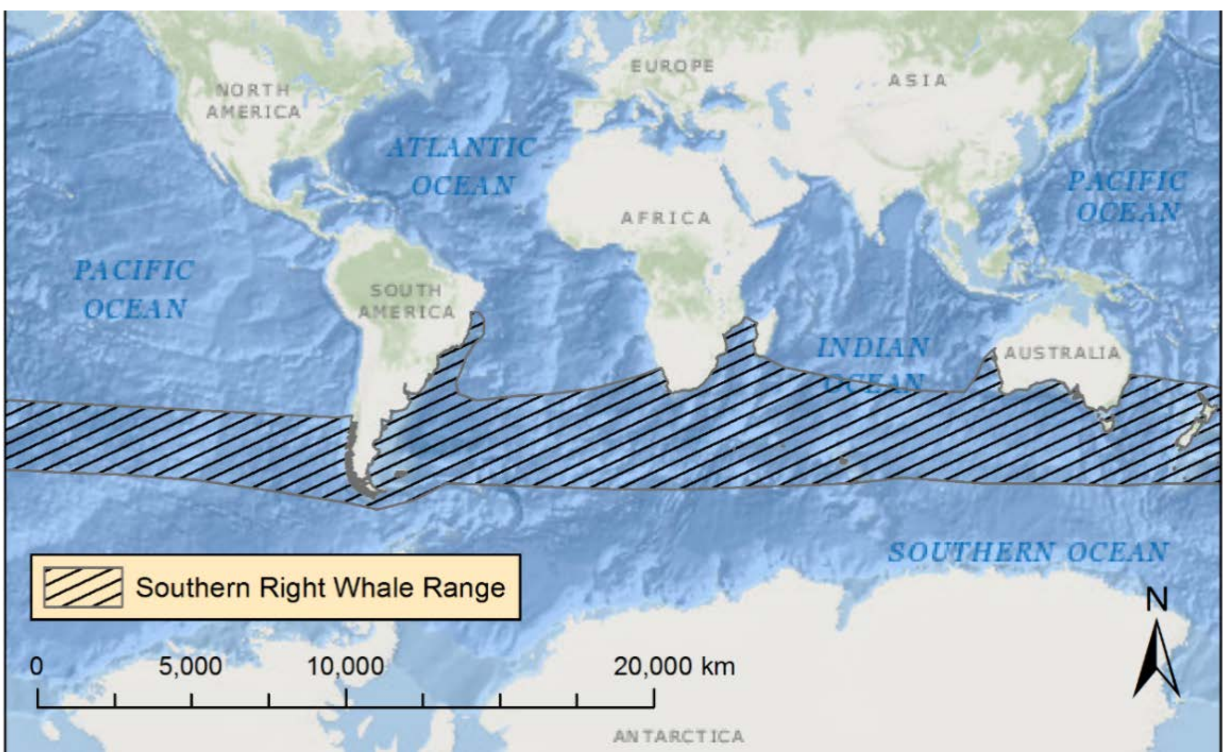

Figure 36. Map identifying the range of the southern right whale.

Southern right whales have a stocky, black body lacking a dorsal fin and a large head covered in callosities (Figure 37). They range in length between 13 to 17 meters, and weigh up to 54,431 kilograms. The southern right whale was listed as endangered under the Endangered Species Preservation Act on June 2, 1970, and this listing was carried over when the ESA was enacted (Table 25).

Figure 37: Southern right whale surfacing. Photo: Michaël Catanzariti

Table 25. Southern right whale information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Eubalaena australis	Southern Right Whale	None	Endangered	2015	35 FR 8491	None	None Designated

We used information available in the 2015 Status Review (NMFS 2015d) and the IWC Commission's 2012 Report on the Assessment of Southern Right Whales (IWC 2012) to summarize the life history, population dynamics and status of this species, as follows.

4.2.17.1 *Life History*

The lifespan of southern right whales is currently unknown but likely similar to North Pacific and North Atlantic right whales, who are believed to live to around 50 years old. Females usually give birth to their first calf between eight and 10 years old and gestation takes approximately one year. Offspring wean at approximately one year of age, and females reproduce every three to four years. Southern right whales feed during austral summer in high latitude feeding grounds in the Southern Ocean, where they use their baleen to "skim" copepods and krill from the water. Mating likely occurs in winter in the low latitude breeding and calving grounds.

4.2.17.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the southern right whale.

In 2010, there were an estimated 15,000 southern right whales world-wide; this is over twice the species estimate of 7,000 in 1997. The population structure for southern right whales is uncertain, but some separation to the population level exists. Breeding populations can be delineate based on geographic region: South Africa, Argentina, Brazil, Peru and Chile, Australia, and New Zealand. Population estimates for all of the breeding populations are not available. There are about 3,500 southern right whales in the Australia breeding population, about 4,000 in Argentina, 4,100 in South Africa, and 2,169 in New Zealand. Other smaller southern right whale populations occur off Tristan da Cunha, South Georgia, Namibia, Mozambique and Uruguay, but not much is known about the population abundance of these groups.

The Australia, South Africa and Argentina breeding stocks of southern right whales are increasing at an estimated seven percent annually. The Brazil breeding population is increasing, while the status of the Peru and Chile breeding population is unknown (NMFS 2015d). The New Zealand breeding population is showing signs of recovery; recent population modeling estimates the population growth rate at 5.6 percent (Davidson 2016). Juveniles in New Zealand show high apparent annual survival rates, between 0.87 and 0.95 percent (Carroll et al. 2016).

Mitochondrial DNA analysis of southern right whales indicates at least 37 unique haplotypes and greater genetic diversity in the South Atlantic than in the Indo-Pacific (Patenaude et al. 2007). Females exhibit high site fidelity to calving grounds, restricting gene flow and establishing geographic breeding populations. Recent genetic testing reveals the possibility that individuals from different ocean basins are mixing on the Antarctic feeding grounds (Kanda et al. 2014).

Southern right whales are found in the Southern Hemisphere from temperate to polar waters, favoring shallow waters less than twenty meters deep. Southern right whales migrate between winter breeding areas in coastal waters of the South Atlantic, Pacific, and Indian Oceans from May to December and offshore summer (January to April) foraging locations in the Subtropical and Antarctic Convergence zones (Figure 36).

4.2.17.3 *Acoustics*

Data on Southern right whale vocalizations indicates that they exhibit similar acoustic behavior to other right whales (Clark 1982; Matthews et al. 2001a). Right whales vocalize to communicate over long distances and for social interaction, including communication apparently informing others of prey path presence (Biedron et al. 2005; Tyson and Nowacek 2005). Vocalization patterns amongst all right whale species are generally similar, with six major call types: scream, gunshot, blow, up call, warble, and down call (McDonald and Moore 2002; Parks and Tyack 2005). A large majority of vocalizations occur in the 300 to 600 Hz range with up and down sweeping modulations (Vanderlaan et al. 2003). Vocalizations below 200 Hz and above 900 Hz were rare (Vanderlaan et al. 2003). Calls tend to be clustered, with periods of silence between clusters (Vanderlaan et al. 2003). Gushot bouts last 1.5 hours on average and up to seven hours (Parks et al. 2012a). Blows are associated with ventilation and are generally inaudible underwater (Parks and Clark 2007). Up calls are 100 to 400 Hz (Gillespie and Leaper 2001). Gushots appear to be largely or exclusively male vocalization (Parks et al. 2005b).

Smaller groups vocalize more than larger groups and vocalization is more frequent at night (Matthews et al. 2001b). Moans are usually produced within 10 m (33 feet) of the surface (Matthews et al. 2001b). Up calls were detected year-round in Massachusetts Bay except July and August and peaking in April (Mussoline et al. 2012). Individuals remaining in the Gulf of Maine through winter continue to call, showing a strong diel pattern of up call and gunshot vocalizations from November through January possibly associated with mating (Bort et al. 2011; Morano et al. 2012; Mussoline et al. 2012). Estimated source levels of gunshots in non-surface active groups are 201 dB re: 1 μPa at 1 m (rms) peak-to-peak (Hotchkin et al. 2011). While in surface active groups, females produce scream calls and males produce up calls and gunshot calls as threats to other males; calves (at least female calves) produce warble sounds similar top their mothers' screams (Parks et al. 2003; Parks and Tyack 2005). Source levels for these calls in surface active groups range from 137 to 162 dB re: 1 μPa at 1 m (rms), except for gunshots, which are 174 to 192 dB re: 1 μPa at 1 m (rms) (Parks and Tyack 2005). Up calls may also be used to reunite mothers with calves (Parks and Clark 2007). Atlantic right whales shift calling frequencies, particularly of up calls, as well as increase call amplitude over both long and short term periods due to exposure to vessel noise (Parks and Clark 2007; Parks et al. 2005a; Parks et al. 2007a; Parks et al. 2011; Parks et al. 2010; Parks et al. 2012b; Parks et al. 2006), particularly the peak frequency (Parks et al. 2009). North Atlantic right whales respond to anthropogenic sound designed to alert whales to vessel presence by surfacing (Nowacek et al. 2003; Nowacek et al. 2004).

There is no direct data on the hearing range of Southern right whales. However, based on anatomical modeling, the hearing range for North Atlantic right whales is predicted to be from 10 Hz-22 kHz with functional ranges probably between 15 Hz-18 kHz (Parks et al. 2007b).

4.2.17.4 *Status*

Southern right whales underwent severe decline due to whaling during the eighteenth and nineteenth centuries (NMFS 2015d). In general, southern right whale populations appear to be increasing at a robust rate. Nonetheless, the current population estimate (15,000) is still much less than the estimated 60,000 pre-whaling estimate (NHT 2005). Southern right whales are currently subject to many of the same anthropogenic threats other large whales face. In the Southern Hemisphere, southern right whales are by far the most vessel struck cetacean, with at least 56 reported instances; nearly four-fold higher than the second most struck large whale (Van Waerebeek et al. 2007). Additional threats include declines in water quality, pollutant exposure and near shore habitat degradation from development. Reproductive success is influenced by krill availability on the feeding grounds; therefore, climatic shifts that change krill abundance may hinder the recovery of southern right whales (Seyboth et al. 2016). Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats, but it has not recovered to pre-exploitation abundance.

4.2.17.5 *Critical Habitat*

No critical habitat has been designated for the southern right whale. NMFS cannot designate critical habitat in foreign waters.

4.2.17.6 *Recovery Goals*

NMFS has not prepared a Recovery Plan for the southern right whale. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.18 Sperm Whale

The sperm whale is a widely distributed toothed whale found in all major oceans (Figure 38).

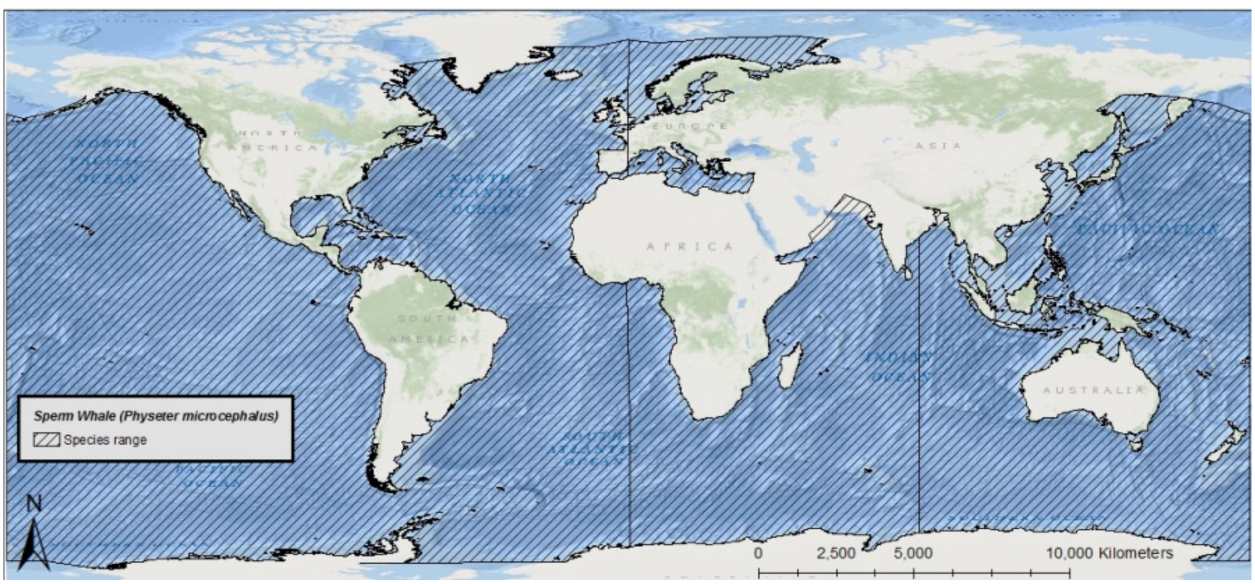

Figure 38: Map showing the range of the sperm whale.

They are the largest toothed whale and distinguishable from other whales by an extremely large head, which takes up to 25 to 35 percent of their total body length, and a single blowhole asymmetrically situated on the left side of the head near the tip (Figure 39). The sperm whale was originally listed as endangered on December 2, 1970 (Table 26). Information available from the recovery plan (NMFS 2010b), recent stock assessment reports (Carretta et al. 2016; Muto et al. 2016; Waring et al. 2016a), and status review (NMFS 2015e) were used to summarize the status of the species as follows.

Figure 39: Sperm whale. Photo: National Oceanic and Atmospheric Administration

Table 26: Sperm whale information bar provides species Latin name, common name, current and proposed Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Physeter microcephalus	Sperm whale	None	Endangered: range-wide	2015	35 FR 18319	2010	None Designated

4.2.18.1 *Life History*

The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years. Sexual maturity is reached between seven to 13 years of age for females with an average calving interval of four to six years. Male sperm whales reach full sexual maturity in their twenties. Sperm whales mostly inhabit areas with a water depth of 600 meters or more, and are uncommon in waters less than 300 meters deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid; other prey include octopus and demersal fish (including teleosts and elasmobranchs).

4.2.18.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the sperm whale.

The sperm whale is the most abundant of the large whale species, with total abundance estimates between 200,000 and 1,500,000. The most recent estimate indicated a global population of between 300,000 and 450,000 individuals (Whitehead 2009). The higher estimates may be approaching population sizes prior to commercial whaling, the reason for ESA listing. There are no reliable estimates for sperm whale abundance across the entire Atlantic Ocean. However, estimates are available for two of the three U.S. stocks in the Atlantic, the Northern Gulf of Mexico stock, estimated to consists of 763 individuals (N_{min}=560) and the North Atlantic stock, underestimated to consists of 2,288, individuals (N_{min}=1,815). There are insufficient data to estimate abundance for the Puerto Rico and the U.S. Virgin Islands stock. In the northeast Pacific, the abundance of sperm whales was estimated to be between 26,300 and 32,100 in 1997. In the eastern tropical Pacific, the abundance of sperm whales was estimated to be 22,700 (95 percent confidence intervals 14,800 to 34,600) in 1993. Population estimates are also available for two of the three U.S. stocks that occur in the Pacific, the California/Oregon/Washington stock, estimated to consist of 2,106 individuals (N_{min}=1,332), and the Hawaii stock, estimated to consist of 3,354 individuals (N_{min}=2,539). There are insufficient data to estimate the population abundance of the North Pacific stock. We are aware of no reliable abundance estimates specifically for sperm whales in the South Pacific, and there is insufficient data to evaluate trends in abundance and growth rates of sperm whale populations at this time.

Ocean-wide genetic studies indicate sperm whales have low genetic diversity, suggesting a recent bottleneck, but strong differentiation between matrilineally related groups (Lyrholm and Gyllensten 1998). Consistent with this, two studies of sperm whales in the Pacific indicate low genetic diversity (Mesnick et al. 2011; Rendell et al. 2012). Furthermore, sperm whales from the Gulf of Mexico, the western North Atlantic, the North Sea, and the Mediterranean Sea all have been shown to have low levels of genetic diversity (Engelhaupt et al. 2009). As none of the stocks for which data are available have high levels of genetic diversity, the species may be at some risk to inbreeding and 'Allee' effects, although the extent to which is currently unknown.

Sperm whales have a global distribution and can be found in relatively deep waters in all ocean basins (Figure 38). While both males and females can be found in latitudes less than 40°, only adult males venture into the higher latitudes near the poles.

4.2.18.3 *Acoustics*

Sound production and reception by sperm whales are better understood than in most cetaceans. Sperm whales produce broadband clicks in the frequency range of 100 Hz to 20 kHz that can be extremely loud for a biological source (200 to 236 dB re: 1 µPa at 1 m [rms]), although lower source level energy has been suggested at around 171 dB re: 1 µPa at 1 m (rms) (Goold and Jones 1995; Møhl et al. 2003; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997a). Most of energy in sperm whale clicks is concentrated around 2 to 4 kHz and 10 to 16 kHz (Goold and Jones 1995; NMFS 2006d; Weilgart and Whitehead 1993). The highly asymmetric head anatomy of sperm whales is likely an adaptation to produce the unique clicks recorded from these animals (Cranford 1992; Norris and Harvey 1972; Norris and Harvey. 1972). Long, repeated clicks are associated with feeding and echolocation (Goold and Jones 1995; Weilgart and Whitehead 1993; Weilgart and Whitehead 1997a). However, clicks are also used in short patterns (codas) during social behavior and intragroup interactions (Weilgart and Whitehead 1993). They may also aid in intra-specific communication. Another class of sound, "squeals," are produced with frequencies of 100 Hz to 20 kHz (e.g., Weir et al. 2007).

Our understanding of sperm whale hearing stems largely from the sounds they produce. The only direct measurement of hearing was from a young stranded individual from which auditory evoked potentials were recorded (Carder and Ridgway 1990). From this whale, responses support a hearing range of 2.5 to 60 kHz. However, behavioral responses of adult, free-ranging individuals also provide insight into hearing range; sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echo sounders and submarine sonar (Watkins et al. 1985a; Watkins and Schevill 1975a). They also stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Because they spend large amounts of time at depth and use low frequency sound, sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll et al. 1999).

Recordings of sperm whale vocalizations reveal that they produce a variety of sounds, such as clicks, gunshots, chirps, creaks, short trumpets, pips, squeals, and clangs (Goold 1999). Sperm whales typically produce short duration repetitive broadband clicks with frequencies below 100 Hz to greater than 30 kHz (Watkins 1977) and dominant frequencies between 1 to 6 kHz and 10 to 16 kHz. The source levels can reach 236 dB re: 1 µPa at 1 m (rms) (Mohl et al. 2003). The clicks of neonate sperm whales are very different from typical clicks of adults in that they are of low directionality, long duration, and low frequency (between 300 Hz and 1.7 kHz) with estimated source levels between 140 to 162 dB re: 1 µPa at 1 m (rms) (Madsen et al. 2003). Clicks are heard most frequently when sperm whales are engaged in diving and foraging behavior (Miller et al. 2004; Whitehead and Weilgart 1991). Creaks (rapid sets of clicks) are heard most frequently when sperm whales are foraging and engaged in the deepest portion of their dives, with inter-click intervals and source levels being altered during these behaviors (Laplanche et al. 2005; Miller et al. 2004).

When sperm whales are socializing, they tend to repeat series of group-distinctive clicks (codas), which follow a precise rhythm and may last for hours (Watkins and Schevill 1977). Codas are shared between individuals in a social unit and are considered to be primarily for intragroup communication (Rendell and Whitehead 2004; Weilgart and Whitehead 1997b). Recent research in the South Pacific Ocean suggests that in breeding areas the majority of codas are produced by mature females (Marcoux et al. 2006). Coda repertoires have also been found to vary geographically and are categorized as dialects, similar to those of killer whales (Pavan et al. 2000; Weilgart and Whitehead 1997b). For example, significant differences in coda repertoire have been observed between sperm whales in the Caribbean Sea and those in the Pacific Ocean (Weilgart and Whitehead 1997b). Three coda types used by male sperm whales have recently been described from data collected over multiple years: these codas associated with dive cycles, socializing, and alarm (Frantzis and Alexiadou 2008).

Direct measures of sperm whale hearing have been conducted on a stranded neonate using the auditory brainstem response technique: the whale showed responses to pulses ranging from 2.5 to 60 kHz and highest sensitivity to frequencies between five to 20 kHz (Ridgway and Carder 2001). Other hearing information consists of indirect data. For example, the anatomy of the sperm whale's inner and middle ear indicates an ability to best hear high-frequency to ultrasonic hearing (Ketten 1992a). The sperm whale may also possess better low-frequency than other odontocetes, although not as low as many baleen whales (Ketten 1992a). Reactions to anthropogenic sounds can provide indirect evidence of hearing capability, and several studies have made note of changes seen in sperm whale behavior in conjunction with these sounds. For example, sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echo sounders and submarine sonar (Watkins et al. 1985b; Watkins and Schevill 1975b). In the Caribbean, Watkins et al. (1985b) observed that sperm whales exposed to 3.25 to 8.4 kHz pulses (presumed to be from submarine sonar) interrupted their activities and left the area. Similar reactions were observed from artificial noise generated by banging on a boat hull (Watkins et al. 1985b). André et al. (1997) reported that foraging whales exposed to a 10 kHz pulsed signals did not ultimately exhibit any general avoidance reactions: when resting at the surface in a compact group, sperm whales initially reacted strongly, and then ignored the signal completely (André et al. 1997). Thode et al. (2007) observed that the acoustic signal from the cavitation of a fishing vessel's propeller (110 dB re: 1 μPa^2 between 250 Hz and 1 kHz) interrupted sperm whale acoustic activity and resulted in the animals converging on the vessel. The full range of functional hearing for the sperm whale is estimated to occur between approximately 150 Hz and 160 kHz, placing them among the group of cetaceans that can hear mid-frequency sounds (Southall et al. 2007).

A sperm whale was tagged for a controlled exposure experiment during SOCAL BRS 2010. The sperm whale did not appear to demonstrate obvious behavioral changes in dive pattern or production of clicks (Miller et al. 2012b; Sivle et al. 2012; Southall et al. 2011b).

4.2.18.4 *Status*

The sperm whale is endangered as a result of past commercial whaling. Although the aggregate abundance worldwide is probably at least several hundred thousand individuals, the extent of depletion and degree of recovery of populations are uncertain. Commercial whaling is no longer allowed, but illegal hunting may occur at biologically unsustainable levels. Continued threats to sperm whale populations include vessel strikes, entanglement in fishing gear, competition for resources due to overfishing, pollution, loss of prey and habitat due to climate change, and noise. The species' large population size indicates it is somewhat resilient to current threats.

4.2.18.5 *Critical Habitat*

No critical habitat has been designated for the sperm whale.

4.2.18.6 *Recovery Goals*

See the 2010 Final Recovery Plan for the sperm whale for complete down listing/delisting criteria for both of the following recovery goals:

1. Achieve sufficient and viable populations in all ocean basins.
2. Ensure significant threats are addressed.

4.2.19 Bearded Seal (Beringia and Okhotsk Distinct Population Segments)

Two subspecies of bearded seals are recognized by NMFS: *Erignathus barbatus nauticus* in the Pacific and *Erignathus barbatus* in the Atlantic (Figure 40). Bearded seals in the Pacific are distributed from 85º N south to Sakhalin Island (45º N), including the Chukchi, Bering and Okhotsk Seas.

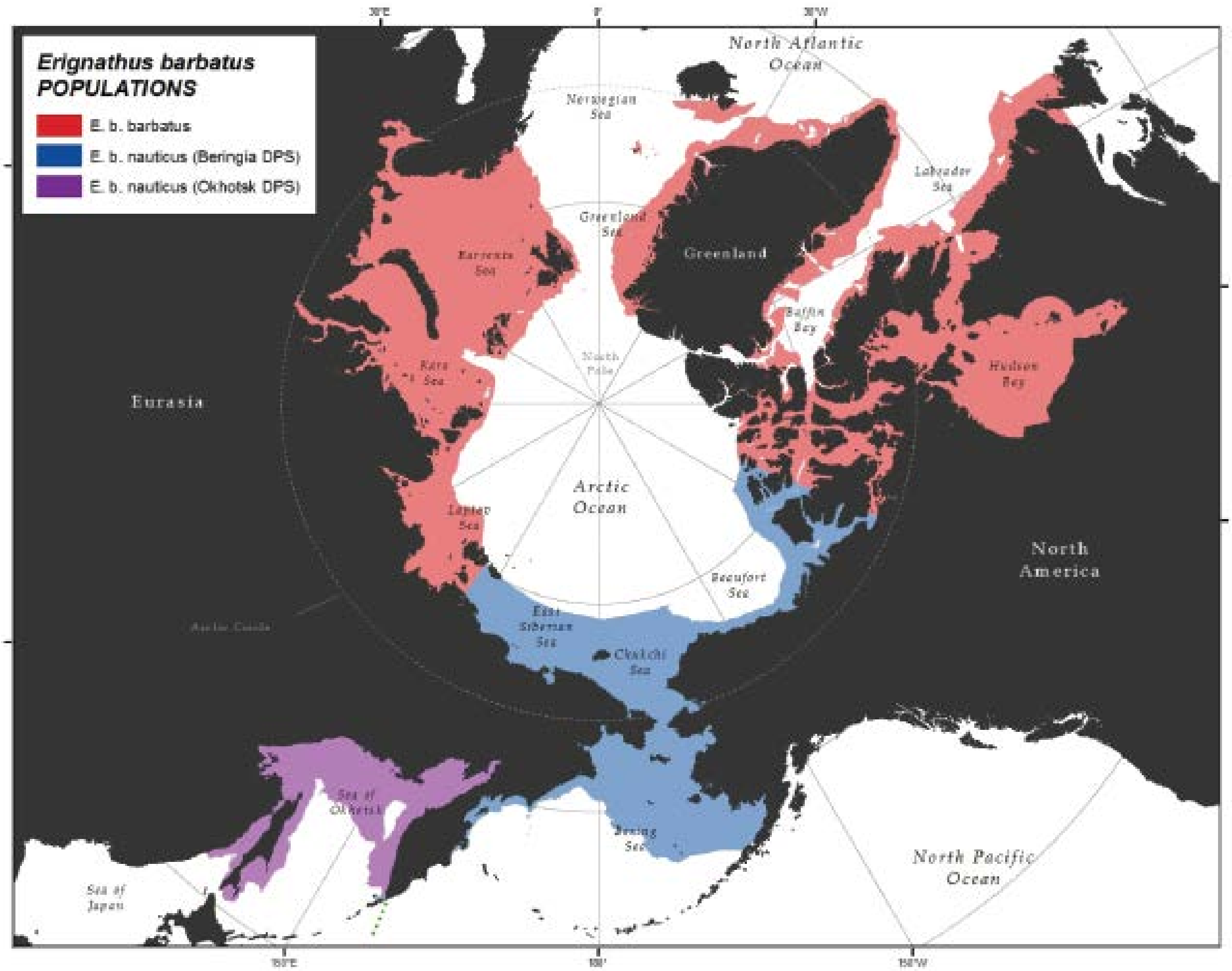

Figure 40. Map identifying the range of the two sub-species of bearded seal, *Erignathus barbatus* and *E. b. nauticus*, and the Beringia and Okhotsk distinct population segments. From Cameron et al. (2010).

Bearded seals are distinguished by their small head, small square foreflippers, and thick, long, white whiskers that have resulted in the name "bearded." Pups have lighter markings on the face, resembling a "T" (Figure 41). The bearded seal is divided into two subspecies, with the Pacific subspecies (*E. b. nauticus*) further divided into two geographically and ecologically discrete DPSs; the Beringia DPS and the Okhotsk DPS. On December 20, 2012, the NMFS issued a final determination to list the Beringia DPS and Okhotsk DPS as threatened under the ESA (Table 27). The U.S. District Court for the District of Alaska issued a decision that vacated the ESA listing of the Beringia DPS of bearded seals on July 25, 2014 (Alaska Oil and Gas Association v. Pritzker, Case No. 4:13-cv-00018-RPB). The NMFS appealed that decision. On October 24, 2016, the Ninth Circuit Court ruled that the listing decision is reasonable, and the threatened status of the Beringia DPS bearded seal was upheld.

Figure 41: Bearded seal. Photo: National Oceanic and Atmospheric Administration.

Table 27. Bearded seal information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Erignathus barbatus nauticus	Bearded seal	Okhotsk	Threatened	2010	77 FR 76739	N/A	None Designated
Erignathus barbatus nauticus	Bearded seal	Beringia	Threatened	2010	77 FR 76739	N/A	None Designated

We used information available in the final listing, the status review (Cameron et al. 2010), the 2015 stock assessment report (Muto 2016) and available literature to summarize the status of the bearded seal, as follows.

4.2.19.1 *Life History*

Generally, bearded seals move north in late spring and summer, staying along the edge of the pack ice in summer, and then move south in the fall. Bearded seals can live up to twenty to twenty-five years old. Female bearded seals become sexually mature at five or six years of age, males at six or seven. Breeding occurs from March to July. Male bearded seals vocalize during the breeding season, with a peak in calling during and after pup rearing. These calls are likely used to attract females and defend their territories to other males (Cameron et al. 2010). Pups are born between mid-March and May, and are usually weaned in fifteen days. Dependent pups spend about fifty percent of their time in the water. Nursing females spend more than ninety percent of their time in water, more than other large phocid seals. Bearded seals forage on a wide variety of benthic invertebrates, demersal fishes and sometimes, schooling fishes.

4.2.19.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Beringia DPS of the bearded seal. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Okhotsk DPS of the bearded seal.

The estimated population size of the Beringia bearded seal DPS is 155,000 individuals. There is substantial uncertainty around this estimate, however, and population trends for the DPS are unknown. An estimate of bearded seals in the western Bering Sea (63,200; 95 percent CI 38,400 to 138,600) from 2003 to 2008 appears to be similar in magnitude to an estimate from 1974 through 1987 (57,000 to 87,000) (Cameron et al. 2010).

The population size of the Okhotsk DPS is uncertain but was thought to be approximately 95,000 at the time of the status review (Cameron et al. 2010).

Population trends are not available at this time for the Beringia DPS (Muto 2016).

The population trend of the Okhotsk DPS is unknown. Incomplete abundance estimates make it impossible to assess trend information. There is some evidence to suggest a decreasing trend over time, but that assessment is not reliable due to inconsistent surveys (Cameron et al. 2010).

There has been some study of the population structure of bearded seals, but it has not been possible to determine if Okhotsk DPS bearded seals are genetically distinct from other Pacific bearded seals (*E.b. nauticus*) (Cameron et al. 2010; Davis et al. 2008). The DPS determination was made on the basis that the Kamchatka Peninsula behaviorally isolates the breeding population in the Sea of Okhotsk.

Bearded seals are boreoarctic with a circumpolar distribution and are closely associated with sea ice. Most seals move seasonally, following the extent of the sea ice; however some remain near the coasts during the summer and early fall. Bearded seals in the Beringia DPS are found in the continental shelf waters throughout the Eastern Siberian, Chukchi and Beaufort Seas. The Okhotsk DPS includes bearded seals found in the Sea Okhotsk, Russia (Figure 40).

4.2.19.3 *Acoustics*

Male bearded seals vocalize during the breeding season (March to July), with a peak in a calling during and after pup rearing. Their complex vocalizations range from 20 Hz to 11 kHz in frequency. These calls are likely used to attract females and defend their territories to other males (Cameron et al. 2010).

4.2.19.4 *Status*

In summary, the Beringia bearded seal DPS has a large, apparently stable population size, which makes it resilient to immediate perturbations. It is, however, threatened by future climate change, specifically the loss of essential sea ice and change in prey availability, and as a result, is likely to become endangered in the future. Bearded seals are an important species for Alaska subsistence hunters; the most recent estimate of annual statewide harvest is from 2000 and was 6,788 bearded seals. The current level of subsistence harvest is not known and there are no efforts to quantify statewide harvest numbers. Additional threats to the species include disturbance from vessels, sound from seismic exploration, and oil spills.

In summary, the Okhotsk bearded seal DPS has a large, apparently stable population size, which makes it resilient to immediate perturbations. It is, however, threatened by future climate change, specifically the loss of essential sea ice and change in prey availability and, as a result, is likely to become endangered in the future. Commercial harvest has depleted the bearded seal population in parts of the Sea of Okhotsk. Additional threats to the species include disturbance from vessels, sound from seismic exploration, and oil spills.

4.2.19.5 *Critical Habitat*

Critical habitat has not been designated for the Beringia DPS bearded seal.

There is no designated critical habitat for the Okhotsk DPS bearded seal; NMFS cannot designate critical habitat in foreign waters.

4.2.19.6 *Recovery Goals*

A Recovery Plan has not been prepared for the Beringia DPS bearded seal.

NMFS has not prepared a Recovery Plan for the Okhotsk DPS bearded seal. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.20 Guadalupe Fur Seal

Guadalupe fur seals were once found throughout Baja California, Mexico and along the California coast. Currently, the species breeds mainly on Guadalupe Island, Mexico, off the coast of Baja California. A smaller breeding colony, discovered in 1997, appears to have been established at Isla Benito del Este in the San Benito Archipelago, Baja California, Mexico (Belcher and T.E. Lee 2002) (Figure 42).

Figure 42. Map identifying the range of the threatened Guadalupe fur seal.

Figure 43: Guadalupe fur seal. Photo: National Oceanic and Atmospheric Administration.

Guadalupe fur seals are medium sized, sexually dimorphic otariids (Belcher and T.E. Lee 2002; Reeves et al. 2002). Distinguishing characteristics of the Guadalupe fur seal include the digits on their hind flippers (all of similar length), large, long fore flippers, and unique vocalizations (Reeves et al. 2002). Guadalupe fur seals are dark brown to black, with the adult males having tan or yellow hairs at the back of their mane (Figure 43). Guadalupe fur seals were listed as threatened under the ESA on December 16, 1985 (Table 28).

Table 28. Guadalupe fur seal information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Arctocephalus townsendi	Guadalupe fur seal	None	Threatened	None	50 FR 51252	None	None Designated

Information available from recent stock assessment reports and available literature were used to summarize the life history, population dynamics and status of the species as follows.

4.2.20.1 *Life History*

Guadalupe fur seals prefer rocky habitats and can be found in natural recesses and caves (Fleischer 1978). Female Guadalupe fur seals arrive on beaches in June, with births occurring between mid-June to July (Pierson 1978); the pupping season is generally over by late July (Fleischer 1978). Females stay with pups for seven to eight days after parturition, and then alternate between foraging trips at sea and lactation on shore; nursing lasts about eight months (Figureroa-Carranza 1994). Guadalupe fur seals feed mainly on squid species (Esperon-Rodriguez and Gallo-Reynoso 2013). Foraging trips can last between four to twenty-four days (average of fourteen days). Tracking data show that adult females spend seventy-five percent of their time sea, and twenty-five percent at rest (Gallo-Reynoso et al. 1995).

4.2.20.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Guadalupe fur seal.

At the time of listing, the population was estimated at 1,600 individuals, compared to approximately 30,000 before hunting began. A population was "rediscovered" in 1928 with the capture of two males on Guadalupe Island; from 1949 on, researchers reported sighting Guadalupe fur seals at Isla Cedros (near the San Benito Archipelago), and Guadalupe Island (Bartholomew Jr. 1950; Peterson et al. 1968). In 1994, the population at Guadalupe Island was estimated at 7,408 individuals (Gallo-Reynoso 1994b).

All Guadalupe fur seals represent a single population, with two known breeding colonies in Mexico, and a purported breeding colony in the United States. When the most recent stock assessment report for Guadalupe fur seals was published in 2000, the breeding colonies in Mexico were increasing; more recent evidence indicates that this trend is continuing (Aurioles-Gamboa et al. 2010; Esperon-Rodriguez and Gallo-Reynoso 2012). After compiling data from counts over thirty years, Gallo calculated that the population of Guadalupe fur seals in Mexico was increasing, with an average annual growth rate of 13.3 percent on Guadalupe Island (Gallo-Reynoso 1994b). More recent estimates of the Guadalupe fur seal population of the San Benito Archipelago (from 1997-2007) indicates that it is increasing as well at an annual rate of 21.6 percent (Esperon-Rodriguez and Gallo-Reynoso 2012), and that this population is at a phase of exponential increase (Aurioles-Gamboa et al. 2010).

Bernardi et al. (1998) compared the genetic divergence in the nuclear fingerprint of samples taken from 29 Guadalupe fur seals, and found an average similarity of 0.59 of the DNA profiles. This average is typical of outbreeding populations. Although the relatively high levels of genetic variability are encouraging, it is important to note that commercial harvest still influenced the population. Later studies comparing mtDNA found in the bones of pre-exploitation Guadalupe fur seals against the extant population showed a loss of genotypes, with twenty-five genotypes in pre-harvest fur seals, and seven present today (Weber et al. 2004).

Guadalupe fur seals have been known to travel great distances, with sightings occurring thousands of kilometers away from the main breeding colonies (Aurioles-Gamboa et al. 1999). Guadalupe fur seals are infrequently observed in U.S. waters. They can be found on California's Channel Islands, with as many fifteen individuals being sighted since 1997 on San Miguel Island, including three females and reared pups.

4.2.20.3 *Acoustics*

Though there has been no auditory assessment of the Guadalupe fur seal, its hearing likely falls within similar range as that of the Northern fur seal 2 to 40 kHz (Moore and Schusterman 1987).

4.2.20.4 *Status*

A number of human activities may have contributed to the current status of this species, historic commercial hunting was likely the most devastating. Commercial sealers in the nineteenth century decimated the Guadalupe fur seal population, taking as many 8,300 fur seals from San Benito Island (Townsend 1924). The species was presumed extinct, until 1926, when a small herd was found on Guadalupe Island by commercial fishermen, who later returned and killed all that could be found. In 1954, during a survey of the island Hubbs (1956) discovered at least fourteen individuals. Although population surveys occurred on an irregular basis in subsequent years, evidence shows that the Guadalupe fur seal has been increasing ever since. Although commercial hunting occurred in the past, and has since ceased, the effects of these types of exploitations persist today. Other human activities, such as entanglements from commercial fishing gear, are ongoing and continue to affect these species. Because that over the last fifty years the population has been increasing since being severely depleted, we believe that the Guadalupe fur seal population is resilient to future perturbations.

4.2.20.5 *Critical Habitat*

No critical habitat has been designated for the Guadalupe fur seal.

4.2.20.6 *Recovery Goals*

There has been no Recovery Plan prepared for Guadalupe fur seals.

4.2.21 Hawaiian Monk Seal

The Hawaiian monk seal is a large phocid ("true seal") that is one of the rarest marine mammals in the world. The Hawaiian monk seal inhabits the Northwestern Hawaiian Islands and Main Hawaiian Islands (Figure 44).

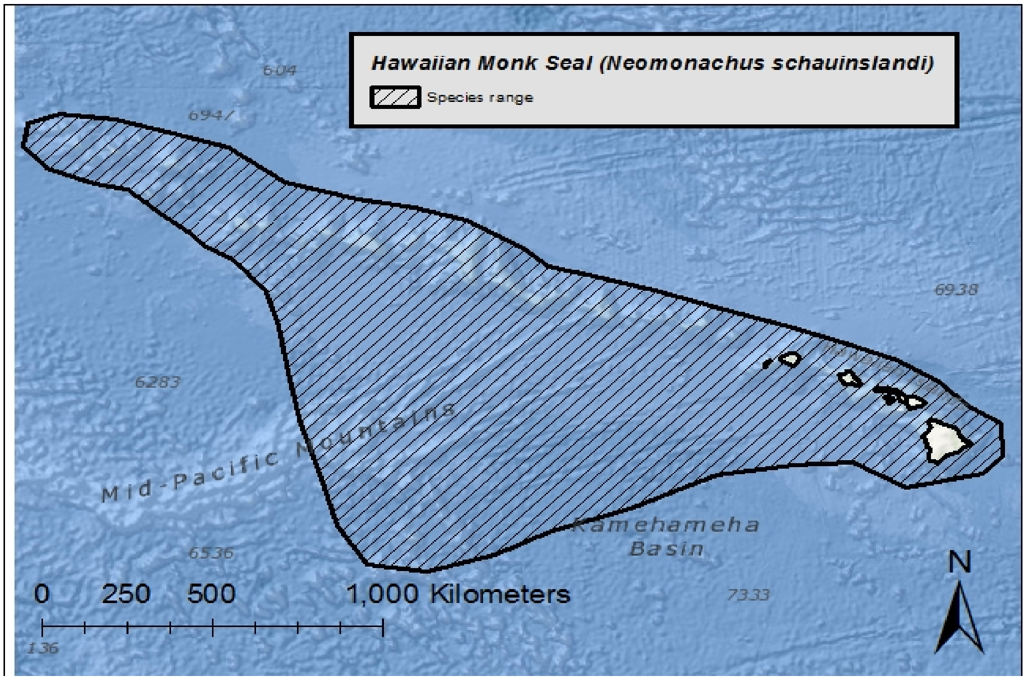

Figure 44. Map identifying the range of the endangered Hawaiian monk seal.

Hawaiian monk seals are silvery-grey with a lighter creamy coloration on their underside (newborns are black), they may also have light patches of red or green tinged coloration from attached algae (Figure 45). The Hawaiian monk seal was originally listed as endangered on November 23, 1976 (Table 29).

Figure 45: Hawaiian monk seal. Photo: National Oceanic and Atmospheric Administration.

Table 29. Hawaiian monk seal Information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Neomonachus schauinslandi	Hawaiian monk seal	None	Endangered	2007	41 FR 51611	2007	80 FR 50925

Information available from the recovery plan (NMFS 2007b), recent stock assessment report (Carretta et al. 2016), and status review (NMFS 2007a) were used to summarize the life history, population dynamics and status of the species as follows.

4.2.21.1 *Life History*

Hawaiian monk seals can live, on average, twenty-five to thirty years. Sexual maturity in females is reached around five years of age and it is thought to be similar for males but they do not gain access to females until they are older. They have a gestation period of ten to eleven months, and calves nurse for approximately one month while the mother fasts and remains on land. After nursing, the mother abandons her pup and returns to the sea for eight to ten weeks before returning to beaches to molt. 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. Monk seals are considered foraging generalist that feed primarily on benthic and demersal prey such as fish, cephalopods, and crustaceans. They forage in subphotic zones either because the areas host favorable prey items or because these areas are less accessible by competitors (Parrish et al. 2000).

4.2.21.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Hawaiian monk seal.

The entire range of the Hawaiian monk seal is located within U.S. waters. In addition to a small but growing population found on the main Hawaiian Islands there are six main breeding subpopulations in the northwestern Hawaiian Islands identified as: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, and French Frigate Shoals. The best estimate of the total population of Hawaiian monk seals is 1,112. This estimate is the sum of estimated abundance at the six main northwestern Hawaiian islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands (smaller breeding sub-populations), and an estimate of minimum abundance in the main Hawaiian islands. The minimum population size for the entire species is 1,088 (781 for the six main northwestern Hawaiian islands reproductive sites, 38.3 and 89.3 for Necker and Nihoa Islands respectively, and 179 individuals in the main Hawaiian islands).

The overall abundance of Hawaiian monk seals has declined by over sixty-eight percent since 1958. Current estimates indicate a growth rate of approximately 6.5 percent annually for the main Hawaiian islands subpopulation (Baker et al. 2011). Likewise, sporadic beach counts at Necker and Nihoa Islands suggest a positive growth rate. The six main northwestern Hawaiian islands subpopulations continue to decline at approximately 3.4 percent annually.

Genetic analysis indicates the species is a single panmictic population, thus warranting a single stock designation (Schultz et al. 2011). Genetic variation among monk seals is extremely low and may reflect a long-term history at low population levels and more recent human influences (Kretzmann et al. 2001; Schultz et al. 2009). In addition to low genetic variability, studies by Kretzmann et al. (1997) suggest the species is characterized by minimal genetic differentiation among sub-populations and, perhaps some naturally occurring local inbreeding. The potential for genetic drift should have increased when seal numbers were reduced by European harvest in the nineteenth century, but any tendency for genetic divergence among sub-populations is probably mitigated by the inter-island movements of seals. Since the population is so small there is concern about long-term maintenance of genetic diversity making it quite likely that this species will remain endangered for the foreseeable future.

The Hawaiian monk seal inhabits the Northwestern Hawaiian Islands and Main Hawaiian Islands (Figure 44).

4.2.21.3 *Acoustics*

The information on the hearing capabilities of endangered Hawaiian monk seals is somewhat limited, but they appear to have their most sensitive hearing at 12 to 28 kHz. Below eight kHz, their hearing is less sensitive than that of other pinnipeds. Their sensitivity to high frequency sound drops off sharply above 30 kHz (Richardson et al. 1995a; Richardson et al. 1995c; Thomas et al. 1990). An underwater audiogram for Hawaiian monk seal, based on a single animals whose hearing may have been affected by disease or age, was best at 12 to 28 kHz and 60 to 70 kHz (Thomas et al. 1990). The hearing showed relatively poor hearing sensitivity, as well as a narrow range of best sensitivity and a relatively low upper frequency limit (Thomas et al. 1990). Schusterman et al. (2000) reviewed available evidence on the potential for pinnipeds to echolocate and indicated that pinnipeds have not developed specialized sound production or reception systems required for echolocation. Instead, it appears pinnipeds have developed alternative sensory systems (e.g., visual, tactile) to effectively forage, navigate, and avoid predators underwater.

4.2.21.4 *Status*

Hawaiian monk seals were once harvested for their meat, oil, and skins, leading to extirpation in the main Hawaiian islands and near-extinction of the species by the twentieth century (Hiruki and Ragen 1992; Ragen 1999). The species partially recovered by 1960, when hundreds of seals were counted on northwestern Hawaiian Islands beaches. Since then, however, the species has declined in abundance. Though the ultimate cause(s) for the decline remain unknown threats include: food limitations in northwestern Hawaiian Islands, entanglement in marine debris, human interactions, loss of haul-out and pupping beaches due to erosion in northwestern Hawaiian Islands, disease outbreaks, shark predation, male aggression towards females, and low genetic diversity. With only approximately 1,112 individuals remaining the species’ resilience to further perturbation is low.

4.2.21.5 *Critical Habitat*

Hawaiian monk seal critical habitat was originally designated on April 30, 1986 and was extended on May 26, 1988. 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 twenty fathoms (thirty-seven meters) around the northwestern Hawaiian Islands breeding atolls and islands. The marine component of this habitat serves as foraging areas, while terrestrial habitat provides resting, pupping, and nursing habitat.

On September 21, 2015, NMFS published a final rule to revise critical habitat for Hawaiian monk seals, extending the current designation in the northwestern Hawaiian islands out to the 200 meter depth contour (including Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island). It also designates six new areas in in the main Hawaiian islands (i.e., terrestrial and marine habitat from five meters inland from the shoreline extending seaward to the

200 meter depth contour around Kaula, Niihau, Kauai, Oahu, Maui Nui, and Hawaii) (Figure 46).

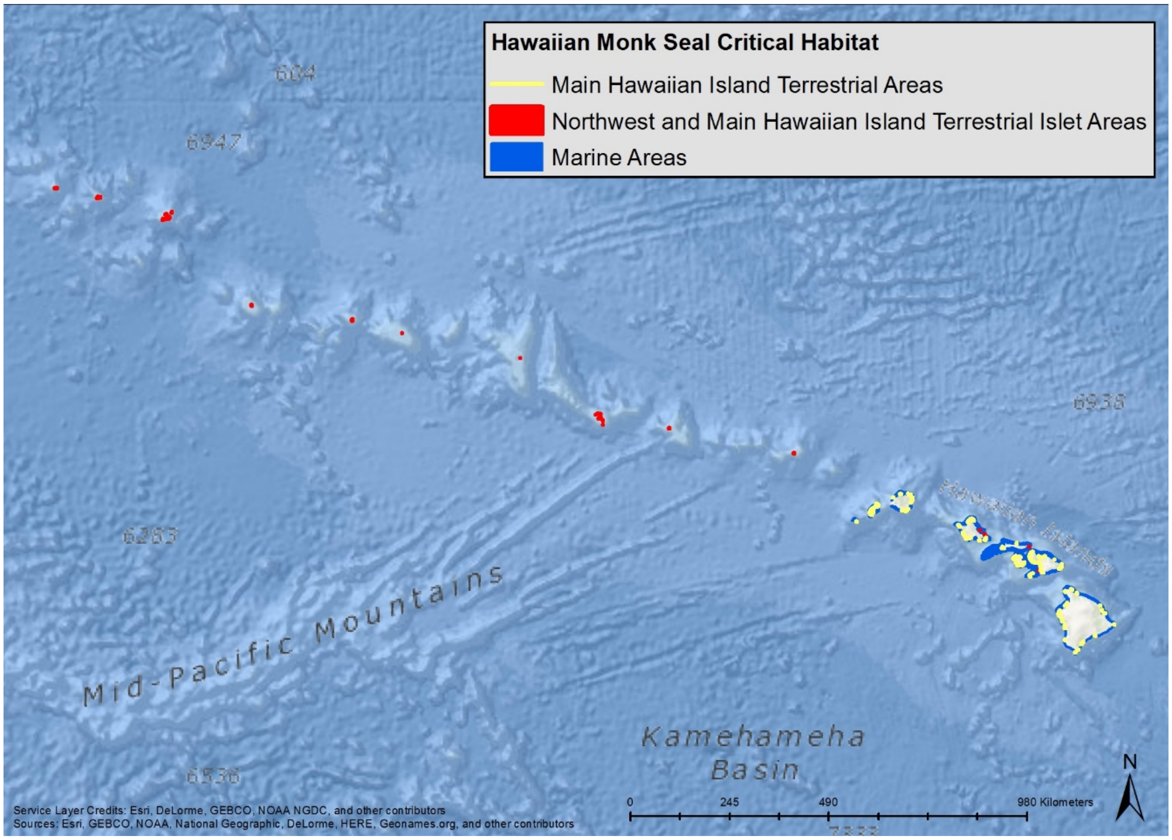

Figure 46: Map identifying designated critical habitat in the Northwest Hawaiian Islands and Main Hawaiian Islands for the endangered Hawaiian monk seal.

4.2.21.6 *Recovery Goals*

See the 2007 Final Recovery Plan for the Hawaiian monk seal for complete down listing/delisting criteria for each of the four following recovery goals.

1. Improve the survivorship of females, particularly juveniles, in sub-populations of the northwestern Hawaiian Islands.
2. Maintain the extensive field presence during the breeding season in the northwestern Hawaiian Islands.
3. Ensure the continued natural growth of the Hawaiian monk seal in the main Hawaiian Islands by reducing threats including interactions with recreational fisheries, disturbance of mother-pup pairs, disturbance of hauled out seals, and exposure to human domestic animal diseases.
4. Reduce the probability of the introduction of infectious diseases into the Hawaiian monk seal population.

4.2.22 Mediterranean Monk Seal

Currently, there are two major concentrations of Mediterranean monk seals: one in the northeastern Mediterranean around Greece and Turkey, and another in the northeastern Atlantic, including island of Madeira and the coast of Mauritania/Western Sahara in North Africa (i.e., the Cabo Blanco peninsula) (Figure 47).

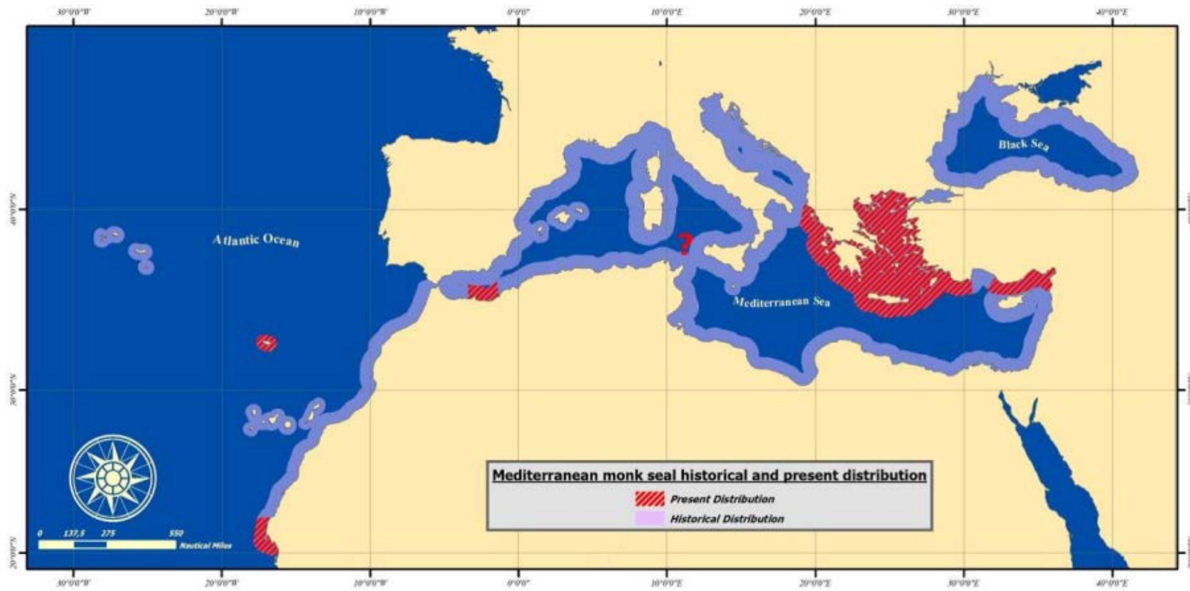

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Figure 47. Map identifying the range of the Mediterranean monk seal. Figure taken from MOm (2014).

Mediterranean monk seals are medium sized, sexually dimorphic phocid seals that are generally reclusive. Members of this species resemble Hawaiian monk seals, the only other remaining monk seal species. Distinguishing characteristics of the Mediterranean monk seal include its distinctive dark hood head and pale mask on its face, relatively short fore-flippers, and slender hind-flippers. Mediterranean monk seals have a brownish to grayish body with an extended, broad muzzle, relatively large, wide-spaced eyes, upward opening nostrils, and fairly big whisker pads (Figure 48). Mediterranean monk seals were listed as endangered under the ESA on June 2, 1970 (Table 30).

Figure 48: Mediterranean monk seal. Photo: MMC.gov; P. Dendrinos

Table 30: Mediterranean monk seal information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Monachus monachus	Mediterranean monk seal	None	Endangered	None	35 FR 8491	None	None Designated

Information available from available scientific publications was used to summarize the life history, population dynamics and status of the species as follows.

4.2.22.1 *Life History*

Mediterranean monk seals occupy shallow coastal waters, but can make extended trips through deeper waters (CMS 2005; MOm 2014). Habitat in Greece tends to be rocky, isolated locations (Azzolin et al. 2014; Sergeant et al. 1978). Unlike most other seal species, Mediterranean monk seals are known to haul-out in grottos or caves frequently accessible only by underwater entrances, possibly as a mechanism to offset human disturbance (Bareham and Furreddu 1975; Bayed et al. 2005; CMS 2005; Dendrinos et al. 2007).

Copulation occurs in the water outside of caves, which are aggressively defended by males, who mate with multiple females (CMS 2005; Pastor et al. 2011). Gestation is likely nine to ten months long (Marchessaux 1988). Adult females produce a single pup on roughly an annual to every third-year basis (CMS 2005; Gazo et al. 1999). The pupping season for the species varies over a broad geographical scale, and is possibly influenced by latitudinal differences – the Cabo Blanco peninsula lies at approximately 20° North, while Greece is at 39 to 40° North (Pastor and Aguilar 2003). Pupping occurs year-round for the colony at Cabo Blanco (Aguilar et al. 1995; Cedenilla et al. 2007; Gazo et al. 1999; Gonzalez et al. 1994; Pastor and Aguilar 2003). Pupping season for Mediterranean monk seals in Greek waters occur from August to December, with a peak in September to October (MOm 2014). During the first week postpartum, mothers remained with pups continuously, but started to leave pupping caves in the second week to forage (Aguilar et al. 2007; Gazo and Aguilar 2005).

Mediterranean monk seals forage on anchovies and pilchards, along with benthic cephalopods, fishes, and crustaceans (Boutiba and Abdelghani 1996; CMS 2005; Guclusoy 2008b; Karamanlidis et al. 2011; Pierce et al. 2011; Pierce et al. 2009; Salman et al. 2001; Sergeant et al. 1978). Individuals may travel for several days to foraging locations. Foraging dives for males averaged 25.5 m (83.7 feet) (maximum of 58 m [190.3 feet]) and averaged 3.5 minutes in duration (maximum of eight minutes) (CMS 2005; Gazo 1997). At Cabo Blanco, lactating females dove somewhat longer and deeper to an average depth of 28 to 38 m (91.9 to 124.7 feet) (maximum of 78 m [255.9 feet]) for an average of five to six minutes (CMS 2005; Gazo and Aguilar 2005). In Greek waters, seals may generally stay closer to their haul-out locations, and return to their caves each evening (Marchessaux and Duguy 1977).

4.2.22.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Mediterranean monk seal.

Few than 600 individual Mediterranean monk seals are thought to survive at present (Alfaghi et al. 2013; Bundone et al. 2013), and may number 400 to 500 individuals (Azzolin et al. 2014). Major breeding centers along the eastern Atlantic at Desertas Islands (Madeira) and Cabo Blanco are believed to host fewer than 200 individuals in genetically isolated, restricted habitats (Anonymous 2001). The two major Atlantic groups, Madeira and Cabo Blanco, represent roughly half of all Mediterranean monk seals and are collectively believed to be about three percent of their former abundance (CMS 2005). Roughly 180 to 200 individuals live in Greek waters, making Greece one of the last strongholds for the species, with about 300 to 350 in the broader eastern Mediterranean Sea (MOm 2014).

There has been no comprehensive population growth rate estimated for the entire Mediterranean monk seal population, but researchers have examined the population dynamics of the individual colonies in Cabo Blanco, Madeira, and the eastern Mediterranean Sea. The Cabo Blanco population hosted about 300 individuals from the 1990s until 1997, when a major die-off took two-thirds of the population, significantly altering the colony's age structure. The current population trajectory of the colony is -3.5 percent annually, including the major die-off (CMS 2005). Excluding this mortality event, the colony seems to be recovering (Martinez-Jauregui et al. 2012). Roughly 150 individuals were believed to live here in 2005 (CMS 2005). Madeira (including Desertas Island), off the coast of Portugal, is thought to have once hosted about 1,600 individuals (Brito et al. 2006). By the 1970s, roughly 50 individuals are thought to have remained and continued to decline to six to eight individuals in the 1980s. The latest estimate in 2008 is that 20 to 30 individuals survive here (Pires et al. 2008). Pup production for the four known reproductive females has amounted to 35 individuals from 1989 through 2005, and annual birth rates have gradually increased over the same period. Population viability analysis suggests the risk of extinction along the Turkish coast is declining, but risks remain due primarily to mortality of adult females, skewed sex ration, 'Allee' effects, and inbreeding stress (Saydam et al. 2014).

Genetic diversity in the Cabo Blanco sub-population is one of the lowest of any pinniped population studies, losing roughly 53 percent of its heterozygosity (CMS 2005; Pastor et al. 2007; Pastor et al. 2004). However, inbreeding does not yet appear to be a problem (CMS 2005; Pastor et al. 2007). Genetic diversity in the Greek population is also low (Pastor et al. 2007).

Once stretching from the Azores and throughout the Mediterranean Sea, the Black Sea, and along the West African coast, Mediterranean monk seal distribution is now limited to isolated pockets. Populations in the Azores and the Black Sea are now considered extirpated. Mediterranean monk seals remain widely distributed in Greece (MOm 2014). Greece hosts the largest Mediterranean monk seal population (Adamantopoulou et al. 2000; Adamantopoulou et al. 2011), with small, isolated groups or individuals in other locations along with other concentrations along Mauritania on the Atlantic coast of Africa (Sergeant et al. 1978). Three islands off the coast of Madeira, Portugal, known as Desertas Islands, host an additional, isolated collection of a few monk seals (CMS 2005).

4.2.22.3 *Acoustics*

Mediterranean monk seals produce two main aerial call types, barks and screams, which are individually specific (Charrier et al. 2017; Munoz 2011). They also produce chirps, grunts, and short screams, and in captivity, pups produce squawks and gaggles (Charrier et al. 2017; Munoz 2011). Calls range in frequency from 70 Hz to 3 kHz (Charrier et al. 2017). These calls are thought to be used in communication, but their specific function is unknown (Charrier et al. 2017). While no data on underwater vocalizations of Mediterranean monk seals exists, like Hawaiian monk seals, male Mediterranean monk seals are thought to produce underwater mating calls since breeding occurs in-water (Charrier et al. 2017). While we are aware of no empirical data on the hearing range of Mediterranean monk seals, their expected hearing range is between two and 40 kHz (Kellett et al. 2014; NOAA 2016).

4.2.22.4 *Status*

Mediterranean monk seals were historically numerous but have been reduced to a small fraction of their former abundance and range due to human exploitation over the past six hundred years (Brito et al. 2006; Sergeant et al. 1978). Occurrence on open beaches generally ended due to exploitation during the 15th and 16th centuries (CMS 2005). Since exploitation for human use, monk seals were killed incidentally or intentionally as part of fisheries activities, with numerous reports of individuals killed throughout the present range of the species (CMS 2005; Gonzalez et al. 1993; Panou et al. 1993), notably in association with gill and bottom trawl nets (Gonzalez and Larrinoa 2013; Guclusoy 2008a) but also hand lines in Madeira (Hale et al. 2011). Sub-adults may be the age class most affected by entanglement (Karamanlidis et al. 2008). Although commercial hunting occurred in the past and has since ceased, the effects of these types of exploitations persist today. Other human activities, such as habitat loss and entanglements from commercial fishing gear, are ongoing and continue to affect the species. Mediterranean monk seal populations have been severely depleted and remain critically endangered. We believe that the Mediterranean monk seal population is not resilient to future perturbations.

4.2.22.5 *Critical Habitat*

No critical habitat has been designated for the Mediterranean monk seal. NMFS cannot designate critical habitat in foreign waters.

4.2.22.6 *Recovery Goals*

NMFS has not prepared a Recovery Plan for the Mediterranean monk seal. In general, ESA-listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.23 Ringed Seal (Arctic, Baltic, Ladoga, Okhotsk, and Saimaa Subspecies)

Ringed seals have widespread, circumpolar distribution, and are found throughout the Arctic Ocean, as well as in the Sea of Okhotsk, Baltic Sea, Lake Ladoga and Lake Saimaa (Figure 49). There are five subspecies of ringed seals recognized: Ladoga (*P. h. ladogensis*), Saimaa (*P. h. saimensis*), Okhotsk (*P. h. ochotensis*), Baltic (*P. h. botnica*) and Arctic (*P. h. hispida*).

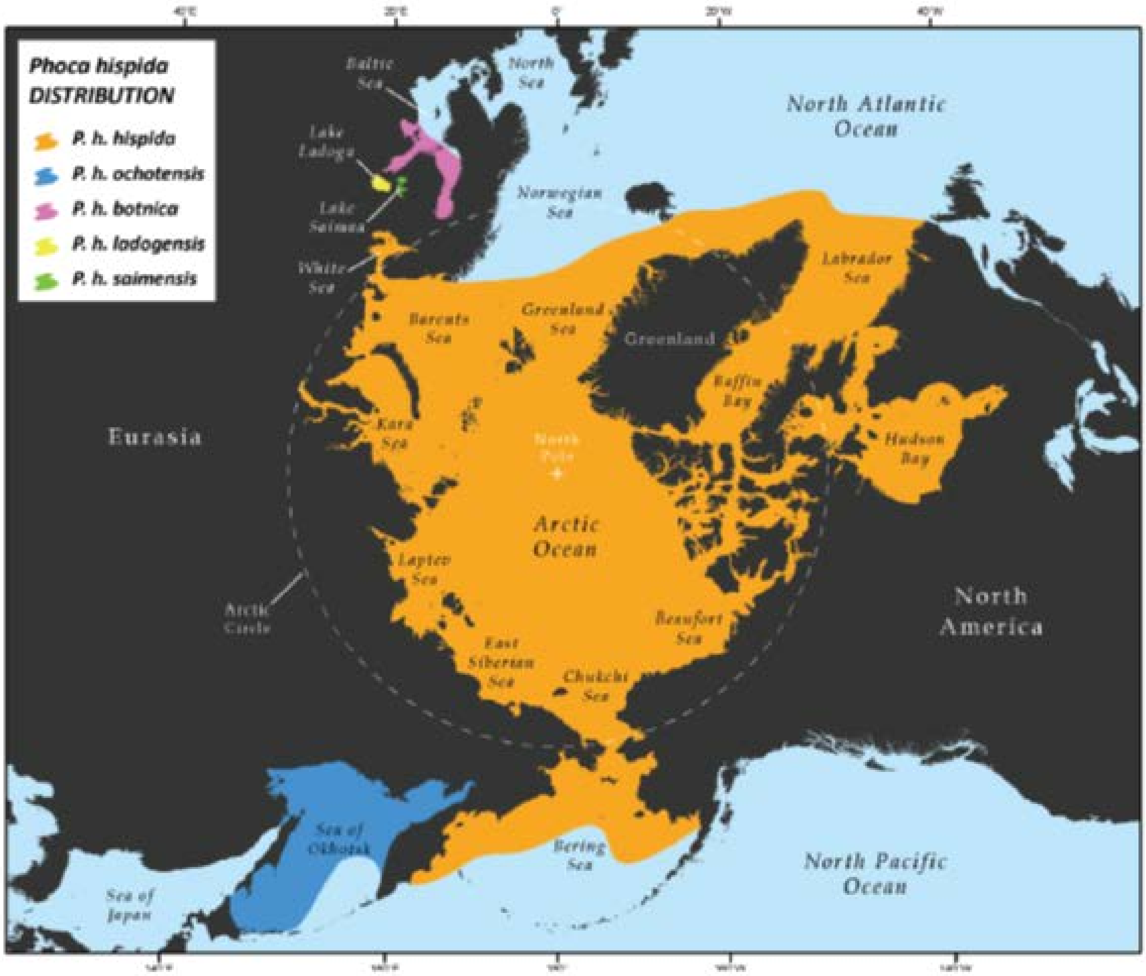

Figure 49. Map identifying the range of the five sub-species of ringed seal. From Kelly et al. 2010.

Ringed seals have a dark coat with silver rings (Figure 50). Adults can be up to five feet (1.5 meters) and weigh between 110 and 150 pounds (50 and 70 kilograms). Saimaa ringed seals can weigh up to 240 pounds (110 kilograms).

Figure 50: Ringed seal. Photo: National Oceanic and Atmospheric Administration.

On December 28, 2012, NMFS issued a final determination to list the Arctic subspecies as threatened under the ESA (Table 31). On July 28, 1993, NMFS issued a final determination to list the Saimaa subspecies as endangered (Table 31). On December 28, 2012, NMFS issued a final determination to list the Okhotsk subspecies as threatened under the ESA (Table 31). On December 28, 2012, NMFS issued a final determination to list the Baltic subspecies as threatened under the ESA (Table 31). On December 28, 2012, NMFS issued a final determination to list the Ladoga subspecies as endangered under the ESA (Table 31).

The U.S. District Court for the District of Alaska issued a decision that vacated the ESA listing of the Arctic subspecies of ringed seal on March 11, 2016 (Alaska Oil and Gas Association v. National Marine Fisheries Service et al., Case 4:14-cv-00029-RRB). NMFS has appealed that decision. While that appeal is pending, our biological opinions will continue to address effects to arctic ringed seals and considered them a proposed species, so that action agencies have the benefit of NMFS' analysis of the consequences of the proposed action on this subspecies, even though the ESA listing of the subspecies was not in effect at the time this opinion was written.

Table 31. Ringed seal information bar provides subspecies Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Phoca hispida ochotensis	Okhotsk Ringed seal	N/A	Threatened	2010	77 FR 76706	N/A	None Designated
Phoca hispida ladogensis	Ladoga Ringed seal	N/A	Endangered	2010	77 FR 76706	N/A	None Designated
Phoca hispida saimensis	Saimaa Ringed seal	N/A	Endangered	2010	58 FR 40538	N/A	None Designated
Phoca hispida botnica	Baltic Ringed seal	N/A	Threatened	2010	77 FR 76706	N/A	None Designated
Phoca hispida hispida	Arctic Ringed seal	N/A	Threatened	2010	77 FR 76706 Listing Vacated, Pending Appeal	N/A	79 FR 73010 (Proposed)

We used information available in the final listing, recent stock assessment reports, the status review (Kelly et al. 2010), and available literature to summarize the status of the ringed seal, as follows.

4.2.23.1 *Life History*

Ringed seals are uniquely adapted to living on the ice. They use stout claws to maintain breathing holes in heavy ice, and excavate lairs in the snow cover above these holes to provide warmth and protection from predators while they rest, pup, and molt. The timing of breeding, whelping and molting varies spatially and is dependent on the availability of sea ice, with populations at lower latitudes performing these activities earlier in the year. Females give birth in late winter to early spring to a single pup annually; they nurse for five to nine weeks. During this time, pups spend an equal amount of time in the water and in the lair. Females attain sexual maturity at four to eight years of age, males at five to seven years. The average lifespan of a ringed seal is fifteen to twenty-eight years. They are trophic generalists, but prefer small schooling prey that form dense aggregations (Kelly et al. 2010).

4.2.23.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the ringed seal.

No reliable population estimates for the entire Arctic ringed seal population due to the species' widespread distribution across political boundaries. In the status review, the population was estimated at approximately two million individuals; however, NMFS considers this a crude estimate, as it relies on outdated data collected in a variety of ways and does not include all areas of its range. In the status review, the population of ringed seals in Alaskan waters of the Chukchi and Beaufort Seas was estimated to be at least 300,000 individuals. This is most likely an underestimate of the true abundance because surveys in the Beaufort Sea were limited to within forty kilometers of the shore (Kelly et al. 2010).

Currently, the population for Saimaa ringed seals is estimated at 320 individuals, calculated by the Metsähallitus Parks and Wildlife in Finland by conducting a snow lair census (Koivuniemi et al. 2016).

There are an estimated 5,068 Ladoga ringed seals (CI 4,026 to 7,086) (Trukhanova 2013).

In total, there are approximately between 7,240 and 7,340 individuals in the Baltic ringed seal population, combined across three known sub-populations. There are between 200 and 300 Baltic ringed seals in the Gulf of Finland (Loseva and Sagitov 2013). There are about 1,000 ringed seals in the Gulf of Riga (in western Estonia) (Jussi et al. 2013). In 2000, there were 6,040 Baltic ringed seals in Bothnian Bay, Sweden (Sundqvist et al. 2012).

Conservative estimates for the Okhotsk ringed seal place the population abundance at 676,000 (Kelly et al. 2010).

Due to insufficient data, population trends for the Arctic subspecies cannot be calculated. It is unknown if the population is stable or fluctuating.

The Saimaa ringed seal population has increased since the late twentieth century, with annual variation in population growth of ± 20 seals (Sipila et al. 2013). This apparent population growth is regarded as unstable, however, as changing ice conditions from year to year can influence breeding success.

There is limited population trend information for the Ladoga ringed seal. There is evidence that the Ladoga ringed seal population is showing a positive trend; the 2012 estimate of 5,068 individuals is more than 2.4 times the 2001 estimate (Trukhanova et al. 2013).

There is no population trend available for the Baltic ringed seal as a whole. The sub-population in the Gulf of Finland has experienced a steep decline, from about 4,000 individuals in the 1980s and then increased from less than 100 to 237 in 2013 (Trukhanova et al. 2013). The number of Baltic ringed seals hauled out in Bothnian Bay increased from 1988 to 2000, from 2,000 to 6,040, a population increase of 4.6 percent (Sundqvist et al. 2012). Since ringed seals are so dependent on changing ice conditions for reproductive success, there is uncertainty as to how these trends will continue in the future.

There is no reliable population trend information for the Okhotsk ringed seal.

The genetic population structure of the Arctic ringed seal is poorly understood. It is likely that population structuring exists in the species, but the extent to which it occurs is unknown.

The Saimaa ringed seal population is characterized as having extremely low genetic diversity (Valtonen et al. 2015). The population exhibits fewer distinct haplotypes than other ringed seal subspecies populations in the region. The Saimaa population has eight distinct haplotypes, while the Ladoga has 13, and the Baltic subspecies has 16 distinct haplotypes (Valtonen et al. 2012). There is clear spatial structuring in the Saimaa population, likely owing to low population density and high fidelity for breeding sites (Valtonen et al. 2012).

There is little genetic information available for the Ladoga ringed seal population. Mitochondrial DNA variability in Ladoga ringed seals is substantially higher than in the nearby Saimaa ringed seal population. The Ladoga population displays 13 distinct haplotypes, compared to eight in Saimaa ringed seals. The nucleotide diversity for the Ladoga population (0.015 ± 0.017) is reduced compared to the nucleotide diversity in the Baltic ringed seal population (0.047 ± 0.038) (Valtonen et al. 2012).

The genetic structure of Baltic ringed seals is not well understood. It is possible that population structuring is taking place between the three sub-populations of Baltic ringed seals, due to the species' high fidelity to breeding sites. The Baltic ringed seal population exhibits 16 distinct haplotypes (Valtonen et al. 2012).

There is no available information on the genetic diversity of Okhotsk ringed seals.

Arctic ringed seals are widely distributed throughout the Arctic Ocean, in waters of Russia, Canada, Greenland, Finland and the United States (Figure 49). In U.S. waters, Arctic ringed seals are found around Alaska in the Bering, Chukchi and Beaufort Seas. Most seals move seasonally, following the extent of the sea ice.

Saimaa ringed seals are one of two freshwater, landlocked ringed seal populations and are found in Lake Saimaa, Finland (Figure 49). Most seals move seasonally, following the extent of the ice. Saimaa ringed seal pups are born from February to March in subnivean snow lairs in snow drifts along shorelines of islands, and molt in April during the nursing period (Kunnasranta et al. 2001).

Ladoga ringed seals are one of two freshwater, landlocked ringed seal populations and are found in Lake Ladoga, Russia (Figure 49). Most seals move seasonally, following the extent of the ice. In spring, seal density is highest in relatively shallow areas less than 50 meters deep (Trukhanova 2013).

Baltic ringed seals are found in the Baltic Sea, bordering Sweden, Finland, Russia, Estonia and Latvia (Figure 49). There are three major sub-populations of Baltic ringed seals, in Bothnian Bay, Sweden, the Gulf of Finland, and the Gulf of Riga, Estonia. Most seals move seasonally, following the extent of the sea ice.

Okhotsk ringed seals occupy the Sea of Okhotsk bordering Russia and Japan (Figure 49). Most seals move seasonally, following the extent of the sea ice.

4.2.23.3 *Acoustics*

Ringed seals produce underwater vocalizations ranging from approximately 100 Hz to 1 kHz (Jones et al. 2014). NMFS classifies ringed seals in the phocid pinniped functional hearing group. As a group, it is estimated that phocid pinnipeds can hear frequencies between 75 Hz and 100 kHz (NOAA 2013). Ringed seals can hear frequencies of 1 to 40 kHz (Blackwell et al. 2004; Richardson et al. 1995a). Though they may be able to hearing frequencies above this limit (Terhune and Ronald 1976); their sensitivity to such sounds diminishes greatly above 45 kHz (Terhune and Ronald 1975). Direct studies of ringed seal hearing have not been conducted, but it is assumed that ringed seals can hear the same frequencies that they produce and are likely most sensitive to this frequency range (Richardson et al. 1995b).

4.2.23.4 *Status*

The Arctic ringed seal is threatened due to climate change, especially from the expected loss of sea ice and snow cover in the foreseeable future. Ringed seals are an important species for Alaska subsistence hunters. The most recent estimate of annual statewide harvest is from 2000 and was 9,567 ringed seals. There are many subsistence communities in Alaska that are not surveyed, and the current statewide level of subsistence harvest is not known. The minimum estimate of the average annual harvest of ringed seals from 11 communities from 2009 to 2013 is 1,040 ringed seals (Muto et al. 2016). Additional threats to the species include fisheries interactions (including entanglement), disturbance from vessels, noise from seismic exploration, and oil spills. In summary, the Arctic ringed seal has an apparently large population, making it resilient to immediate perturbations. However, since it is threatened by climate change in the long-term, the species is likely to become endangered in the future.

The Saimaa ringed seal underwent a dramatic decline in the twentieth century, falling from historic levels of between 4,000 and 6,000 to below two hundred individuals in the mid-1980s, mostly due to overexploitation (Kelly et al. 2010; Kokko et al. 1999). Additional anthropogenic threats include contamination from persistent organic pollutants, incidental by-catch in fisheries, and human disturbance during nursing (Kokko et al. 1999). Because of the low genetic diversity, small population size, unstable population growth, the Saimaa ringed seal is considered to have an elevated risk of extinction (Nyman et al. 2014). The species faces further threats from climate change and the predicted loss of pack ice. Finland has banned harvest of Saimaa seals. The Saimaa ringed seal is not resilient to future perturbations.

Although there is some evidence the population is exhibiting a positive trend, the Ladgoa ringed seal population is still regarded as unstable. Poor ice conditions, fishing activity and risk of interactions, and the expected loss of sea ice and snow cover in the foreseeable future, indicate uncertainty about the resiliency of the Ladoga ringed seal population.

Historically, there were approximately between 50,000 to 450,000 Baltic ringed seals (Kokko et al. 1999), and severely reduced by hunting to about 7,000 individuals present in the population today. The Baltic ringed seal population in the Gulf of Finland appears to be increasing (Trukhanova et al. 2013), and the population in Bothnian Bay has increased from 1988 to 2000 at a rate of 4.6 percent (Sundqvist et al. 2012). The species faces threats from fisheries by-catch, climate change, and the predicted loss of sea ice. Harvest of Baltic ringed seals was banned by Baltic Sea countries.

There are about 676,000 Okhotsk ringed seals. Russia permits subsistence hunting and for commercial purposes, but the overall take is thought to be minimal (Kelly et al. 2010). The Okhotsk ringed seal has an apparently large population, making it resilient to immediate perturbations. However, threatened by climate change in the long-term, the species is likely to become endangered in the future.

4.2.23.5 *Critical Habitat*

Critical habitat for Arctic ringed seals was proposed for designation in the Bering, Chukchi, and Beaufort seas in Alaska. Physical or biological features essential to the conservation of the species included sea ice habitat suitable for the formation of and maintenance of subnivean birth lairs, sea ice habitat suitable as a platform for basking and molting, and primary prey resources to support Arctic ringed seals.

There is no designated critical habitat for the Saimaa ringed seal; NMFS cannot designate critical habitat in foreign waters.

There is no designated critical habitat for the Ladoga ringed seal; NMFS cannot designate critical habitat in foreign waters.

There is no designated critical habitat for the Baltic ringed seal; NMFS cannot designate critical habitat in foreign waters.

There is no designated critical habitat for the Okhotsk ringed seal; NMFS cannot designate critical habitat in foreign waters.

4.2.23.6 *Recovery Goals*

NMFS has not prepared a Recovery Plan for the Saimaa, Okhotsk, Ladoga, or Baltic ringed seal. In general, listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

NMFS has not prepared a Recovery Plan for the Arctic ringed seal.

4.2.24 Spotted Seal (Southern Distinct Population Segment)

Spotted seals in the Pacific are distributed from 85° North south to Sakhalin Island (45° North), including the Chukchi, Bering, and Okhotsk Seas. Eight breeding areas throughout the range of the spotted seal have been identified (Figure 51).

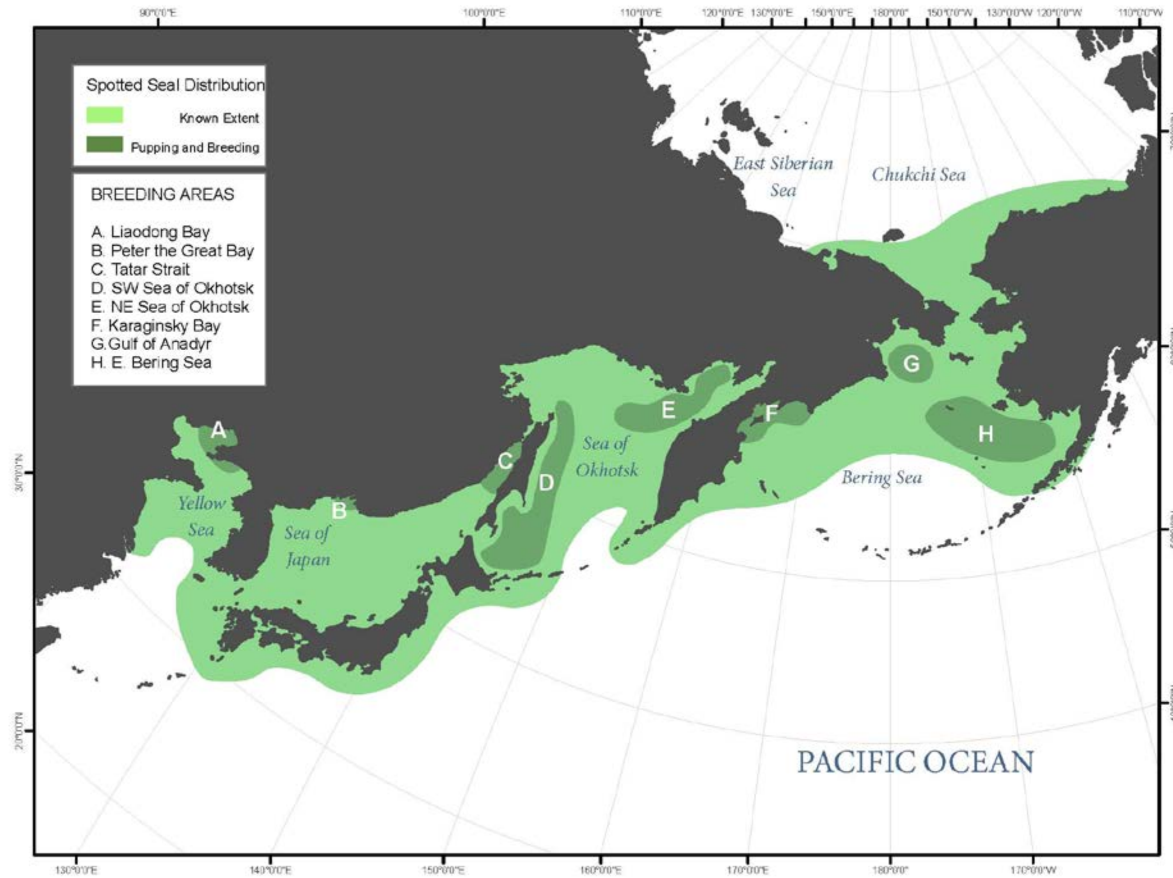

Figure 51. Map identifying the range, pupping, and breeding areas of the spotted seal. Breeding areas A and B (Liaodong Bay and Peter the Great Bay) comprise the Southern DPS spotted seal (Boveng et al. 2009).

Spotted seals have a silver to light gray coat with dark spots (Figure 52). Adult can be up to 1.5 meters (5 feet) and weigh between 65 to 115 kilograms (140 to 250 pounds). The spotted seal is divided into three DPSs: the Southern DPS, the Bering Sea DPS, and the Sea of Okhotsk DPS. The Southern DPS is composed of spotted seals breeding in the Liaodong Bay, Yellow Sea, and Peter the Great Bay in the Sea of Japan. On October 22, 2010, the NMFS issued a final determination to list the Southern DPS as threatened under the ESA (Table 32).

Figure 52: Spotted seal. Photo: National Oceanic and Atmospheric Administration.

Table 32: Spotted seal Southern distinct population segment information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Phoca largha	Spotted seal	Southern	Threatened	2009	75 FR 65239	N/A	None Designated

We used information available in the final listing, the status review (Boveng et al. 2009) and available literature to summarize the status of the Southern DPS spotted seal, as follows.

4.2.24.1 *Life History*

Spotted seals can live up to 30 to 35 years old. Most spotted seals are sexually mature by age four. Spotted seals haul out onto the sea ice to breed; the timing of breeding depends on the region. Breeding in Liaodong Bay occurs from February to mid-March and in March and April in the Peter the Great Bay. The implantation of the fertilized embryo is delayed by two to four months, and gestation lasts seven to nine months. Pups are born between early January to mid-

February in Liaodong Bay, and between early February and mid-March in peter the Great Bay. Pups are usually weaned in three to four weeks. Nursing pups do not enter the water until they are weaned and molted. They are dependent on the sea ice until they learn to dive and forage for themselves, which usually occurs ten to 15 days after molting. After breeding and birthing, the herds break up to migrate in spring and summer towards open water for favorable foraging grounds. Adult spotted seals forage on a wide variety of fishes like Pacific herring, Japanese smelt and capelin. Juveniles eat krill and small crustaceans. While foraging, spotted seals generally stay in continental shelf waters up to 200 meters (656.2 feet) deep (Boveng et al. 2009).

4.2.24.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Southern DPS of the bearded seal.

Due to the logistical difficulties of surveying ice seals in remote areas, there is some uncertainty surrounding abundance estimates for the Southern DPS of spotted seal. For the Southern DPS as a whole, the population could number as many as 3,500 individuals. The breeding population in Liaodong Bay was estimated at 1,000 individuals from 2005 through 2008 (Han et al. 2010) and about 800 individuals in 2007 (Boveng et al. 2009). The most recent abundance estimate for the Peter the Great Bay breeding population is 2,500 spotted seals in the spring, with about 300 pups produced annually (Boveng et al. 2009).

Population trends are not available at this time for the Southern DPS of spotted seal. Available information for the breeding population in Liaodong Bay indicate that the population there has fluctuated from a maximum of 8,137 individuals in 1940 to as few as 700 in 2007.

There has been some study of the population structure of Southern DPS of spotted seals. (Han et al. 2010) found low levels of genetic diversity in the Liaodong Bay breeding colony, likely the result of a population reduction over the past several decades.

Spotted seals are found in the North Pacific Ocean, preferring arctic and sub-arctic waters and are closely associated with outer margins of sea ice. Spotted seals in the Southern DPS are found in the Yellow Sea and Sea of Japan (Figure 51). Most seals move seasonally, following the extent of the sea ice.

4.2.24.3 *Acoustics*

Five distinct sounds have been identified in captive spotted seals of both sexes: growls, drums, snorts, chirps, and barks that range in frequency from 500 Hz to 3.5 kHz (Beier and Wartzok 1979; Richardson et al. 1995a). A "creaky door sound" has only been recorded from males (Beier and Wartzok 1979). A recent study on wild spotted seals in Liaodong Bay, China identified four major call types (knocks, growls, drums, and seeps), some of which are similar to those previously mentioned for captive animals (Yang et al. 2017). These calls also appeared to be similar to the closely related harbor seal, and consist of short, low frequency (less than 600 Hz) sounds(Yang et al. 2017). Little is known about the hearing of spotted seals. Recently, Sills et al. (2014) measured the underwater and in-air hearing capabilities of young spotted seals and found that the best hearing sensitivity in air spanned four octaves, ranging from approximately 0.6 to 11 kHz, while the hearing sensitivity underwater ranged from 0.3 and 56 kHz. Sills et al. (2014) concluded that the sound reception capabilities of spotted seals differ from those described previously for ice seals, with capabilities more similar to harbor seals.

4.2.24.4 *Status*

Commercial harvesting in the 19th and 20th centuries depleted Southern DPS of spotted seals. In Peter the Great Bay, as many as 80 or more spotted seals per day were harvested in the late 19th century. Populations in Liaodong Bay were also heavily impacted by hunting; about 30,000 spotted seals were harvested in the Yellow Sea from 1930 through 1990 (Boveng et al. 2009). Bycatch in fishing nets and shooting by fishermen are considered to be the greatest current threats to Southern DPS of spotted seals. In addition, the species is threatened by future climate change, specifically the loss of essential sea ice and change in prey availability. Even though spotted seals in Liaodong Bay and Peter the Great Bay can breed and molt on land, a loss of sea ice habitat will reduce suitable space for reproduction and rearing. As a result, is likely to become endangered in the future.

4.2.24.5 *Critical Habitat*

No designated critical habitat for the Southern DPS of spotted seal; NMFS cannot designate critical habitat in foreign waters.

4.2.24.6 *Recovery Goals*

NMFS has not prepared a Recovery Plan for the Southern DPS of spotted seal. In general, ESA-listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296; June 15, 1990).

4.2.25 Steller Sea Lion (Western Distinct Population Segment)

The Steller sea lion ranges from Japan, through the Okhotsk and Bering Seas, to central California. It consists of two morphologically, ecologically, and behaviorally separate DPSs: the Eastern, which includes sea lions in Southeast Alaska, British Columbia, Washington, Oregon and California; and the Western, which includes sea lions in all other regions of Alaska, as well as Russia and Japan (Figure 53).

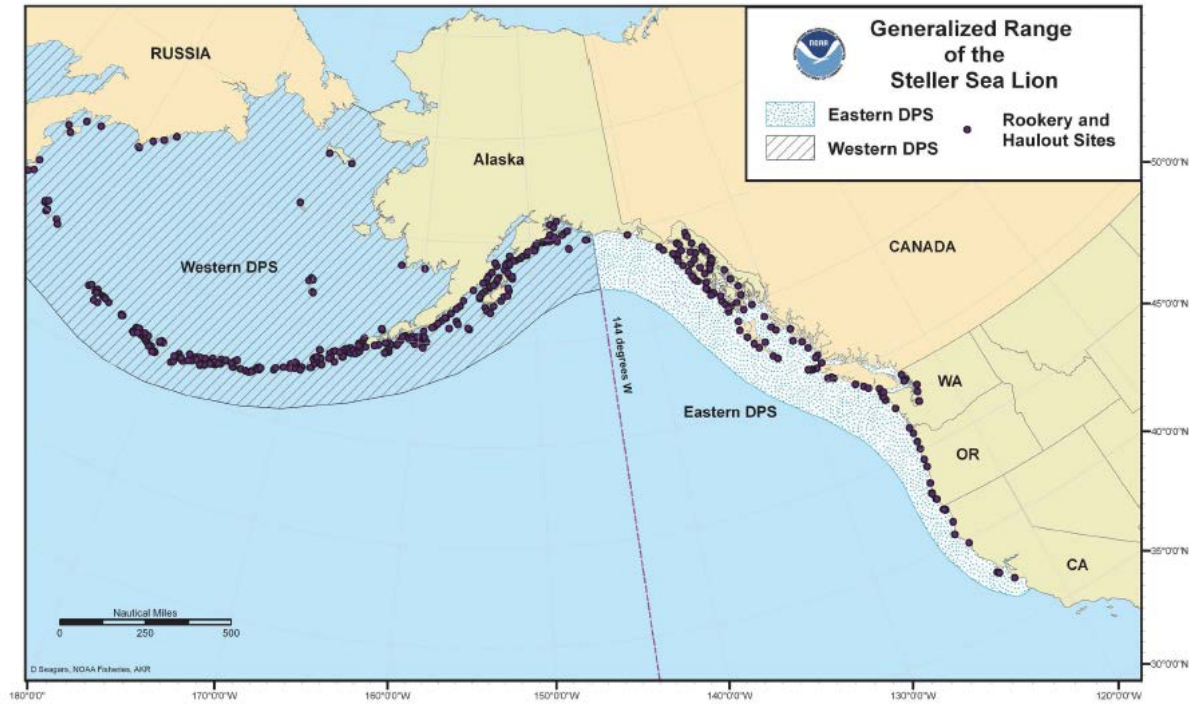

Figure 53: Map identifying the range of the western distinct population segment Steller sea lions.

Steller sea lions adults are light blonde to reddish brown and slightly darker on the chest and abdomen (Figure 54). At the time of their initial listing, Steller sea lions were considered a single population listed as threatened. On May 5, 1997, following a status review, NMFS established two DPSs of Steller sea lions, and issued a final determination to list the Western DPS as endangered under the ESA. The Eastern DPS was delisted on November 4, 2013, and the Western DPS retained its endangered status (Table 33).

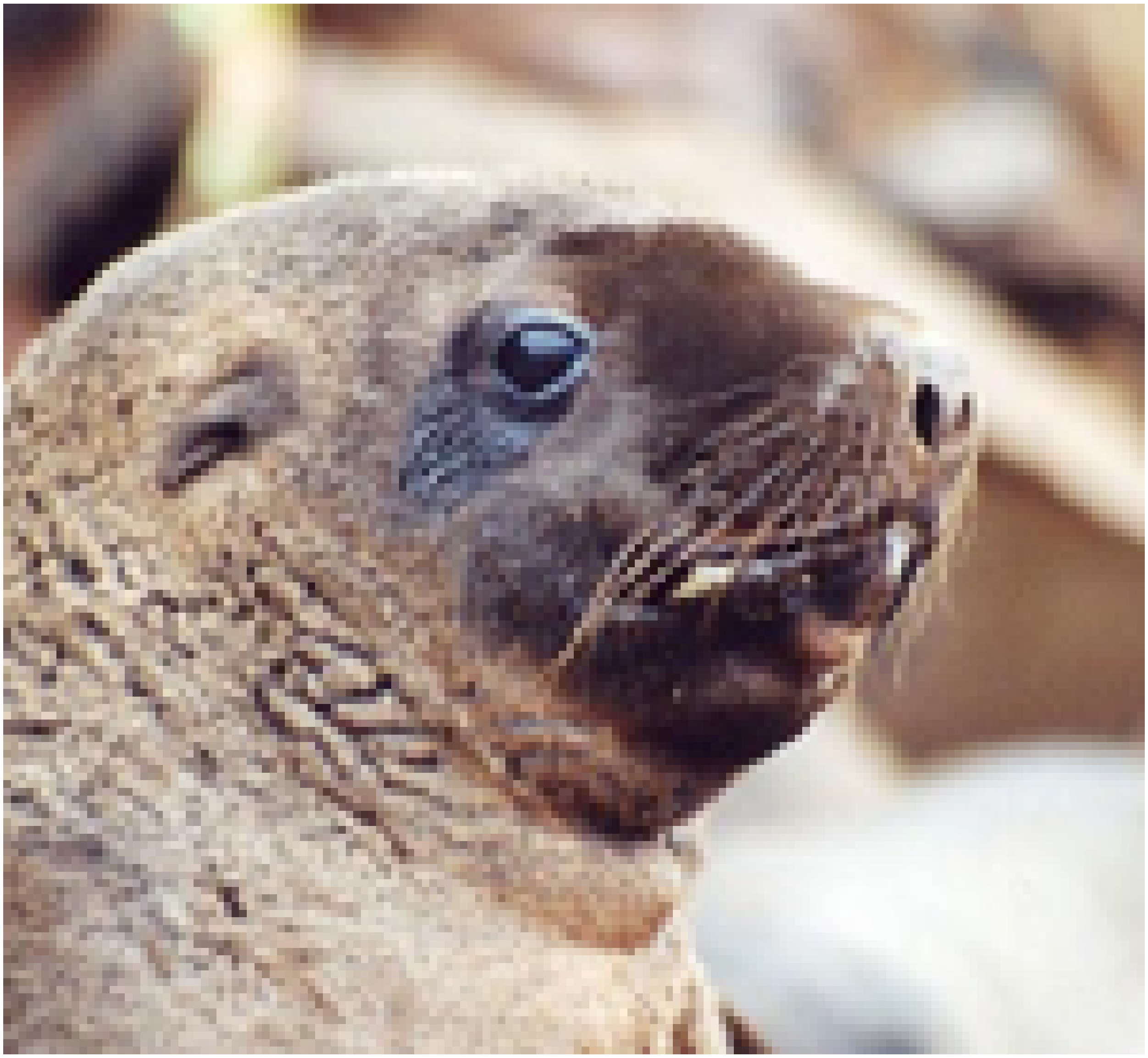

Figure 54: Steller sea lion. Photo: National Oceanic and Atmospheric Administration

Table 33. Steller sea lion Western distinct population segment information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Eumetopias jubatus	Steller sea lion	Western	Endangered	N/A	62 FR 24345	3/2008	58 FR 45269

We used information available in the final listing, the revised Recovery Plan (NMFS 2008b) and the 2015 stock assessment report (Muto et al. 2016) to summarize the status of the Western DPS, as follows.

4.2.25.1 *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 three to seven years of age. They are polygynous, competing for territories and females by age 10 or 11. Female Steller sea lions become sexually mature at three to six years of age and reproduce into their early 20s. Most females breed annually, giving birth to a single pup. Pups are usually weaned in one to two years. Females and their pups disperse from rookeries by August to 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.

4.2.25.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Western DPS of the Steller sea lion.

As of 2015, the best estimate of abundance of the western Steller sea lion DPS in Alaska was 12,189 for pups and 37,308 for non-pups (total N_{min} = 49, 497) (Muto et al. 2016). This represents a large decline since counts in the 1950s (N = 140,000) and 1970s (N = 110,000).

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 three percent between 2004 and 2008, the first recorded population increase since the 1970s (NMFS 2008b). However, there are regional differences in population growth rate, with positive trends in the eastern portion of the range, and negative trends west of Samalga Pass (approximately 170° West) (Muto et al. 2016). These trends indicate that overall, the Western DPS may be stable or exhibiting a slight negative trend as a whole.

Based on the results of genetic studies, the Steller sea lion population was reclassified into two DPSs: western and eastern. These data indicate that the two populations have been separate since the last ice age (Bickham et al. 1998). Further examination of the Steller sea lions from the Gulf of Alaska (i.e., the Western DPS) revealed a high level of haplotype diversity, indicating that genetic diversity has been retained despite the decline in abundance (Bickham et al. 1998).

Steller sea lions are distributed mainly around the coasts to the outer continental shelf along the North Pacific Ocean rim from northern Hokkaiddo, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, and southern coast of Alaska including the central and western Gulf of Alaska (Figure 53).

4.2.25.3 *Acoustics*

Steller sea lions hear within the range of 0.5 to 32 kHz (Kastelein et al. 2005). Males and females apparently have different hearing sensitivities, with males hearing best at 1 to 16 kHz (best sensitivity at the low end of the range) and females hearing from 16 to 25 kHz (best hearing at the upper end of the range) (Kastelein et al. 2005).

4.2.25.4 *Status*

The species was listed as threatened in 1990 because of significant declines in population sizes. 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 three 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. Despite the added protection (and an annual incidental fisheries take of twenty-six 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.

4.2.25.5 *Critical Habitat*

In 1997, NMFS designated critical habitat for the Steller sea lion. 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.

Figure 55: Map depicting Alaskan designated critical habitat for the Western distinct population segment Steller sea lion.

In Alaska, areas include major Steller sea lion rookeries, haulouts and associated terrestrial, air, and aquatic zones (Figure 55). Designated critical habitat includes a terrestrial zone extending 3,000 feet (0.9 kilometers) landward from each major rookery and haulout; it also includes air zones extending 3,000 feet (0.9 kilometers) above these terrestrial zones and aquatic zones. Aquatic zones extend 3,000 feet (0.9 kilometers) seaward from the major rookeries and haulouts east of 144° West. 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.

Although within the range of the now delisted Eastern DPS, the designated critical habitat in California and Oregon remains in effect. 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 kilometers) above rookery areas historically occupied by sea lions. Critical habitat also includes an aquatic zone extending 3,000 feet (0.9 kilometers) seaward.

4.2.25.6 *Recovery Goals*

See the 2008 Revised Recovery Plan for the Steller sea lion for complete down listing/delisting criteria for each of the following recovery goals.

1. Baseline population monitoring
2. Insure adequate habitat and range for recovery
3. Protect from over-utilization for commercial, recreational, scientific or educational purposes
4. Protect from diseases, contaminants and predation
5. Protect from other natural or anthropogenic actions and administer the recovery program

4.2.26 Green Turtle (Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, and North Atlantic and Distinct Population Segments)

The green sea turtle is globally distributed and commonly inhabits nearshore and inshore waters, occurring throughout tropical, subtropical and, to a lesser extent, temperate waters (Figure 56).

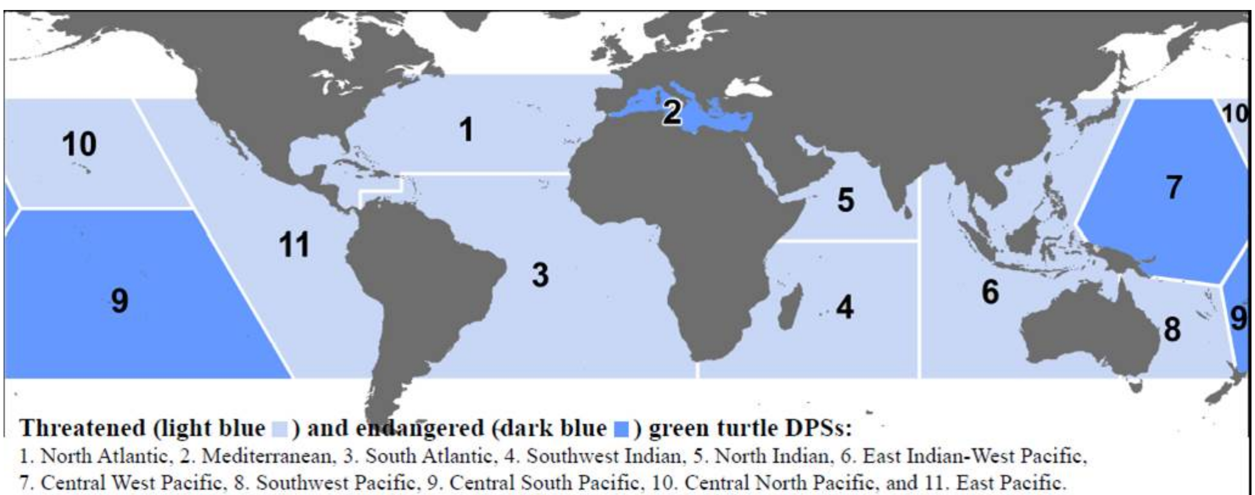

Figure 56. Map depicting range and distinct population segment boundaries for green turtles.

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter) (Figure

57). The species was listed under the ESA on July 28, 1978. The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed eleven DPSs of green sea turtles as threatened or endangered under the ESA (Table 34). Eight DPSs are listed as threatened: Central North Pacific, East Indian-West Pacific, East Pacific, North Atlantic, North Indian, South Atlantic, Southwest Indian, and Southwest Pacific. Three DPSs are listed as endangered: Central South Pacific, Central West Pacific, and Mediterranean. Only the North Atlantic, Central North Pacific, Central South Pacific, Central West Pacific, and East Pacific DPSs are considered in this opinion, as all other DPSs fall outside the action area for cetacean net captures.

Figure 57: Green sea turtle. Photo: Mark Sullivan, National Oceanic and Atmospheric Administration.

Table 34. Green sea turtle information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Chelonia mydas	Green Turtle	North Atlantic	Threatened	2015	81 FR 20057	10/1991	63 FR 46693
		Central North Pacific	Threatened	2015	81 FR 20057	63 FR 28359	None Designated
		Central South Pacific	Endangered	2015	81 FR 20057	63 FR 28359	None Designated
		Central West Pacific	Endangered	2015	81 FR 20057	63 FR 28359	None Designated
		East Pacific	Threatened	2015	81 FR 20057	63 FR 28359	None Designated

We used information available in the 2007 Five Year Review (USFWS 2007) and 2015 Status Review (Seminoff et al. 2015) to summarize the life history, population dynamics and status of the species, as follows.

4.2.26.1 *Life history*

Age at first reproduction for females is twenty to forty years. Green sea turtles lay an average of three nests per season with an average of 100 eggs per nest. The remigration interval (i.e., return to natal beaches) is two to five years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey.

4.2.26.2 *Population dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to each DPS of green sea turtle.

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). The number of nesting females, nesting sites and the percentage of nesting females in the distinct population nesting at the largest nesting beach are shown in Table 35.

Table 35. Green turtle nesting abundance at sites in each distinct population segment (Seminoff et al. 2015).

Distinct Population Segment	Abundance Estimate (nesting females)	Number of Nesting Sites	Largest Nesting Site	Percentage at largest nesting site
North Atlantic	167,424	73	Tortuguero, Costa Rica	79
Central North Pacific	3,846	12	East Island, French Frigate Shoals, Hawaii	96
Central South Pacific	2,677	59	Scilly Atoll, French Polynesia	36
Central West Pacific	6,518	51	Federated States of Micronesia	22
East Pacific	20,062	39	Colola, Mexico	58

Many nesting sites worldwide suffer from a lack of consistent, standardized monitoring, making it difficult to characterize population growth rates for a DPS. Nesting surveys have been conducted since 1973 for green turtles in the Central North Pacific DPS. Nesting abundance at East Island, French Frigate Shoals, increases at 4.8 percent annually. There are no estimates of population growth for the Central South Pacific DPS. The DPS suffers from a lack of consistent, systematic nesting monitoring, with no nesting site having even five years of continuous data. What data are available indicate steep declines at Scilly Atoll due to illegal harvest, with some smaller nesting sites (e.g., Rose Atoll) showing signs of stability. There are no estimates of population growth rates for the Central West Pacific DPS. Long-term nesting data is lacking for many of the nesting sites in the Central West Pacific DPS, making it difficult to assess population trends. The only site which as long-term data available—Chichijima, Japan—shows a positive trend in population growth. There are no estimates of population growth for the East Pacific DPS. Only one nesting site in the East Pacific DPS at Colola, Mexico, has sufficient long-term data to determine population trends. Data analysis indicates that the population there is increasing and is likely to continue to do so. For the North Atlantic DPS, the available data indicate an increasing trend in nesting. There are no reliable estimates of population growth rate for the DPS as a whole, but estimates have been developed at a localized level. Modeling by Chaloupka et al. (2008) using data sets of 25 years or more show the Florida nesting stock at the Archie Carr National Wildlife Refuge growing at an annual rate of 13.9 percent, and the Tortuguero, Costa Rica, population growing at 4.9 percent.

Globally, the green turtle is divided into eleven distinct population segments based on genetic analyses. The majority of nesting for the Central North Pacific DPS is centered at one site on French Frigate Shoals, and there is little diversity in nesting areas. Overall, the Central North Pacific DPS has a relatively low level of genetic diversity and stock sub-structuring (Seminoff et al. 2015).There is very limited information available for the Central South Pacific DPS. Mitochondrial DNA studies indicate at least two genetic stocks in the DPS—American Samoa and French Polynesia. Overall, there is a moderate level of diversity for the DPS, and the presence of unique haplotypes (Seminoff et al. 2015). The Central West Pacific DPS is made up of insular rookeries separated by broad geographic distances. Rookeries that are more than 1,000 kilometers apart are significantly differentiated, while rookeries 500 kilometers apart are not (Seminoff et al. 2015). Mitochondrial DNA analyses suggest that there are at least seven independent stocks in the region (Dutton et al. 2014). Rare and unique haplotypes are present in the East Pacific DPS. Genetic sampling has identified four regional stocks in the Eastern Pacific DPS—Revillagigedos Archipelago, Mexico, Michoacán, Mexico, Central America (Costa Rica), and the Galapagos Islands, Ecuador (Seminoff et al. 2015). The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the population for the DPS. Evidence from mtDNA studies indicates that there are at least 4 independent nesting subpopulations in Florida, Cuba, Mexico and Costa Rica (Seminoff et al. 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

The green sea turtle occupies the coastal waters of over 140 countries worldwide; nesting occurs in more than eighty countries (Figure 56). The green sea turtle is distributed in tropical, subtropical, and to a lesser extent, temperate waters (Seminoff et al. 2015). Green turtles in the Central North Pacific DPS are found in the Hawaiian Archipelago and Johnston Atoll. The major nesting site for the DPS is at East Island, French Frigate Shoals, in the Northwestern Hawaiian islands; lesser nesting sites are found throughout the Northwestern Hawaiian Islands and the Main Hawaiian Islands (Seminoff et al. 2015). Green turtles in the Central South Pacific DPS are found in the South Pacific Ocean, from northern New Zealand to Fiji, Tuvalu, and Kiribati and east to include French Polynesia, with nesting occurring sporadically throughout this expansive region (Seminoff et al. 2015). The Central West Pacific DPS is composed of nesting assemblages in the Federated States of Micronesia, the Japanese islands of Chichijima and Hahajima, the Marshall Islands, and Palau. Green turtles in this DPS are found throughout the western Pacific Ocean, in Indonesia, the Philippines, the Marshall Islands and Papua New Guinea (Seminoff et al. 2015). Green turtles in the East Pacific DPS are found from the California/Oregon border south to central Chile. Major nesting sites occur at Michoacán, Mexico, and the Galapagos Islands, Ecuador. Smaller nesting sites are found on the Pacific Coast of Costa Rica, and in the Revillagigedos Archipelago, Mexico. Scattered nesting occurs in Columbia, Ecuador, Guatemala and Peru (Seminoff et al. 2015). Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5° North, 77° West) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48° North, 77° West) in the north. The range of the DPS then extends due east along latitudes 48° North and 19° North to the western coasts of Europe and Africa. Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba (Seminoff et al. 2015).

4.2.26.3 *Acoustics*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to

1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

4.2.26.4 *Status*

Once abundant in tropical and subtropical waters, green sea turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation. Globally, 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 beach erosion and re-nourishment, construction and artificial lighting) threatens nesting success and hatchling survival. On a regional scale, the different DPSs experience these threats as well, to varying degrees. Differing levels of abundance combined with different intensities of threats and effectiveness of regional regulatory mechanisms make each DPS uniquely susceptible to future perturbations.

Green turtles from the Central North Pacific DPS in the Hawaiian Archipelago were subjected to hunting pressure for subsistence and commercial trade, which was largely responsible for the decline in the region. Though the practice has been banned, there are still anecdotal reports of harvest. Incidental bycatch in fishing gear, ingestion of marine debris, and the loss of nesting habitat due to sea level rise are current threats to the population. Although these threats persist, the increase in annual nesting abundance, continuous scientific monitoring, legal enforcement and conservation programs are all factors that favor the resiliency of the DPS.

Historically, the Central South Pacific DPS declined due to harvest of eggs and females for human consumption or for their shells, a practice that still continues throughout the region. Incidental bycatch in commercial and artisanal fishing gear, lack of regulatory mechanisms and climate change are significant threats to the long-term viability of the DPS.

The Central West Pacific DPS is impacted by incidental bycatch in fishing gear, predation of eggs by ghost crabs and rats, and directed harvest eggs and nesting females for human consumption. Historically, intentional harvest of eggs from nesting beaches was one of the principal causes for decline, and this practice continues today in many locations. The Central West Pacific DPS has a small number of nesting females and a widespread geographic range. These factors, coupled with the threats facing the DPS and the unknown status of many nesting sites makes the DPS vulnerable to future perturbations.

The population decline for the East Pacific DPS was primarily caused by commercial harvest of green turtles for subsistence and other uses (e.g., sea turtle oil as a cold remedy). Conservation laws are in place in several countries across the range of the DPS, but enforcement is inconsistent, limiting effectiveness. Incidental bycatch in commercial fishing gear, continued harvest, coastal development and beachfront lighting are all continuing threats for the DPS. The observed increases in nesting abundance for the largest nesting aggregation in the region (Michocán, Mexico), a stable trend at Galapagos, and record high numbers at sites in Costa Rica suggest that the population is resilient, particularly in Mexico.

Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population’s decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to 50 years. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

4.2.26.5 *Critical Habitat (North Atlantic Distinct Population Segment)*

The only designated critical habitat for green sea turtles is in Culebra Island, Puerto Rico. On September 2, 1998, NMFS designated critical habitat for green sea turtles, which include coastal waters surrounding Culebra Island, Puerto Rico (Figure 58). 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. Activities that may affect the critical habitat include beach renourishment, dredge and fill activities, coastal construction, and freshwater discharge. Due to its location, this critical habitat would be accessible by individuals of the North Atlantic DPS.

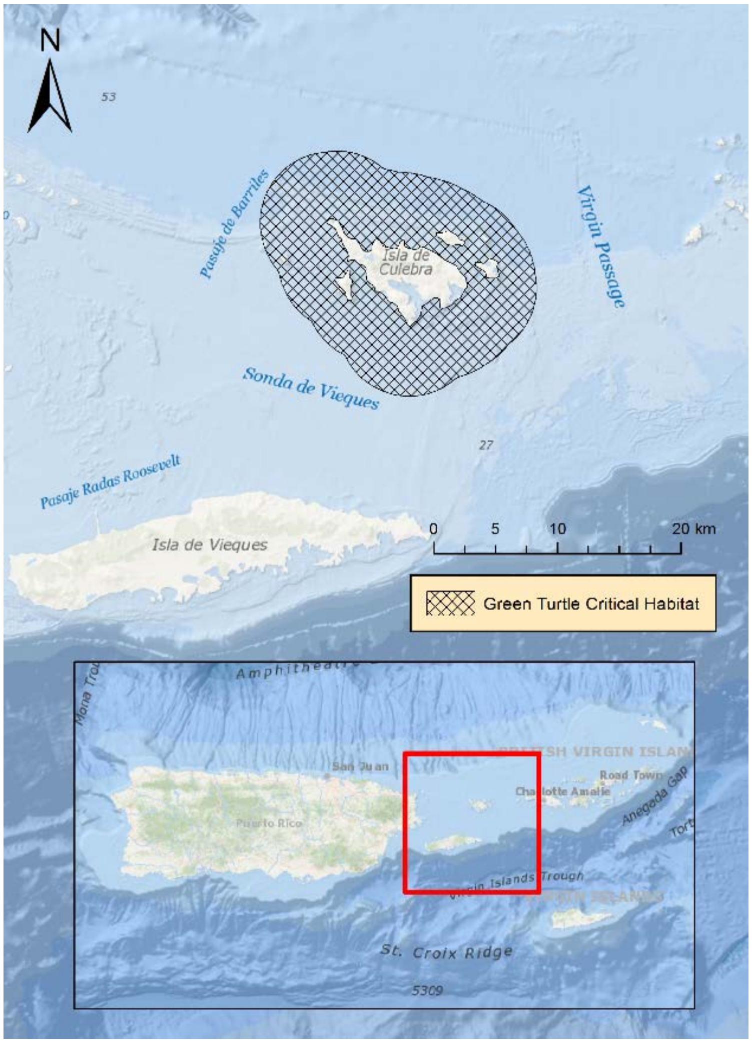

Figure 58: Map depicting green turtle designated critical habitat in Culebra Island, Puerto Rico.

4.2.26.6 *Recovery Goals*

See the 1998 and 1991 recovery plans for the Pacific, East Pacific and Atlantic populations of green turtles for complete down-listing/delisting criteria for recovery goals for the species. Broadly, recovery plan goals emphasize the need to protect and manage nesting and marine habitat, protect and manage populations on nesting beaches and in the marine environment, increase public education, and promote international cooperation on sea turtle conservation topics.

4.2.27 Hawksbill Turtle

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans (Figure 59).

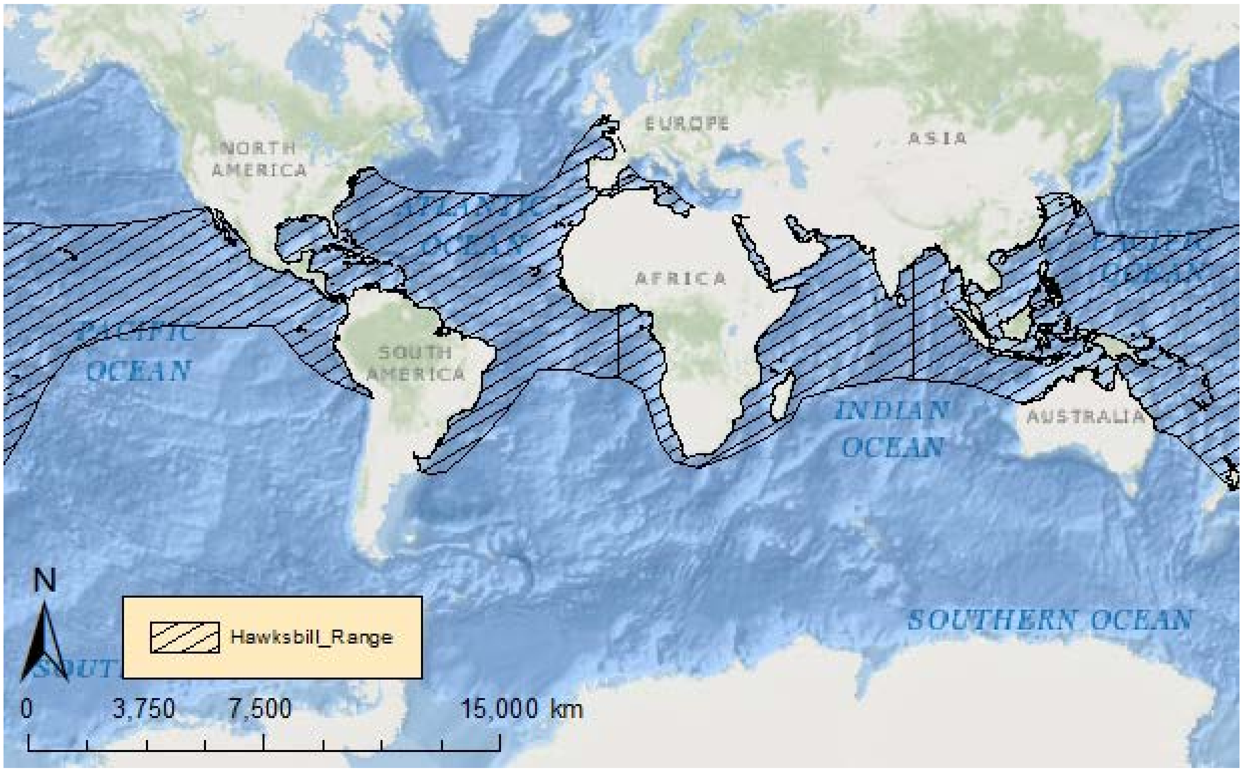

Figure 59. Map identifying the range of the hawksbill turtle.

The hawksbill turtle has a sharp, curved, beak-like mouth and a "tortoiseshell" pattern on its carapace, with radiating streaks of brown, black, and amber (Figure 60). The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973 (Table 36).

Figure 60: Hawksbill turtle. Photo: John Chevalier

Table 36: Hawksbill turtle information bar provides species Latin name, common name and current Federal Register notifications for notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Eretmochelys imbricata	Hawksbill turtle	N/A	Endangered	2013	35 FR 8491	1991	63 FR 46693

We used information available in the five-year reviews (NMFS 2013b; NMFS and USFWS 2007a) to summarize the life history, population dynamics and status of the species, as follows.

4.2.27.1 *Life History*

Hawksbill turtles reach sexual maturity at 20 to 40 years of age. Females return to their natal beaches every two to five years to nest and nest an average of three to five times per season. Clutch sizes are large and can be 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 to 25 centimeters in straight carapace length. As juveniles, they take up residency in coastal waters to forage and grow. As adults, hawksbills use their sharp beak-like mouths to feed on sponges and corals. Hawksbill turtles are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Satellite tagged turtles have shown significant variation in movement and migration patterns. Distance traveled between nesting and foraging locations ranges from a few hundred to a few thousand kilometers (Horrocks et al. 2001; Miller et al. 1998).

4.2.27.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the hawksbill sea turtle.

Surveys at 88 nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS 2013b). 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.

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2013b).

Populations are distinguished generally by ocean basin and more specifically by nesting location. Our understanding of population structure is relatively poor. Genetic analysis of hawksbill turtles foraging off the Cape Verde Islands identified three closely-related haplotypes in a large majority of individuals sampled that did not match those of any known nesting population in the western Atlantic, where the vast majority of nesting has been documented (McClellan et al. 2010; Monzon-Arguello et al. 2010). Hawksbills in the Caribbean seem to have dispersed into separate populations (rookeries) after a bottleneck roughly 100,000 to 300,000 years ago (Leroux et al. 2012).

The hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbills can be found in *Sargassum* mats; post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Bjorndal and Bolten 2010; Musick and Limpus 1997).

4.2.27.3 *Acoustics*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

4.2.27.4 *Status*

Long-term data on the hawksbill turtle indicate that 63 sites have declined over the past 20 to one 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 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.

4.2.27.5 *Critical Habitat*

On September 2, 1998, NMFS established critical habitat for hawksbill turtles around Mona and Monito Islands, Puerto Rico (Figure 61). Aspects of these areas that are important for hawksbill turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill turtle prey.

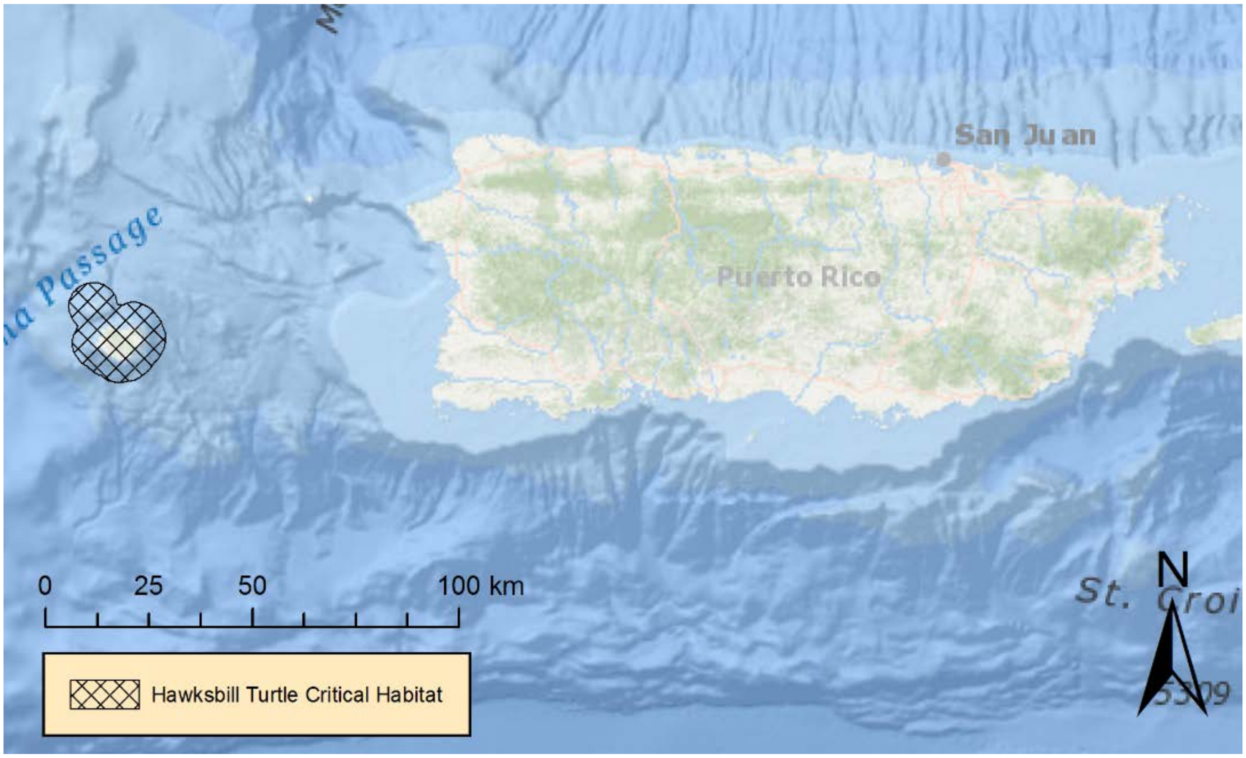

Figure 61. Map depicting hawksbill sea turtle critical habitat.

4.2.27.6 *Recovery Goals*

See the 1992 and 1998 Recovery Plans for the U.S. Caribbean, Atlantic and Gulf of Mexico and U.S. Pacific populations of hawksbill turtles, respectively, for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top recovery actions identified to support in the Recovery Plans:

1. Identify important nesting beaches.
2. Ensure long-term protection and management of important nesting beaches.
3. Protect and manage nesting habitat; prevent the degradation of nesting habitat caused by seawalls, revetments, sand bags, other erosion-control measures, jetties and breakwaters.
4. Identify important marine habitats; protect and manage populations in marine habitat.
5. Protect and manage marine habitat; prevent the degradation or destruction of important [marine] habitats caused by upland and coastal erosion.
6. Prevent the degradation of reef habitat caused by sewage and other pollutants.
7. Monitor nesting activity on important nesting beaches with standardized index surveys.
8. Evaluate nest success and implement appropriate nest-protection on important nesting beaches.
9. Ensure that law-enforcement activities prevent the illegal exploitation and harassment of sea turtles and increase law-enforcement efforts to reduce illegal exploitation.
10. Determine nesting beach origins for juveniles and subadult populations.

4.2.28 Kemp's Ridley Turtle

The Kemp's ridley turtle is considered the most endangered sea turtle internationally (Groombridge 1982; Zwinenberg 1977). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas (Figure 62).

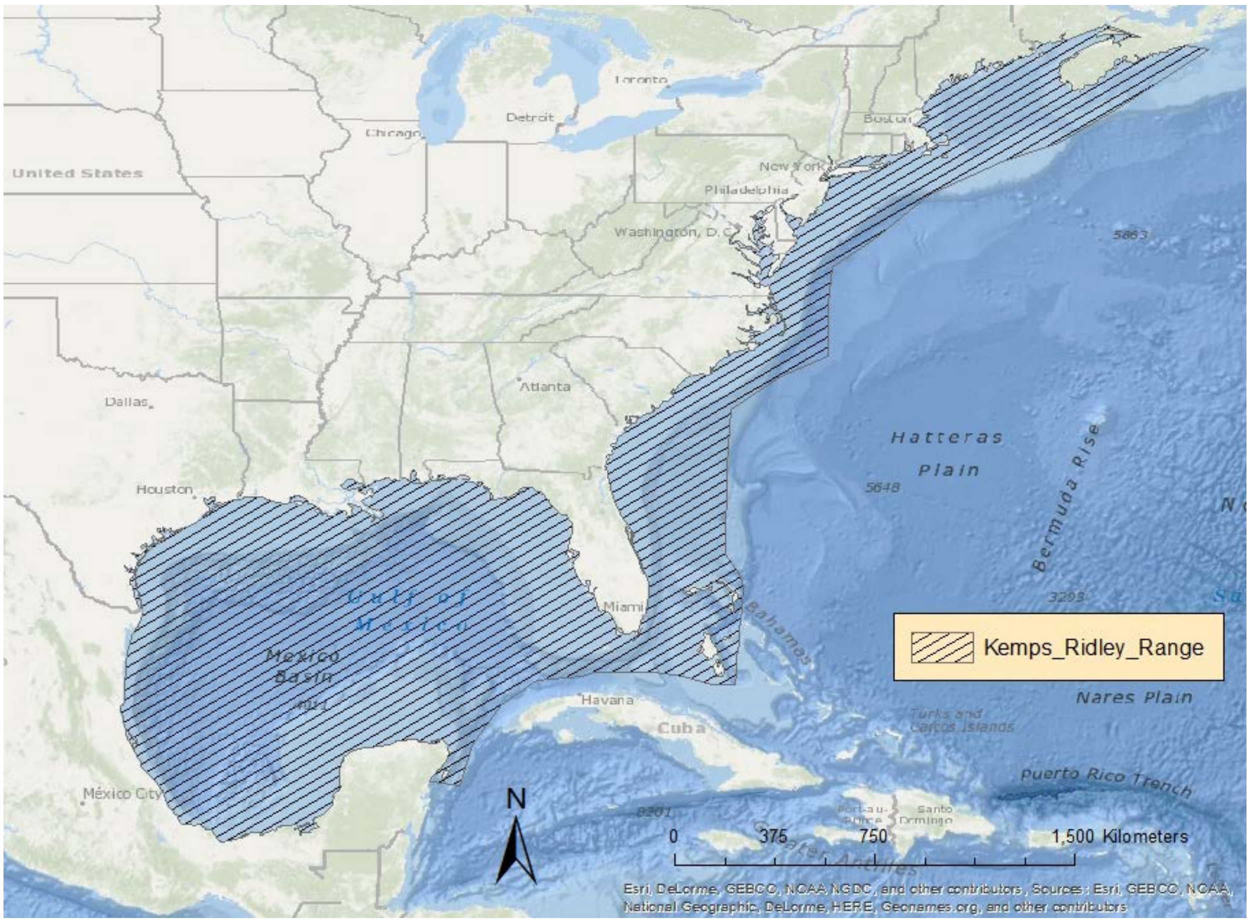

Figure 62. Map identifying the range of the Kemp's ridley turtle.

Kemp's ridley turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell (Figure 63). The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973 (Table 37).

Figure 63: Kemp's ridley turtle. Photo: National Oceanic and Atmospheric Administration.

Table 37. Kemp's ridley turtle information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Lepidochelys kempii	Kemp's ridley turtle	None Designated	Endangered range wide	2015	35 FR 18319	75 FR 12496 U.S. Caribbean, Atlantic, and Gulf of Mexico (draft) U.S. Caribbean, Atlantic, and Gulf of Mexico	None Designated

We used information available in the revised recovery plan (NMFS 2011a) and the five-year review (NMFS 2015b) to summarize the life history, population dynamics and status of the species, as follows.

4.2.28.1 *Life History*

Females mature at 12 years of age. The average remigration is two years. Nesting occurs from April to July in large arribadas, primarily at Rancho Nuevo, Mexico. Females lay an average of

2.5 clutches per season. The annual average clutch size is 97 to 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 two years before returning to nearshore coastal habitats. Juvenile Kemp's ridley turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep, although they can also be found in deeper offshore waters. As adults, Kemp's ridleys forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS 2011a).

4.2.28.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Kemp's ridley turtle.

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS 2015b). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, fifty in 2005, 197 in 2009, and 119 in 2014 (NMFS 2015b).

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2015b).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS 2011a). Additional analysis of the mtDNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

The Kemp's ridley turtle occurs from the Gulf of Mexico and along the Atlantic coast of the United States (TEWG 2000). Kemp's ridley turtles have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomas and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2010).

4.2.28.3 *Acoustics*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

4.2.28.4 *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.

4.2.28.5 *Critical Habitat*

No critical habitat has been designated for Kemp's ridley turtles.

4.2.28.6 *Recovery Goals*

See the 2011 Final Bi-National (United States and Mexico) Revised Recovery Plan for Kemp's ridley turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were identified as priorities to recover Kemp's ridley turtles:

1. Protect and manage nesting and marine habitats.

2. Protect and manage populations on the nesting beaches and in the marine environment.
3. Maintain a stranding network.
4. Manage captive stocks.
5. Sustain education and partnership programs.
6. Maintain, promote awareness of and expand United States and Mexican laws.
7. Implement international agreements.
8. Enforce laws.

4.2.29 Leatherback Turtle

The leatherback 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 (Figure 64).

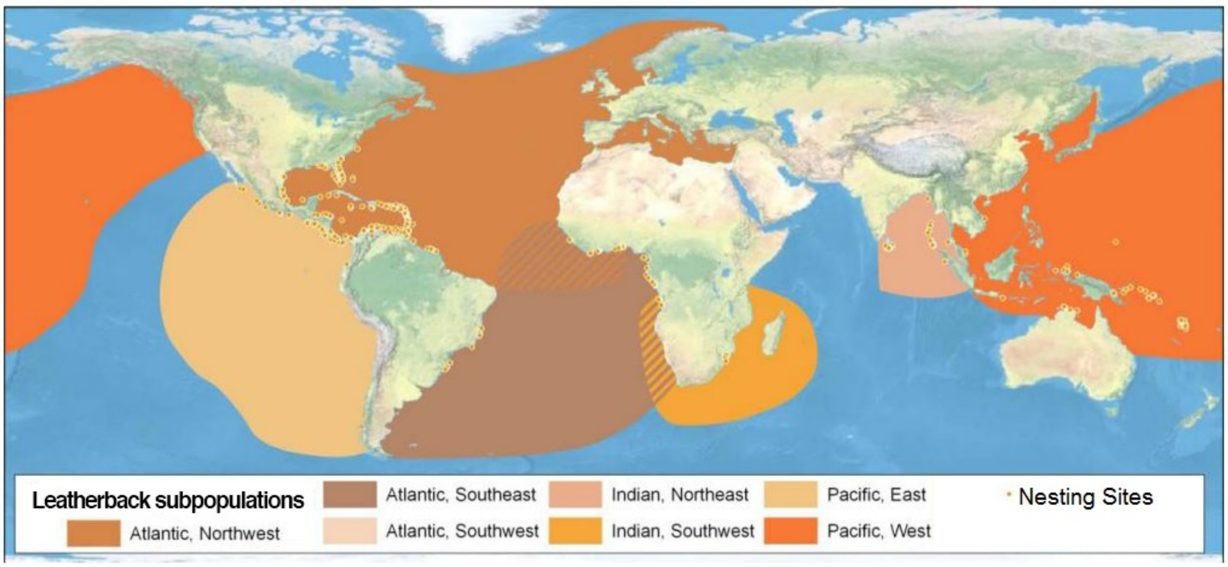

Figure 64: Map identifying the range of the leatherback turtle. Adapted from Wallace et al. (2010).

Leatherbacks are the largest living turtle, reaching lengths of six feet long, and weighing up to one ton. Leatherback sea turtles have a distinct black leathery skin covering their carapace with pinkish white skin on their belly (Figure 65). The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973 (Table 38).

Figure 65: Leatherback turtle. Photo: R.Tapilatu

Table 38. Leatherback turtle information bar provides species Latin name, common name and current Federal Register notifications for notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Dermochelys coriacea	Leatherback turtle	N/A	Endangered	2013	35 FR 8491	63 FR 28359 Pacific U.S. Caribbean, Atlantic and Gulf of Mexico	44 FR 17710 and 77 FR 4170

We used information available in the five-year review (NMFS 2013c) and the critical habitat designation to summarize the life history, population dynamics and status of the species, as follows.

4.2.29.1 *Life History*

Age at maturity has been difficult to ascertain, with estimates ranging from five to 29 years (Avens et al. 2009; Spotila et al. 1996). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50 percent worldwide (Eckert et al. 2012). Females nest every one to seven years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33 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). Leatherback turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

4.2.29.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the leatherback turtle.

Leatherbacks are globally distributed, with nesting beaches in the Pacific, Atlantic, and Indian oceans. Detailed population structure is unknown, but is likely dependent upon nesting beach location. Based on estimates calculated from nest count data, there are between 34,000 and 94,000 adult leatherbacks in the North Atlantic (TEWG 2007). In contrast, leatherback populations in the Pacific are much lower. Overall, Pacific populations have declined from an estimated 81,000 individuals to less than 3,000 total adults and subadults (Spotila et al. 2000). Population abundance in the Indian Ocean is difficult to assess due to lack of data and inconsistent reporting. Available data from southern Mozambique show that approximately ten females nest per year from 1994 to 2004, and about 296 nests per year counted in South Africa (NMFS 2013c).

Population growth rates for leatherback turtles vary by ocean basin. Counts of leatherbacks at nesting beaches in the western Pacific indicate that the subpopulation has been declining at a rate of almost six percent per year since 1984 (Tapilatu et al. 2013). Leatherback subpopulations in the Atlantic Ocean, however, are showing signs of improvement. Nesting females in South Africa are increasing at an annual rate of four to 5.6 percent, and from nine to 13 percent in Florida and the U.S. Virgin Islands (TEWG 2007), believed to be a result of conservation efforts.

Analyses of mtDNA from leatherback turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS 2013c).

Leatherback turtles are distributed in oceans throughout the world Figure 64). Leatherbacks occur throughout marine waters, from nearshore habitats to oceanic environments (Shoop and

Kenney 1992). Movements are largely dependent upon reproductive and feeding cycles and the oceanographic features that concentrate prey, such as frontal systems, eddy features, current boundaries, and coastal retention areas (Benson et al. 2011).

4.2.29.3 *Acoustics*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

4.2.29.4 *Status*

The leatherback turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback turtles include fisheries bycatch, harvest of nesting females and their eggs. Because of these threats, once large rookeries are now functionally extinct, and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism, and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat), and habitat (through the loss of nesting beaches, because of sea-level rise. The species' resilience to additional perturbation is low.

4.2.29.5 *Critical Habitat*

On March 23, 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 meter isobath to mean high tide level between 17°42'12" North and 65°50'00" West (Figure 66). This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. The designated critical habitat is within the Sandy Point National Wildlife Refuge. Leatherback nesting increased at an annual rate of thirteen percent from 1994 to 2001; this rate has slowed according to nesting data from 2001 to 2010 (NMFS 2013c).

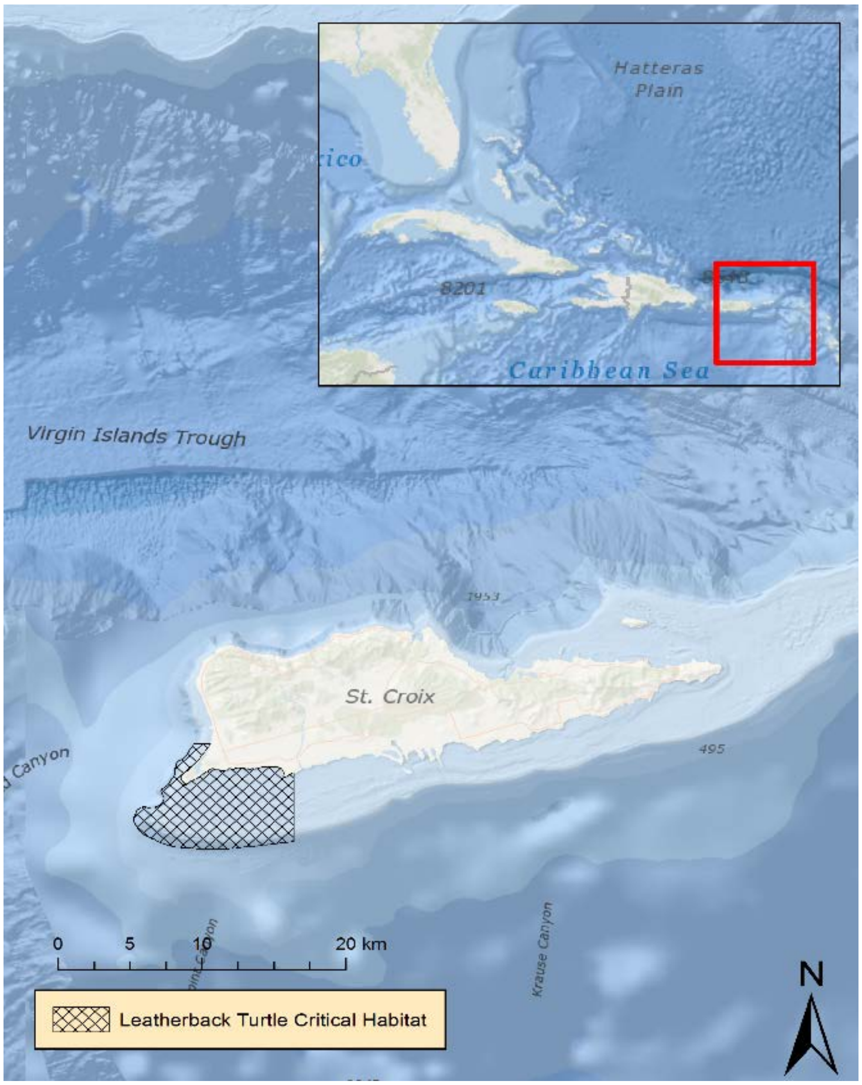

Figure 66: Map depicting leatherback turtle designated critical habitat in the United States Virgin Islands.

On January 20, 2012, NMFS issued a final rule to designate additional critical habitat for the leatherback turtle. This designation includes approximately 43,798 square kilometers stretching along the California coast from Point Arena to Point Arguello east of the 3000 meter depth contour; and 64,760 square kilometers stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meters depth contour (Figure 67). The designated areas comprise approximately 108,558 square kilometers of marine habitat and include waters from the ocean surface down to a maximum depth of 80 meters. They were designated specifically because of the occurrence of prey species, primarily *scyphomedusae* of the order Semaeostomeae (i.e., jellyfish), of sufficient condition, distribution, diversity, abundance and density necessary to support individual as well as population growth, reproduction, and development of leatherbacks.

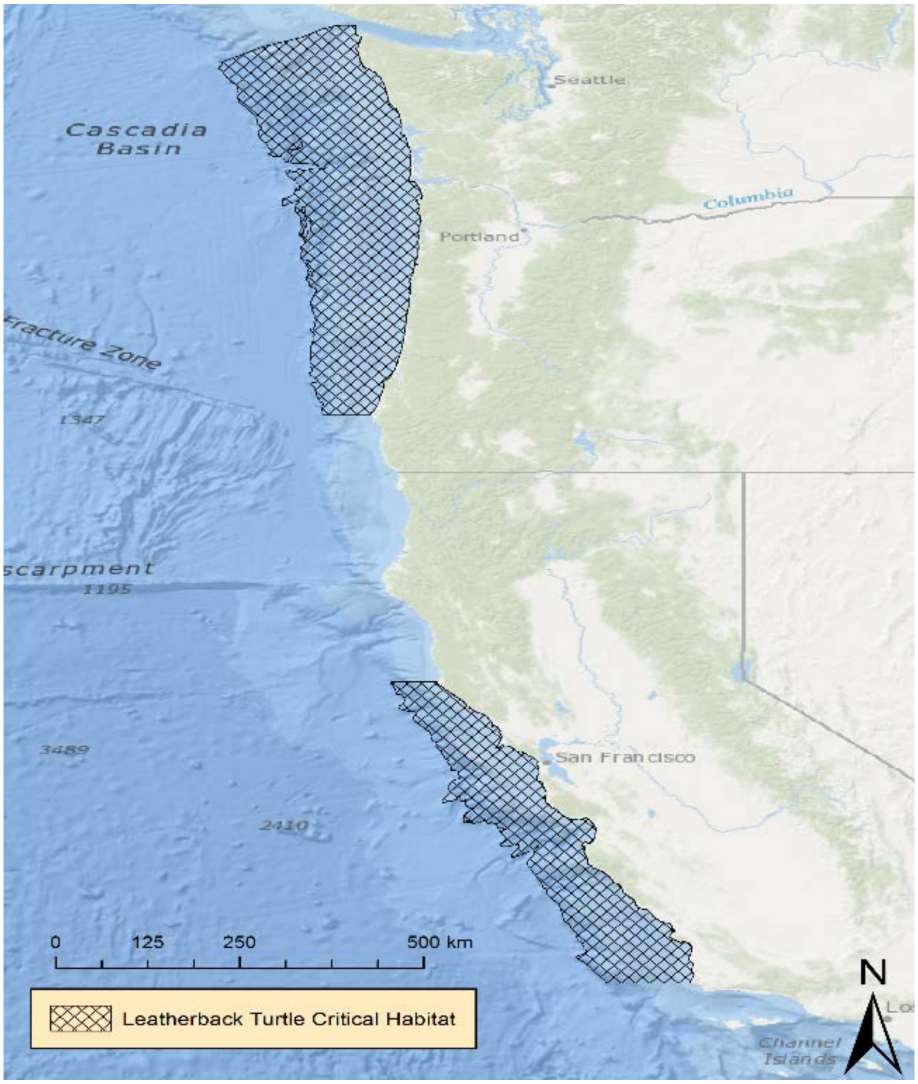

Figure 67: Map depicting leatherback turtle designated critical habitat along the United States Pacific Coast.

4.2.29.6 *Recovery Goals*

See the 1998 and 1991 Recovery Plans for the U.S. Pacific and U.S. Caribbean, Gulf of Mexico and Atlantic leatherback sea turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items are the top five recovery actions identified to support in the Leatherback Five Year Action Plan:

1. Reduce fisheries interactions.
2. Improve nesting beach protection and increase reproductive output.
3. International cooperation.
4. Monitoring and research.

5. Public engagement.

4.2.30 Loggerhead Turtle (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean Distinct Population Segments)

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans (Figure 68).

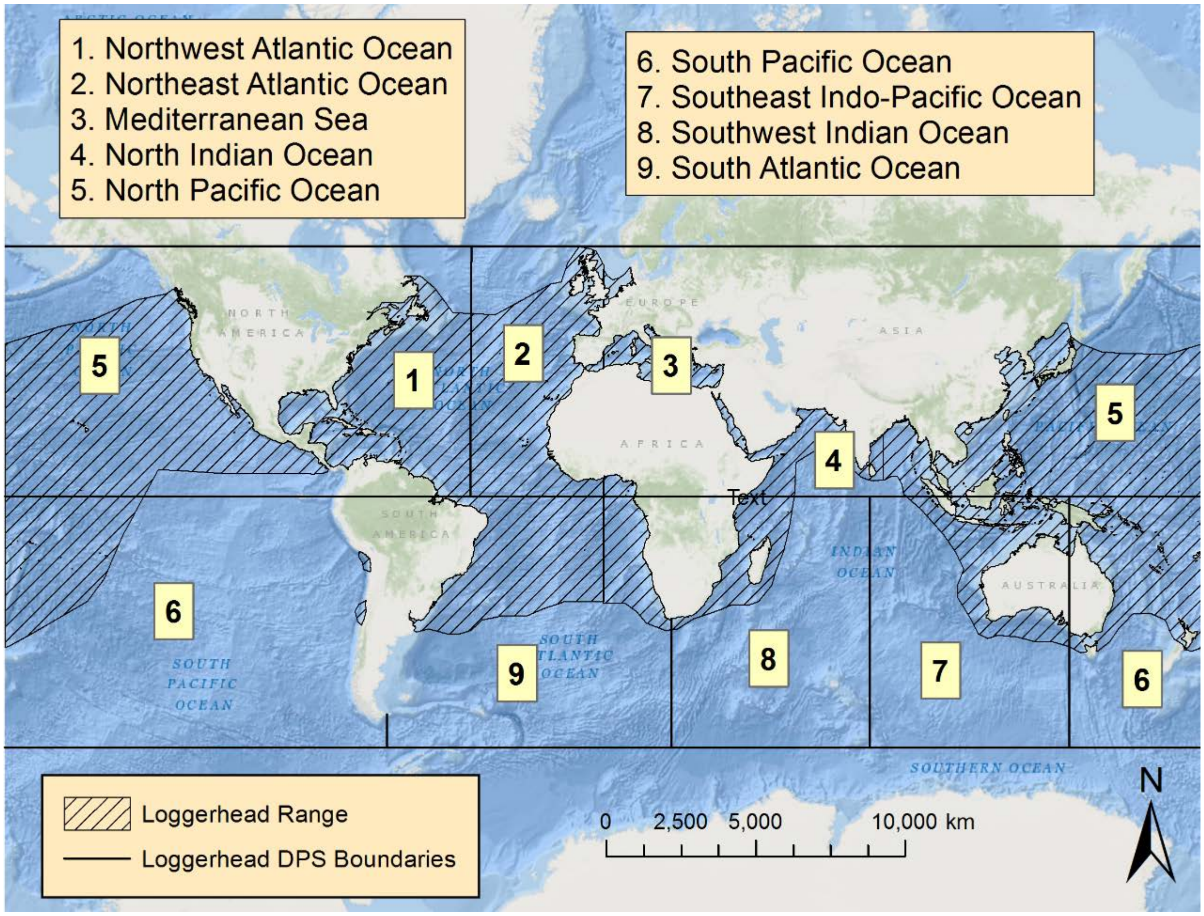

Figure 68. Map identifying the range and distinct population segment boundaries of the loggerhead sea turtle.

The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws (Figure 69). The species was first listed as threatened under the Endangered Species Act in 1978. On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles: South Atlantic Ocean and Southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, Northwest Atlantic Ocean, South Pacific Ocean, and Southeast Indo-Pacific Ocean as endangered (Table 39). Recent ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based upon nesting beaches (Shamblin et al. 2014). Only the Northwest Atlantic, North Pacific, and South Pacific DPSs are considered in this opinion, as all other DPSs fall outside the action area for cetacean net captures.

Figure 69: Loggerhead sea turtle. Photo: National Oceanic and Atmospheric Administration.

Table 39. Loggerhead sea turtle information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Caretta caretta	Loggerhead sea turtle	Northwest Atlantic Ocean	Threatened	2009	76 FR 58868	2009	79 FR 39855
		North Pacific Ocean	Endangered	2009	76 FR 58868	1998	None Designated
		South Pacific Ocean	Endangered	2009	76 FR 58868	None	None Designated

We used information available in the 2009 Status Review (Conant et al. 2009) and the final listing rule to summarize the life history, population dynamics and status of the species, as follows.

4.2.30.1 *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 on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the turtle during the middle of the incubation period. Turtles spend the post-hatchling stage in pelagic waters. The juvenile stage is spent first in the oceanic zone and later in the neritic zone (i.e., coastal waters). Coastal waters provide important foraging habitat, inter-nesting habitat, and migratory habitat for adult loggerheads.

4.2.30.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the loggerhead sea turtle.

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). Adult nesting females often account for less than one percent of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320 to 44,560 (Spotila 2004). Abundance estimates for the loggerhead sea turtle DPSs are found in (Table 40).

Table 40. Abundance estimates for loggerhead sea turtle distinct population segments.

Distinct Population Segment	Abundance Estimate	Citation
North Pacific Ocean	2,300 nesting females annually; 43,320 to 44,560 individuals	(Matsuzawa 2011; Seminoff et al. 2014)
Northwest Atlantic Ocean	53,000 to 92,000 nests annually	(NMFS-SEFSC 2009)
Northern Recovery Unit	5,215 nests, on average, 1989 to 2008	(NMFS and USFWS 2008)
Peninsular Florida Recovery Unit	>10,000 nesting females annually	(Ehrhart et al. 2003)
Greater Caribbean Recovery Unit	903 to 2,700 nests annually	(Ehrhart et al. 2003; NMFS and USFWS 2008; Zurita et al. 2003)
Dry Tortugas Recovery Unit	246 nests annually	(NMFS and USFWS 2007b)
Gulf of Mexico Recovery Unit	100 to 999 nesting females annually	(NMFS-SEFSC 2009)
South Pacific Ocean	200 nesting females annually	(Wabnitz and Andréfouët 2008)

Overall, Gilman (2009) estimated that the number of loggerheads nesting in the Pacific (thus both North Pacific and South Pacific Ocean DPSs) has declined by eighty percent in the past twenty years. There was a steep (fifty to ninety percent) decline in the annual nesting population in Japan, which would be from the North Pacific Ocean DPS, during the last half of the twentieth century (Kamezaki et al. 2003) Since then, nesting has gradually increased here, but is still considered to be depressed compared to historical numbers, and the population growth rate is negative (-0.032) (Conant et al. 2009). Eastern Australia (South Pacific Ocean DPS) supported one of the major global loggerhead nesting assemblages until recently (Limpus 1985). For many years, the nesting population at Queensland was in decline; there were approximately 3,500 females in the 1976 and 1977 nesting season, and less than 500 in 1999, representing an 86 percent reduction in the size of the annual nesting population in twenty-three years (Limpus and Reimer 1994; Limpus 1985; Limpus and Limpus 2003). From 2000 to 2009, there has been an increasing number of females nesting. Despite that increase, the arithmetic mean of the log - population growth rate calculated for various nesting beaches in eastern Australia range from - 0.013 to -0.075 (Conant et al. 2009). Population modeling focusing on a nesting beach in Queensland, Australia indicates that the loss of only a few hundred adult and sub-adult females would lead to the extinction of the population in eastern Australia in less than one hundred years (Heppell et al. 1996).

The population growth rate for each of the four of the recovery units for the Northwest Atlantic DPS (Peninsular Florida, Northern, Northern Gulf of Mexico, and Greater Caribbean) all exhibit negative growth rates (Conant et al. 2009). Nest counts taken at index beaches in Peninsular Florida show a significant decline in loggerhead nesting from 1989 to 2006, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Loggerhead nesting on the Archie Carr National Wildlife Refuge (representing individuals of the Peninsular Florida subpopulation) has fluctuated over the past few decades. There was an average of 9,300 nests throughout the 1980s, with the number of nests increasing into the 1990s until it reached an all-time high in 1998, with 17,629 nests. From that point, the number of loggerhead nests at the Refuge have declined steeply to a low of 6,405 in 2007, increasing again to 15,539, still a lower number of nests than in 1998 (Bagley et al. 2013). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina and Georgia declined at 1.9 percent annually from 1983 to 2005 (NMFS and USFWS 2007b). The nesting subpopulation in the Florida panhandle has exhibited a significant declining trend from 1995 to 2005 (Conant et al. 2009; NMFS and USFWS 2007b). Recent model estimates predict an overall population decline of 17 percent for the St. Joseph Peninsula, Florida subpopulation of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014).There are nine loggerhead DPSs, which are geographically separated and genetically isolated, as indicated by genetic, tagging, and telemetry data. Our understanding of the genetic diversity and population structure of the different loggerhead DPSs is being refined as more studies examine samples from a broader range of specimens using longer mtDNA sequences.

Loggerhead turtles were separated into DPS due, in part, to their distinct genetic differences. However, recent mtDNA analysis using longer sequences has revealed an even more complex population sub-structure for the North Pacific Ocean DPS. Previously, five haplotypes were present, and now, nine haplotypes have been identified in the North Pacific Ocean DPS. This evidence supports the designation of three management units in the North Pacific Ocean DPS: 1) the Ryukyu management unit (Okinawa, Okinoerabu, and Amami), 2) Yakushima Island management unit and 3) Mainland management unit (Bousou, Enshu-nada, Shikoku, Kii and Eastern Kyushu) (Matsuzawa et al. 2016). Genetic analysis of loggerheads captured on the feeding grounds of Sanriku, Japan, found only haplotypes present in Japanese rookeries (Nishizawa et al. 2014). Based on genetic analysis of nesting subpopulations, the Northwest

Atlantic Ocean DPS is further divided into five recovery units: Northern, Peninsular Florida, Dry Tortugas, Northern Gulf of Mexico, and Greater Caribbean (Conant et al. 2009). A more recent analysis using expanded mtDNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct, and that rookeries from Mexico's Caribbean coast express high haplotype diversity (Shamblin et al. 2014). Furthermore, the results suggest that the Northwest Atlantic Ocean DPS should be considered as ten management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012). South Pacific Ocean DPS loggerheads possess three haplotypes, including one dominant haplotype not found elsewhere (Conant et al. 2009).

Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans, returning to their natal region for mating and nesting (Figure 68). Adults and sub-adults occupy nearshore habitat. While in their oceanic phase, loggerheads undergo long migrations using ocean currents. Individuals from multiple nesting colonies can be found on a single feeding ground. Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71 to 88 percent) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madiera, Canary Islands and Adalusia, Gulf of Mexico and Brazil (Masuda 2010). Hatchlings from Japanese nesting beaches use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to foraging grounds. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off of Mexico's Baja California Peninsula. Both of these feeding grounds are frequented by individuals from Japanese nesting beaches (Abecassis et al. 2013; Seminoff et al. 2014). Loggerheads hatched on beaches in the southwest Pacific range widely in the southern portion of the basin, with individuals from nesting beaches in western Australia found as far east as Peruvian coast foraging areas (Boyle et al. 2009). Loggerhead sea turtles are also present in the waters offshore northern Chile and Peru, where they comprise the majority of sea turtle bycatch in commercial fisheries (Alfaro-Shigueto et al. 2011; Donoso and Dutton 2010).

4.2.30.3 *Acoustics*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at

300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

4.2.30.4 *Status*

Once abundant in tropical and subtropical waters, loggerhead sea turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation. Globally, egg harvest, the harvest of females on nesting beaches and directed hunting of turtles in foraging areas remain the greatest threats to their recovery. In addition, bycatch in drift-net, long-line, set-net, pound-net and trawl fisheries kill thousands of loggerhead sea turtles annually. Increasing coastal development (including beach erosion and re-nourishment, construction and artificial lighting) threatens nesting success and hatchling survival. On a regional scale, the different DPSs experience these threats as well, to varying degrees. Differing levels of abundance combined with different intensities of threats and effectiveness of regional regulatory mechanisms make each DPS uniquely susceptible to future perturbations.

Neritic juveniles and adults in the North Pacific Ocean DPS are at risk of mortality from coastal fisheries in Japan and Baja California, Mexico. Habitat degradation in the form of coastal development and armoring pose a threat to nesting females. Based on these threats and the relatively small population size, the Biological Review Team concluded that the North Pacific Ocean DPS is currently at risk of extinction (Conant et al. 2009). Based on nest count data from the past thirty years, and mortality of juveniles and adults from fishery bycatch, the South Pacific Ocean DPS is at risk, and is likely to decline in the foreseeable future (Conant et al. 2009; Limpus 2008). Due to declines in nest counts at index beaches in the United States and Mexico, and continued mortality of juveniles and adults from fishery bycatch, the Northwest Atlantic Ocean DPS is at risk and likely to decline in the foreseeable future (Conant et al. 2009).

4.2.30.5 *Critical Habitat (Northwest Atlantic Ocean Distinct Population Segment)*

The only designated critical habitat for loggerhead sea turtles is along the U.S. Atlantic and Gulf of Mexico coasts, for the Northwest Atlantic Ocean DPS loggerhead sea turtles. On July 10, 2014, NMFS and FWS designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtles along the U.S. Atlantic and Gulf of Mexico coasts from North Carolina to Mississippi. These areas contain one or a combination of nearshore reproductive habitat, winter area, breeding areas, and migratory corridors. The critical habitat is categorized into 38 occupied marine areas and 685 miles of nesting beaches (Figure 70).

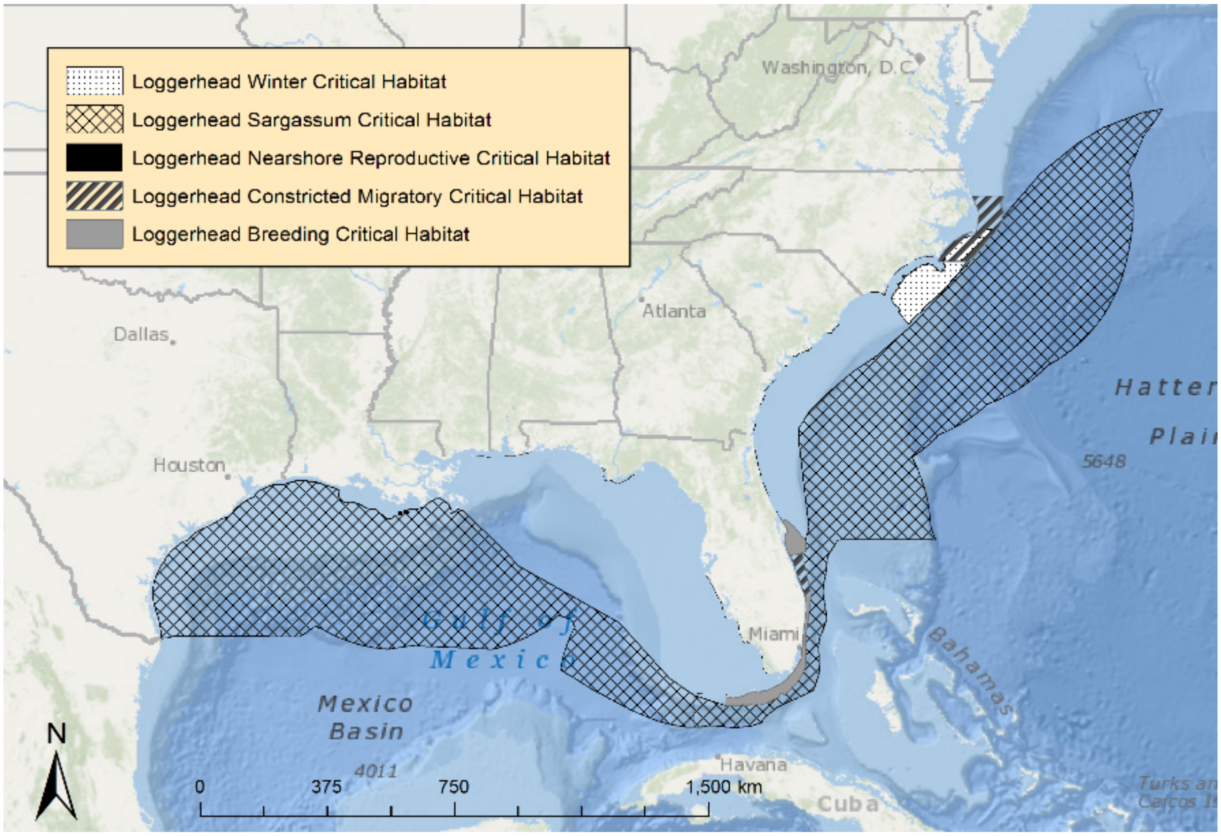

Figure 70: Map identifying designated critical habitat for the Northwest Atlantic Ocean DPS loggerhead sea turtle.

The physical or biological features and primary constituent elements identified for the different habitat types include waters adjacent to high density nesting beaches, waters with minimal obstructions and manmade structures, high densities of reproductive males and females, appropriate passage conditions for migration, conditions that support sargassum habitat, available prey, and sufficient water depth and proximity to currents to ensure offshore transport of post-hatchlings.

4.2.30.6 *Recovery Goals*

See the 2009 Final Recovery Plan for the Northwest Atlantic Population of Loggerheads for complete down listing/delisting criteria for each of the following recovery objectives.

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.

3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, Federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

4.2.31 Olive Ridley Turtle (breeding populations on the Pacific Coast of Mexico and all other areas)

The olive ridley turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution (Figure 71).

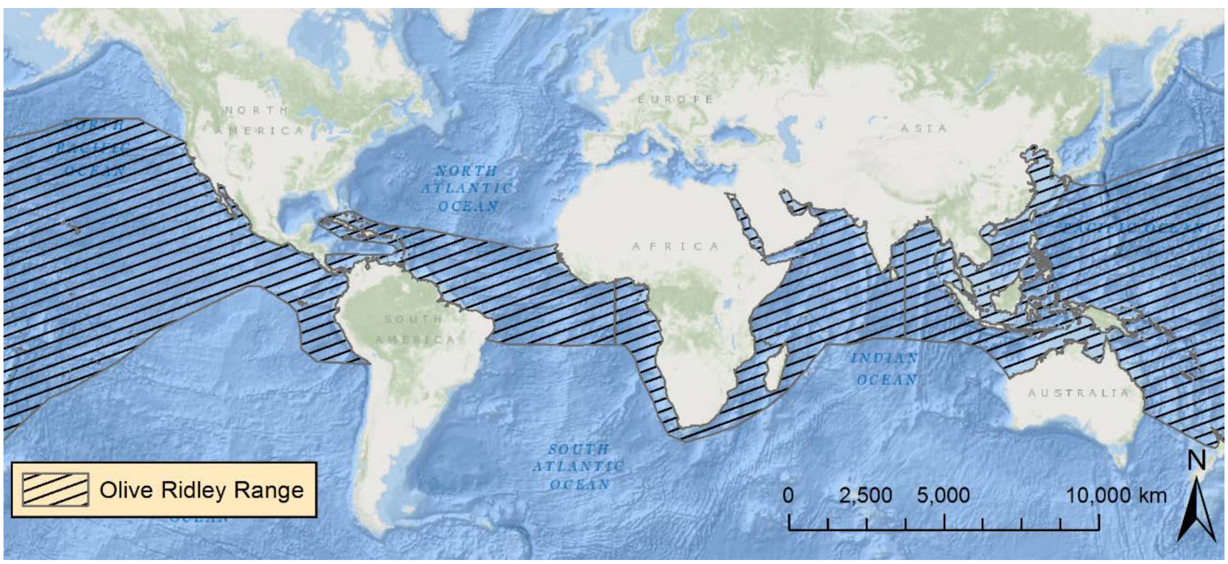

Figure 71. Map identifying the range of the olive ridley turtle.

Olive ridley turtles are olive or grayish-green in color, with a heart-shaped carapace (Figure 72). The species was listed under the ESA on July 28, 1978. 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) (Table 41).

Figure 72: Olive ridley turtle. Photo: Reuven Walder.

Table 41. Olive ridley turtle all other populations information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Lepidochelys olivacea	Olive ridley turtle	All other populations	Threatened	2014	43 FR 32800	N/A	None Designated
		Breeding population of the Pacific Coast of Mexico	Endangered	2014	43 FR 32800	1998	None Designated

We used information available in the five-year review (NMFS and USFWS 2014) to summarize the life history, population dynamics and status of the threatened olive ridley turtle, as follows.

4.2.31.1 *Life History*

Olive ridley females mature at 10 to 18 years of age. They lay an average of two clutches per season (three to six months in duration). The annual average clutch size is 100 to 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. The post-breeding behavior of olive ridleys in the eastern Pacific Ocean is unique in that they are nomadic, migrating across ocean basins. This contrasts with other sea turtle species, which typically migrate to a particular feeding ground after nesting. As adults, olive ridleys forage on crustaceans, fish, mollusks, and tunicates, primarily in pelagic habitats.

4.2.31.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the olive ridley turtle.

Olive ridley turtles are thought to be the most abundant species of turtle, and can be found in the Atlantic, Indian and Pacific Oceans. There is no global estimate of olive ridley abundance, and we rely primarily on nest counts and nesting females to estimate abundance for the breeding populations on the Pacific Coast of Mexico and all other areas, as described below.

Shipboard transects along the Mexico and Central American coasts between 1992 and 2006 indicate an estimated 1.39 million adults. There are six primary arribada nesting beaches in Mexico, the largest being La Escobilla, with about one million nesting females annually. There are several monitored nesting beaches where solitary nesting occurs. At Nuevo Vallarta, about 4,900 nests are laid annually.

In the western Atlantic, two arribada nesting beaches occur in Suriname and French Guiana. The Cayenne Peninsula in French Guiana hosts about 2,000 nests annually, while the Galibi Nature Reserve in Suriname had 335 nests in 1995. Solitary nesting also occurs elsewhere in Suriname, Guyana and French Guiana, although no abundance estimates are available. In Sergipe, Brazil, solitary nesting amounted to about 2,600 nests in 2002 and 2003.

In the eastern Atlantic, there are no arribada nesting beaches, but solitary nesting occurs in several countries along the western coast of Africa, from Gambia to Angola. For many countries, there are no abundance estimates available. For beaches with data available (Angola, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Guinea Bissau), nest counts are low, with most monitoring taking place for only a few years. The most abundant nesting beaches are Orango National Park in Guinea Bissau, which had between 170 and 620 nests from 1992 to 1994; and the Republic of Congo, which had between 300 and 600 nests annually from 2003 to 2010 (NMFS and USFWS 2014).

In the Indian Ocean, three arribada nesting beaches are found in India, amounting to 150,000 to 200,000 nesting females annually. Solitary nesting also occurs elsewhere in the region, in eastern Africa, Oman, India, Pakistan, and other southeast Asian countries; for many, there are no estimates available. The largest recorded solitary nesting beach is in Myanmar, when in 1999, 700 nests were counted (NMFS and USFWS 2014).

There are no known arribada nesting beaches in the western Pacific; however, some solitary nesting occurs in Australia, Brunei, Malaysia, Indonesia and Vietnam. Data are lacking for many sites. Terengganu, Malaysia had 10 nests in 1998 and 1999. Alas Purwo, Indonesia, had 230 nests annually from 1993 to 1998.

In the eastern Pacific (excluding breeding populations in Mexico), there are arribada nesting beaches in Nicaragua, Costa Rica and Panama. La Flor, Nicaragua had 521,440 effective nesting females in 2008 and 2009; Chacocente, Nicaragua had 27,947 nesting females over the same period (Gago et al. 2012). Two other arribada nesting beaches are in Nicaragua, Masachapa and Pochomil, but there are no abundance estimates available. Costa Rica hosts two major arribada nesting beaches; Ostional has between 3,564 and 476,550 turtles per arribada, and Nancite has between 256 and 41,149 turtles per arribada. Panama has one arribada nesting beach, with 8,768 turtles annually. There are also several solitary nesting beaches in the eastern Pacific (excluding breeding populations in Mexico); however no abundance estimates are available for beaches in El Salvador, Honduras, Nicaragua, Costa Rica, Panama, Columbia and Ecuador. On Hawaii Beach in Guatemala, 1,004 females were recorded in 2005 (NMFS and USFWS 2014).

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), decreasing at Chacahua, and stable at all others. At-sea estimates of olive ridleys off of Mexico and Central America also support an increasing population trend.

Population growth rate and trend information for the threatened population of olive ridley sea turtles is difficult to discern, owing to its range over a large geographic area, and a lack of consistent monitoring data in all nesting areas. Below, we present any known population trend information for olive ridley sea turtles by ocean basin (NMFS and USFWS 2014).

Nesting at arribada beaches in French Guiana appears to be increasing, while in Suriname, nesting has declined by more than ninety percent since 1968. Solitary nesting also occurs elsewhere in Suriname, Guyana and French Guiana; no trend data are available. Solitary nesting in Brazil appears to be increasing, with 100 nests recorded in 1989 to 1990, to 2,606 in 2002 to 2003.

In the eastern Atlantic, trend data is not available for most solitary nesting beaches. Nest counts in the Republic of Congo decreased from 600 nests in 2003 and 2004 to less than 300 in 2009 and 2010.

The three arribada nesting beaches in India—Gahirmatha, Rushikulya, and Devi River—are considered stable over three generations. There is no trend data available for several solitary nesting beaches in the Indian Ocean. However, even for the few beaches with short-term monitoring, the nest counts are believed to represent a decline from earlier years.

There are no arribada nesting beaches in the western Pacific. Data are lacking or inconsistent for many solitary nesting beaches in the western Pacific, so it is not possible to assess population trends for these sites. Nest counts at Alas Purwo, Indonesia, appear to be increasing, the nest count at Terengganu, Malaysia, is thought to be a decline from previous years.

Population trends at Nicaraguan arribada nesting beaches are unknown or stable (La Flor). Ostional, Costa Rica arribada nesting beach is increasing, while trends Nancite, Costa Rica, and Isla Cañas, Panama, nesting beaches are declining. For most solitary nesting beaches in the eastern Pacific, population trends are unknown, except for Hawaii Beach, Guatemala, which is decreasing.

Genetic studies have identified four main lineages of olive ridleys: east India, Indo-Western Pacific, Atlantic, and the eastern Pacific. In the eastern Pacific, rookeries on the Pacific coasts of Costa Rica and Mexico were not genetically distinct, and fine-scale population structure was not found when solitary and arribada nesting beaches were examined. There was no population subdivision among olive ridleys along the east India coastline. Low levels of genetic diversity among Mexican, Atlantic French New Guinea, and eastern Pacific Baja California nesting sites are attributed to a population collapse caused by past overharvest (NMFS and USFWS 2014).

Globally, olive ridley sea turtles can be found in tropical and subtropical waters in the Atlantic, Pacific and Indian Oceans (Figure 71). The range of the endangered Pacific coast breeding population extends as far south as Peru and up to California. Olive ridley sea turtles of the Pacific coast breeding colonies nest on arribada beaches at Mismaloya, Ixtapilla and La Escobilla, Mexico. Solitary nesting takes place all along the Pacific coast of Mexico. Major nesting arribada beaches for threatened olive ridley turtles are found in Nicaragua, Costa Rica, Panama, India and Suriname.

4.2.31.3 *Acoustics*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

4.2.31.4 *Status*

In the first half of the twentieth century, there was an estimated ten million olive ridleys nesting on the Pacific coast of Mexico. Olive ridleys became targeted in a fishery in Mexico and Ecuador, which severely depleted the population; there was an estimated one million olive ridleys by 1969. Olive ridley breeding populations on the Pacific coast of Mexico were listed as endangered in response to this severe population decline. Legal harvest of olive ridleys has been prohibited, although illegal harvest still occurs. The population is subject to incidental capture in fisheries, exposure to pollutants, and climate change. In spite of the severe population decline, the olive ridley breeding populations on the Pacific coast of Mexico appear to be resilient, evidenced by the increasing population.

For threatened olive ridley turtles in all other areas, it is likely that solitary nesting locations once hosted large arribadas; since the 1960s, populations have experienced declines in abundance of 50 to 80 percent. Many populations continue to decline. Olive ridley 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 turtle is the most abundant sea turtle in the world; however, several populations are declining as a result of continued harvest and fisheries bycatch. The large population size of the range-wide population, however, allows some resilience to future perturbation.

4.2.31.5 *Critical Habitat*

No critical habitat has been designated for the olive ridley sea turtles of the breeding population of the Pacific coast of Mexico range-wide, nor the range-wide threatened population of olive ridley turtles.

4.2.31.6 *Recovery Goals*

There has not been a Recovery Plan prepared specifically for the range-wide, threatened population of olive ridley turtles. The 1998 Recovery Plan was prepared for olive ridleys found in the U.S. Pacific. Olive ridley turtles found in the Pacific could originate from the Pacific Coast of Mexico or from another nesting population. As such, the recovery goals in the 1998 Recovery Plan for the U.S Pacific olive ridley turtle can apply to both listed populations. See the 1998 Recovery Plan for the U.S. Pacific olive ridley turtles for complete down listing/delisting criteria for their recovery goals. The following items were the recovery criteria identified to consider delisting:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region.
3. All females estimated to nest annually at source beaches are either stable or increasing for over ten years.
4. Management plan based on maintaining sustained populations for turtles is in effect.
5. International agreements in place to protect shared stocks.

4.2.32 Atlantic Sturgeon (Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic Distinct Population Segments)

The Atlantic sturgeon is a long lived, late maturing, sub-tropical, anadromous species. They occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASMFC 2006; Stein et al. 2004) (Figure 73).

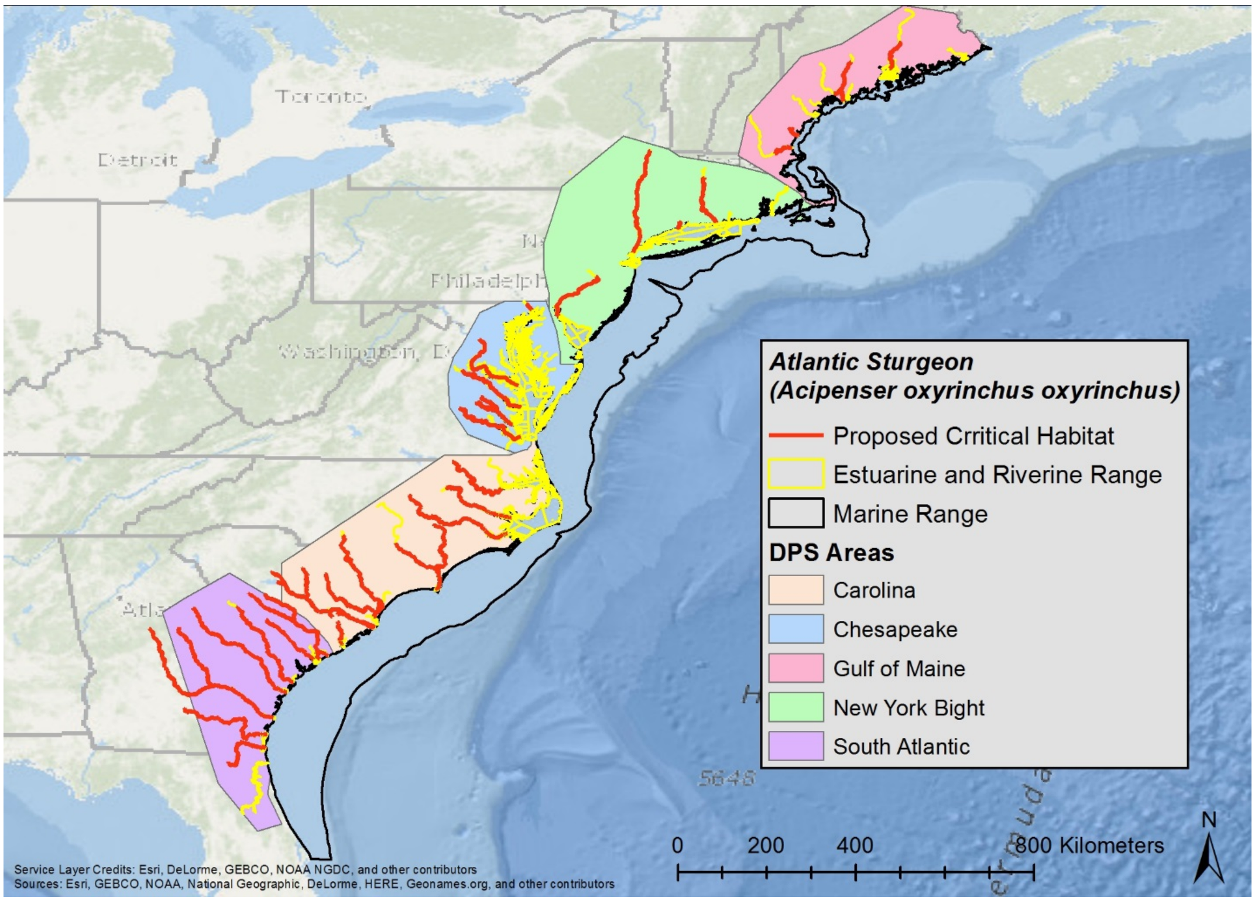

Figure 73: Map depicting the range and proposed critical habitat for Atlantic sturgeon distinct population segments.

Atlantic sturgeon attain lengths of up to approximately 14 feet, and weights of more than 800 pounds. They are bluish black or olive brown dorsally with paler sides and a white ventral surface and have five major rows of dermal scutes (Colette and Klein-MacPhee 2002) (Figure 74). Five separate DPSs of Atlantic sturgeon were listed under the ESA by NMFS effective April 6, 2012. The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered and the Gulf of Maine DPS was listed as threatened (Table 42).

Figure 74: Atlantic Sturgeon. Photo: Robert Michelson.

Table 42. Atlantic sturgeon information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser oxyrinchus oxyrinchus	Atlantic Sturgeon	**Carolina**	**Endangered**		**77 FR 5913**	**--**	**81 FR 36077 and 81 FR 41926 (Proposed)**
		Chesapeake Bay	Endangered		77 FR 5879	--	81 FR 35701 (Proposed)
		Gulf of Maine	Threatened		77 FR 5879	--	81 FR 35701 (Proposed)
		New York Bight	Endangered		77 FR 5879	--	81 FR 35701 (Proposed)
		South Atlantic	Endangered		77 FR 5913	--	81 FR 36077 and 81 FR 41926 (Proposed)

We used information available in the final listing the status review (ASSRT 2007) and available literature to summarize the status of Atlantic sturgeon as follows.

4.2.32.1 *Life History*

Atlantic sturgeon are long-lived, late-maturing, estuarine-dependent, anadromous fish distributed along the eastern coast of North America (Waldman and Wirgin 1998). Historically, sightings have been reported from Hamilton Inlet, Labrador, Canada, south to the St. Johns River, Florida (Murawski et al. 1977; Smith and Clugston 1997). Atlantic sturgeon may live up to 60 years, reach lengths up to 14 feet, and weigh over 800 pounds (ASSRT 2007; Collette and Klein-MacPhee 2002). They are distinguished by armor-like plates (called scutes) and a long protruding snout that has four barbels (slender, whisker-like feelers extending from the head used for touch and taste). Atlantic sturgeon spend the majority of their lives in nearshore marine waters, returning to the rivers where they were born (natal rivers) to spawn (Wirgin et al. 2002). Young sturgeon may spend the first few years of life in their natal river estuary before moving out to sea (Wirgin et al. 2002). Atlantic sturgeon are omnivorous benthic (bottom) feeders and filter quantities of mud along with their food. Adult diets include mollusks, gastropods, amphipods, isopods, and fish. Juvenile sturgeon feed on aquatic insects and other invertebrates (Smith 1985).

4.2.32.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to all of the Atlantic Sturgeon distinct population segments.

Historically, the Gulf of Maine DPS likely supported more than 10,000 spawning adults, (ASSRT 2007; Secor 2002a) suggesting the recent estimate of spawning adults within the DPS is one to two orders of magnitude smaller than historical levels (i.e., hundreds to low thousands). Secor (2002a) estimates that 8,000 adult females were present in South Carolina prior to 1890 for the Carolina DPS. Prior to the collapse of the fishery in the late 1800s, the sturgeon fishery was the third largest fishery in Georgia. Secor (2002b) estimated from U.S. Fish Commission landing reports that approximately 11,000 spawning females were likely present in Georgia prior to 1890. The Altamaha River population of Atlantic sturgeon, with an estimated 343 adults spawning annually, is believed to be the largest population in the Southeast, yet is estimated to be only 6 percent of its historical population size. The abundances of the remaining river populations within the South Atlantic DPS, each estimated to have fewer than 300 annually spawning adults, are estimated to be less than 1 percent of what they were historically (ASSRT 2007). The New York Bight DPS only supports two spawning subpopulations, the Delaware and Hudson River. The number of Atlantic Sturgeon in this DPS are extremely low compared to historical levels and have remained so for the past one-hundred years. The spawning population of this DPS is thought to be one to two orders of magnitude below historical levels. Historically, Atlantic sturgeon were common throughout the Chesapeake Bay and its tributaries. There is currently only one known spawning population (James River) with some evidence of spawning in the York River as well. The spawning population of this DPS is thought to be one to two orders of magnitude below historical levels.

There are some positive signs for the Gulf of Maine distinct population segment, which include observations of Atlantic sturgeon in rivers from which sturgeon observations have not been reported for many years (Saco, Presumpscot, and Charles rivers) and potentially higher catch-per-unit-effort levels than in the past (Kennebec). These observations suggest that the abundance of the Gulf of Maine DPS is large enough that recolonization to rivers historically suitable for spawning may be occurring. Precise estimates of population growth rate for the Carolina DPS are unknown due to lack of long-term abundance data. The status review team concluded that the subpopulations in the Roanoke, Tar/Pamlico, Neuse, Waccamaw, and Pee Dee river systems are at a moderate extinction risk the subpopulations in the Cape Fear and Santee-Cooper river systems are at a moderately high risk of extinction. Low population numbers of every river population in the South Atlantic 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. Although the largest impact that caused the precipitous decline of the species has been restricted (directed fishing), the population sizes within the South Atlantic DPS have remained relatively constant at greatly reduced levels (approximately 6 percent of historical population sizes in the Altamaha River, and 1 percent of historical population sizes in the remainder of the DPS) for 100 years. The New Your Bight DPS currently supports only two spawning subpopulations, the Delaware and Hudson River. Population estimates based on mark and recapture of juvenile Atlantic sturgeon and voluntary logbook reporting indicate that the Delaware subpopulation has been declining rather rapidly over the last 20 years. In the U.S., the Hudson River currently supports the largest subpopulation of spawning adults (approximately 850 males and females) and approximately 8,000 subadults, although historically it supported 6,000 to 7,000 spawning females. Long-term surveys indicate that the Hudson River subpopulation has been stable since 1995 and/or slightly increasing in abundance. The Chesapeake Bay once supported at least six historical spawning subpopulations; however, today the Bay is believed to support at the most, only two spawning subpopulations (James and York). Precise estimates of population growth rate (intrinsic rates) are unknown due to lack of long-term abundance data. The status review team concluded that the subpopulations in the James and York Rivers are at a moderate and moderately high risk of extinction.

While adult Atlantic sturgeon from all DPSs mix extensively in marine waters, the majority of Atlantic sturgeon return to their natal rivers to spawn. Genetic studies show that fewer than two adults per generation spawn in rivers other than their natal river (King et al. 2001; Waldman et al. 2002; Wirgin et al. 2000). Young sturgeon spend the first few years of life in their natal river estuary before moving out to sea. We expect that all DPSs would be affected by the proposed action of Permit No. 20339 and the Carolina and South Atlantic DPSs would be affected by the proposed action of Permit No. 19621-01.

The Atlantic sturgeon were once present in 38 river systems and, of these, spawned in 35 of them. Individuals are currently present in 36 rivers, and spawning occurs in at least 20 of these (ASSRT 2007). Atlantic sturgeon occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (Figure 73).

4.2.32.3 *Acoustics*

We are not aware of any vocalization and hearing studies directly on Green sturgeon (Southern DPS), but data from other species are applicable. Sturgeon are known to produce sounds, especially during spawning. Lake sturgeon produce low frequency sounds during spawning bouts, principally consisting of drumming sounds that range from 5 to 8 Hz, but low frequency rumbles and hydrodynamic sounds as well as high frequency sounds have also been reported (Bocast et al. 2014). The pallid sturgeon (*Scaphirhynchus albus*) and shovelnose sturgeon (*Scaphirhynchus platorynchus*) are known to produce at least four types of sounds during the breeding season, ranging from squeaks and chirps from one to two kHz, with low frequency moans ranging in frequency between 90 and 400 Hz (Johnston and Phillips 2003).

While sturgeon have swimbladders, they are not known to be used hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon (*Acipenser sturio*) using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon (*Acipenser fulvescens*) and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar (*Astronotus ocellatus*) and goldfish (*Carassius auratus*) and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of Atlantic sturgeon.

4.2.32.4 *Status*

The viability of the Gulf of Maine, Carolina, South Atlantic, New York Bight, and Chesapeake Bay DPSs depends on having multiple self-sustaining riverine spawning populations and maintaining suitable habitat to support the various life functions (spawning, feeding, and growth) of Atlantic sturgeon populations. Because a DPS is a group of populations, the stability, viability, and persistence of individual populations affects the persistence and viability of the larger DPS. The loss of any population within a DPS will result in (1) a long-term gap in the range of the DPS that is unlikely to be recolonized, (2) loss of reproducing individuals, (3) loss of genetic biodiversity, (4) potential loss of unique haplotypes, (5) potential loss of adaptive traits, (6) reduction in total number, and (7) potential for loss of population source of recruits. The loss of a population will negatively impact the persistence and viability of the DPS as a whole, as fewer than two individuals per generation spawn outside their natal rivers (King et al. 2001; Waldman et al. 2002; Wirgin et al. 2000). The persistence of individual populations, and in turn the DPS, depends on successful spawning and rearing within the freshwater habitat, the immigration into marine habitats to grow, and then the return of adults to natal rivers to spawn.

4.2.32.5 *Critical Habitat*

NMFS proposed critical habitat for each ESA-listed DPS of Atlantic sturgeon in June of 2016. The following physical and biological features were determined to be essential for Atlantic sturgeon reproduction and recruitment:

1. Suitable hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 parts per thousand range) for settlement of fertilized eggs, refuge, growth, and development of early life stages
2. Transitional salinity zones inclusive of waters with a gradual downstream gradient of 0.5 to 30 parts per thousand and soft substrate (e.g., sand, mud) downstream of spawning sites for juvenile foraging and physiological development
3. Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support (1) unimpeded movement of adults to and from spawning sites, (2) seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary, and (3) staging, resting, or holding of subadults or spawning condition adults. Water depths in the main river channels must also be deep enough (e.g., greater than or equal to 1.2 meters) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river
5. Water quality conditions, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support (1) spawning, (2) annual and inter-annual adult, subadult, larval, and juvenile survival, and (3) larval, juvenile, and subadult growth, development, and recruitment (e.g., 13° Celsius to 26° Celsius for spawning habitat and no more than 30° Celsius for juvenile rearing habitat, and 6 mg/L DO for juvenile rearing habitat.

4.2.32.6 *Recovery Plan*

No recovery plan exists for Atlantic Sturgeon.

4.2.33 Green Sturgeon (Southern Distinct Population Segment)

The North American green sturgeon is an anadromous fish that occurs in the nearshore Eastern Pacific Ocean from Alaska to Mexico (Moyle 2002) (Figure 75).

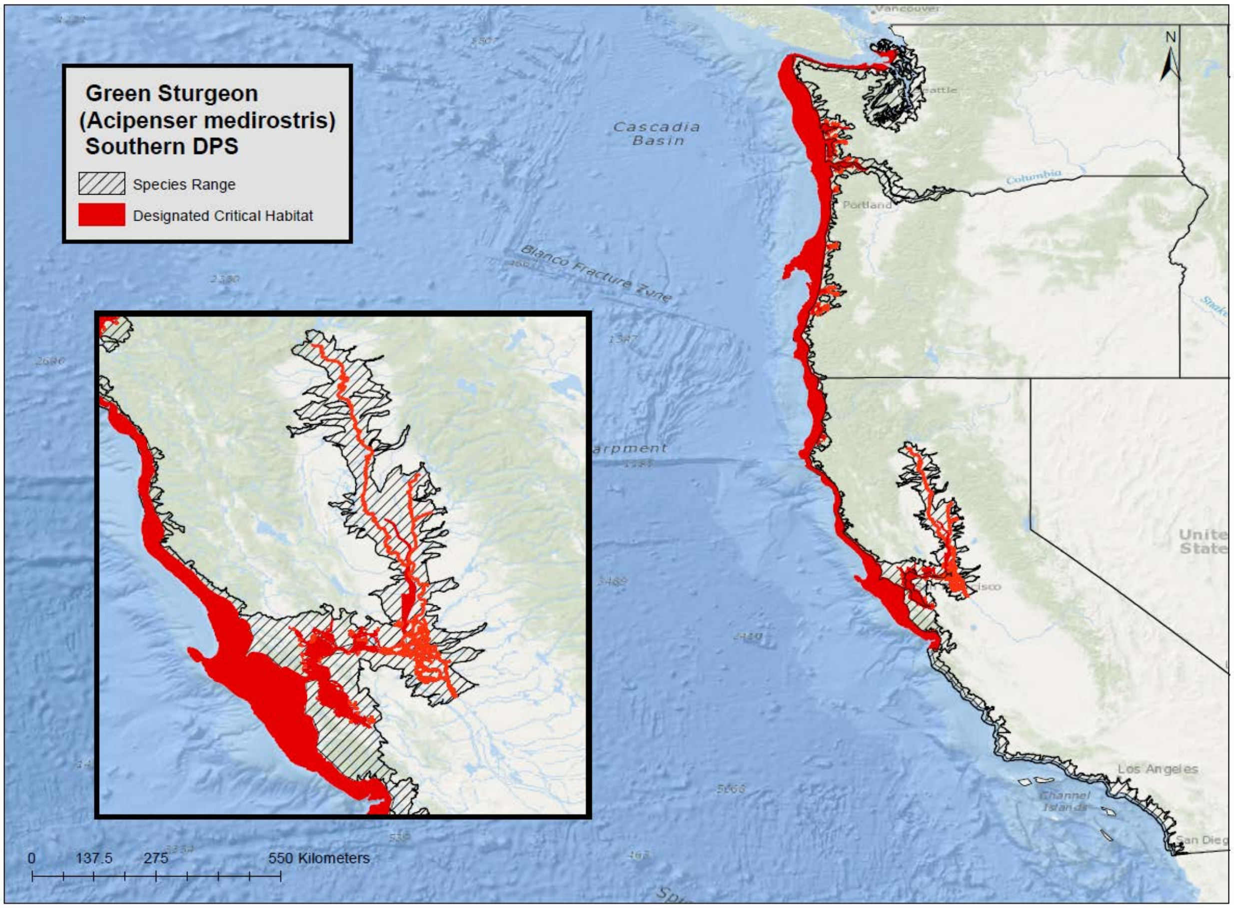

Figure 75. Geographic range (within the contiguous US) and designated critical habitat for green sturgeon, southern distinct population segment.

Green sturgeon are long lived, late maturing, spawn infrequently in natal streams, and spend substantial portions of their lives in marine waters. Although they are members of the class of bony fishes, the skeleton of sturgeons is composed mostly of cartilage. Sturgeon lack scales; however, they have five rows of scutes on their body. Green sturgeon have an olive green to dark green back, a yellowish green-white belly (Adams et al. 2002) (Figure 76). NMFS has identified two DPSs of green sturgeon; northern and southern (Israel et al. 2009). In 2006, NMFS determined that the southern DPS green sturgeon warranted listing as a threatened species under the ESA (Table 43).

Figure 76: Green Sturgeon. Photo: Toz Soto, Karuk Tribe Fisheries Department.

Table 43. Green Sturgeon, southern distinct population segment information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser medirostris	Green Sturgeon	Southern	Threatened	2015	71 FR 17757	2010 (Outline)	74 FR 52300

We used information available in the final listing the status review and available literature to summarize the status of green sturgeon as follows.

4.2.33.1 *Life history*

Green sturgeon reach sexual maturity at approximately fifteen years of age (Van Eenennaam et al. 2006), and may spawn every three to five years throughout their long lives (Tracy 1990). Southern DPS green sturgeon spawn in cool (14 to 17° Celsius), deep, turbulent areas with clean, hard substrates. The only confirmed spawning sites for southern DPS green sturgeon is a short stretch of the upper mainstem Sacramento River (below Keswick Dam) and in the Feather River near the Thermalito Afterbay Outlet (Seesholtz et al. 2015). Little is known about green sturgeon feeding other than general information. Adults captured in the Sacramento-San Joaquin delta are benthic feeders on invertebrates including shrimp, mollusks, amphipods, and even small fish (Houston 1988; Moyle et al. 1992). Juveniles in the Sacramento River delta feed on opossum shrimp, *Neomysis mercedis*, and *Corophium* amphipods (Radtke 1966).

In preparation for spawning, adult Southern DPS green sturgeon enter San Francisco Bay between mid-February and early-May, and migrate rapidly (on the order of a few weeks) up the Sacramento River (Heublein et al. 2009). Spawning occurs from April through early July, with peaks of activity that depend on a variety of factors including water temperature and water flow rates (Poytress et al. 2009; Poytress et al. 2010). Post-spawn fish typically congregate and hold for several months in a few deep pools in the upper mainstem Sacramento River near spawning sites and migrate back downstream when river flows increase in fall. They re-enter the ocean during the winter months (November through January) and begin their marine migration north along the coast (California Fish Tracking Consortium database).

Green sturgeon larvae are different from all other sturgeon because of the absence of a distinct swim-up or post-hatching stage. Larvae grow fast; young fish grow to 74 mm 45 days after hatching (Deng 2000). Larvae and juveniles migrate downstream toward the Sacramento-San Joaquin Delta/Estuary, where they rear for one to four years before migrating out to the Pacific Ocean as subadults (Nakamoto et al. 1995). Once at sea, subadults and adults occupy coastal waters to a depth of 110 m from Baja California, Mexico to the Bering Sea, Alaska (Hightower 2007). Seasonal migrations are known to occur. Fish congregate in coastal bays and estuaries of Washington, Oregon, and California during summer and fall. In winter and spring, similar aggregations can be found from Vancouver Island to Hecate Strait, British Columbia, Canada (Lindley et al. 2008)

4.2.33.2 *Population dynamics*

The following is a discussion of the species' population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the southern DPS green sturgeon.

Preliminary results from 2010-14 surveys indicated the presence of the following number of adult Southern DPS green sturgeon in the Sacramento River (with 95 percent confidence intervals): 2010: 164 ± 47; 2011: 220 ± 42; 2012: 329 ± 57; 2013: 338 ± 61; 2014: 526 ± 64. Based on these numbers and estimates of mean spawning periodicity, the total number of adults in the Southern DPS population is estimated to be 1,348 ± 524 (Mora 2015; NMFS 2015c).

Attempts to evaluate the status of southern DPS green sturgeon have been met with limited success due to the lack of reliable long term data. Intrinsic rates of growth for southern DPS green sturgeon have not been estimated.

The available genetic data do not change the status of the species or the imminence or magnitude of any threat; data only confirm the DPS structure and add detail to the DPS composition in different estuaries during the sampling periods (NMFS 2015c). Green sturgeon stocks from the DPSs have been found to be genetically differentiated (Israel et al. 2009; Israel et al. 2004).

Green sturgeon have been observed in large concentrations in the summer and autumn within coastal bays and estuaries along the west coast of the US, including the Columbia River estuary, Willapa Bay, Grays Harbor, San Francisco bay and Monterey bay (Huff et al. 2012; Lindley et al. 2011; Lindley et al. 2008; Moser and Lindley 2007). Six discrete spawning sites have been identified in the upper Sacramento River between Gianella Bridge and the Keswick dam (Poytress et al. 2013). Spawning has also been confirmed in the Feather River near the Thermalito Afterbay Outlet (Seesholtz et al. 2015).

4.2.33.3 *Acoustics*

We are not aware of any vocalization and hearing studies directly on Green sturgeon (Southern DPS), but data from other species are applicable. Sturgeon are known to produce sounds, especially during spawning. Lake sturgeon produce low frequency sounds during spawning bouts, principally consisting of drumming sounds that range from 5 to 8 Hz, but low frequency rumbles and hydrodynamic sounds as well as high frequency sounds have also been reported (Bocast et al. 2014). The pallid sturgeon and shovelnose sturgeon are known to produce at least four types of sounds during the breeding season, ranging from squeaks and chirps from one to two kHz, with low frequency moans ranging in frequency between 90 and 400 Hz (Johnston and Phillips 2003).

While sturgeon have swimbladders, they are not known to be used hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar and goldfish and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of Green sturgeon (Southern DPS).

4.2.33.4 *Status*

Attempts to evaluate the status of southern DPS green sturgeon have been met with limited success due to the lack of reliable long term data, however based on available scientific data (Adams et al. 2007) and ongoing conservation efforts, NMFS concluded in the final rule designating this species that southern DPS green sturgeon were likely to become endangered in the foreseeable future throughout all of its range. The final rule listing Southern DPS green sturgeon indicates that the principle factor for the decline in the DPS is the reduction of spawning to a limited area in the Sacramento River. In general, the primary threats to southern DPS green sturgeon are the reduction of potential spawning habitat (most notably by impoundments), water temperature and flow, and commercial and recreational bycatch. Climate change has the potential to impact Southern DPS green sturgeon in the future, but it is unclear how changing oceanic, nearshore and river conditions will affect the Southern DPS overall (NMFS 2015c).

4.2.33.5 *Critical Habitat*

Critical habitat was designated for Southern DPS green sturgeon on October 9, 2009, and includes marine, coastal bay, estuarine, and freshwater areas (Figure 75). The physical and biological features identified as being essential to the conservation of Southern DPS green sturgeon include food resources, specific substrate types or sizes, necessary water flow and quality, specific water depths and sediment quality, and a safe and open migratory corridor.

4.2.33.6 *Recovery Goals*

The final recovery plan for Southern DPS green sturgeon has not been released. The recovery outline (NMFS 2010a) indicates that the recovery potential for Southern DPS green sturgeon is considered moderate to high; however, certain life history characteristics (e.g., long-lived, delayed maturity) indicate recovery could take many decades, even under the best circumstances. According to the recovery outline key recovery needs and implementation measures identified include additional spawning and egg/larval habitat as well as additional research and monitoring (NMFS 2010a).

4.2.34 Gulf Sturgeon

The Gulf sturgeon subspecies of Atlantic sturgeon is a large anadromous fish that resides completely within the Gulf of Mexico (Figure 77).

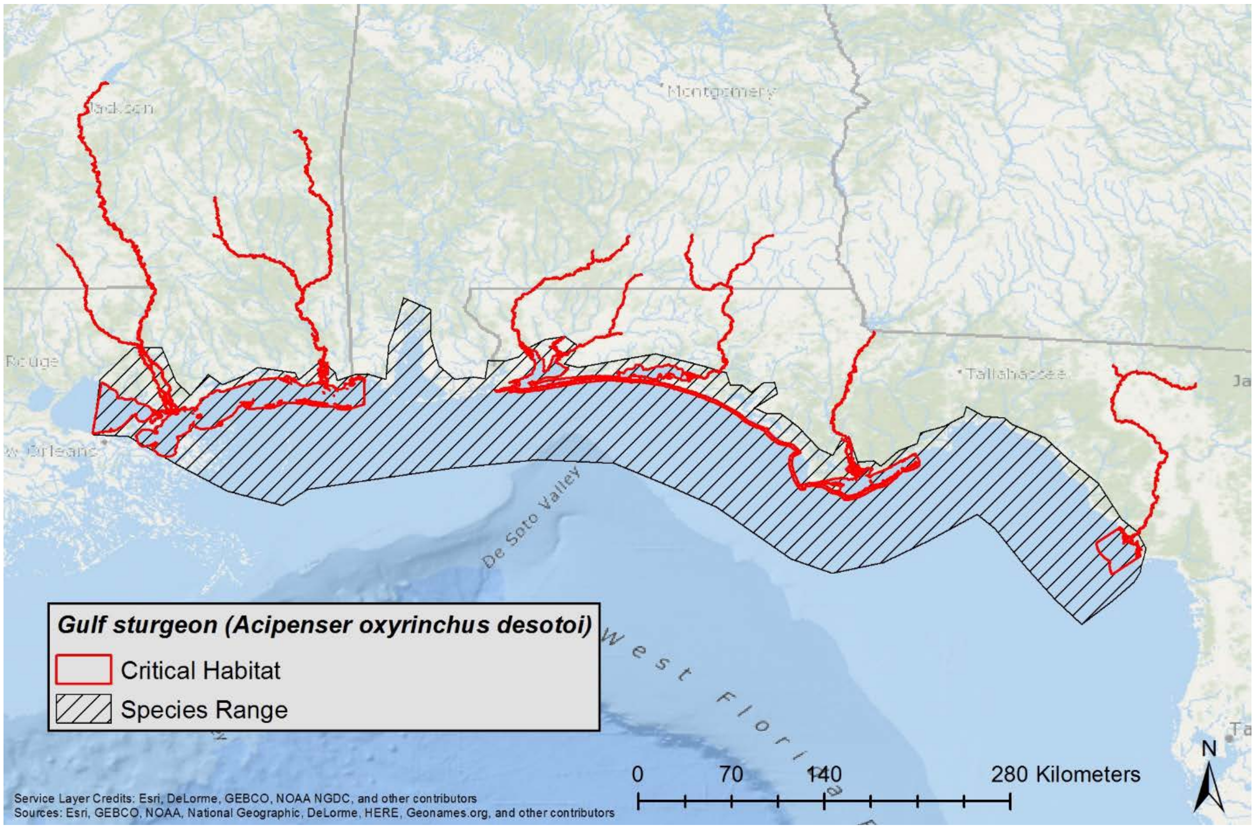

Figure 77: Map representing the range and designated critical habitat for Gulf Sturgeon.

Gulf sturgeon are nearly cylindrical fish with an extended snout, vertical mouth, five rows of scutes (bony plates surrounding the body), four chin barbels (slender, whisker-like feelers extending from the head used for touch and taste), and a heterocercal (upper lobe is longer than lower) caudal fin (Figure 78). Adults range from six to eight feet in length and weigh up to 200 pounds; females grow larger than males (USFWS 2009).

Gulf sturgeon were listed as threatened effective October 30, 1991 (56 CFR 49653, September 30, 1991), after their stocks were greatly reduced or extirpated throughout much of their historic range by overfishing, dam construction, and habitat degradation (Table 44). NMFS and the U.S. Fish and Wildlife Service jointly manage Gulf sturgeon. In marine areas, NMFS is responsible for all consultations regarding Gulf sturgeon and critical habitat. In estuarine habitats, responsibility is divided based on the action agency involved. NMFS consults with the Department of Defense, U.S. Army Corps of Engineers, the Bureau of Ocean Energy Management, and any other federal agencies not specifically mentioned at 50 CFR 226.214.

Figure 78: Gulf sturgeon: Photo: National Oceanic and Atmospheric Administration.

Table 44: Gulf sturgeon information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser oxyrinchus desotoi	Gulf Sturgeon	Subspecies of Atlantic sturgeon	Threatened	2009	56 FR 49653	1995	68 FR 13370

We used information available in the final listing the status review (USFWS and NMFS 2009) and available literature to summarize the status of green sturgeon as follows.

4.2.34.1 *Life History*

Gulf sturgeon are long-lived, with some individuals reaching at least 42 years in age (Huff 1975). Age at sexual maturity ranges from eight to 17 years for females and seven to 21 years for males (Huff 1975). Chapman and Carr (1995) estimated that mature female Gulf sturgeon that weigh between 64 and 112 pounds (29 to 51 kilograms) produce an average of 400,000 eggs. Spawning intervals range from one to five years for males, while females require longer intervals ranging from three to five years (Fox et al. 2000; Huff 1975).

Gulf sturgeon move from the Gulf of Mexico into coastal rivers in early spring (i.e., March through May). Fox et al. (2000) found water temperatures at time of river entry differed significantly by reproductive stage and sex. Individuals entered the river system when water temperatures ranged anywhere between 11.2 and 27.1° Celsius. Spawning occurs in the upper reaches of rivers in the spring when water temperature is around 15 to 20° Celsius. While Sulak and Clugston (1999) suggest that sturgeon spawning activity is related to moon phase, other researchers have found little evidence of spawning associated with lunar cycles (Fox et al. 2000; Slack et al. 1999). Fertilization is external; females deposit their eggs on the river bottom and males fertilize them. Gulf sturgeon eggs are demersal, adhesive, and vary in color from gray to brown to black (Huff 1975; Vladykov and Greeley 1963). Parauka et al. (1991) reported that hatching time for artificially spawned Gulf sturgeon ranged from 85.5 hours at 18.4° Celsius to 54.4 hours at about 23° Celsius. Published research on the life history of younger Gulf sturgeon is limited. After hatching, young-of-year individuals generally disperse downstream of spawning sites, though some may travel upstream as well (Clugston et al. 1995; Sulak and Clugston 1999), and move into estuarine feeding areas for the winter months.

Tagging studies confirm that Gulf sturgeon exhibit a high degree of river fidelity (Carr 1983). Of 4,100 fish tagged, 21 percent (860 of 4,100 fish) were later recaptured in the river of their initial collection, eight fish (0.2 percent) moved between river systems, and the remaining fish (78.8 percent) have not yet been recaptured (USFWS and GSMFC 1995). There is no information documenting the presence of spawning adults in non-natal rivers. However, there is some evidence of movements by both male and female Gulf sturgeon (n = 22) from natal rivers into non-natal rivers (Carr et al. 1996; Craft et al. 2001; Fox et al. 2002; Ross et al. 2001; Wooley and Crateau 1985).

After spawning, Gulf sturgeon move downstream to areas referred to as “summer resting” or “holding” areas. Adults and subadults are not distributed uniformly throughout the river, but instead show a preference for these discrete holding areas usually located in the lower and middle river reaches (Hightower et al. 2002). While it was suggested these holding areas were sought for cooler water temperatures (Carr et al. 1996; Chapman and Carr 1995), Hightower et al. (2002) found that water temperatures in holding areas where Gulf sturgeon were repeatedly found in the Choctawhatchee River were similar to temperatures where sturgeon were only occasionally found elsewhere in the river.

In the fall, movement from the rivers into the estuaries and associated bays begins in September (at water temperatures around 23° Celsius) and continues through November (Foster and Clugston 1997; Huff 1975; Wooley and Crateau 1985). Because the adult and large subadult sturgeon have spent at least six months fasting or foraging sparingly on detritus in the rivers, it is presumed they immediately begin foraging (Mason and Clugston 1993). Telemetry data indicate Gulf sturgeon are found in high concentrations near the mouths of their natal rivers with individual fish traveling relatively quickly between foraging areas where they spend an extended period of time (Edwards et al. 2007; Edwards et al. 2003).

Most subadult and adult Gulf sturgeon spend the cool winter months (October/November through March/April) in bays, estuaries, and nearshore environments in the Gulf of Mexico (Clugston et al. 1995; Fox et al. 2002; Odenkirk 1989). Tagged fish have been located in well-oxygenated shallow water (less than seven meters) areas that support burrowing macro invertebrates (Craft et al. 2001; Fox and Hightower 1998; Fox et al. 2002; Parauka et al. 2001; Rogillio et al. 2007; Ross et al. 2001; Ross et al. 2009). These areas may include shallow shoals five to seven feet (1.5 to 2.1 meters), deep holes near passes (Craft et al. 2001), unvegetated sand habitats such as sandbars, and intertidal and subtidal energy zones (Abele and Kim 1986; Menzel 1971; Ross et al. 2009). Subadult and adult Gulf sturgeon overwintering in Choctawhatchee Bay (Florida) were generally found to occupy the sandy shoreline habitat at depths of four to six feet (two to three meters) (Fox et al. 2002; Parauka et al. 2001). These shifting, predominantly sandy, areas support a variety of potential prey items including estuarine crustaceans, small bivalve mollusks, ghost shrimp, small crabs, various polychaete worms, and lancelets (Abele and Kim 1986; Menzel 1971; Williams et al. 1989). Preference for sandy habitat is supported by studies in other areas that have correlated Gulf sturgeon presence to sandy substrate (Fox et al. 2002).

Gulf sturgeon are described as opportunistic and indiscriminate benthivores that change their diets and foraging areas during different life stages. Their guts generally contain benthic marine invertebrates including amphiopods, lancelets, polychaetes, gastropods, shrimp, isopods, mollusks, and crustaceans (Carr et al. 1996; Fox et al. 2002; Huff 1975; Mason and Clugston 1993). Generally, Gulf sturgeon prey are burrowing species that feed on detritus and/or suspended particles, and inhabit sandy substrate. In the river, young-of-year sturgeon eat aquatic invertebrates and detritus (Mason and Clugston 1993; Sulak and Clugston 1999) and juveniles forage throughout the river on aquatic insects (e.g., mayflies and caddisflies), worms (oligochaete), and bivalves (Huff 1975; Mason and Clugston 1993). Adults forage sparingly in freshwater and depend almost entirely on estuarine and marine prey for their growth (Gu et al. 2001). Both adult and subadult Gulf sturgeon are known to lose up to 30 percent of their total body weight while in fresh water, and subsequently compensate the loss during winter feeding in marine areas (Carr 1983; Clugston et al. 1995; Heise et al. 1999; Morrow et al. 1998; Sulak and Clugston 1999; Wooley and Crateau 1985).

4.2.34.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Gulf sturgeon.

Abundance of Gulf sturgeon is measured at the riverine scale. Currently, seven rivers are known to support reproducing populations of Gulf sturgeon: the Pearl, Pascagoula, Escambia, Yellow, Choctawhatchee, Apalachicola, and Suwannee rivers. The number of individuals within each riverine population is variable across their range, but generally over the last decade (USFWS and NMFS 2009) populations in the eastern part of the range (Suwannee, Apalachicola Choctawhatchee) appear to be relatively stable in number or have a slightly increasing population trend. In the western portion of the range, populations in the Pearl and Pascagoula Rivers have never been nearly as abundant as those to the east, and their current status, post-hurricanes Katrina and Rita, is unknown as comprehensive surveys have not occurred.

Both acute and episodic events are known to impact individual populations of Gulf sturgeon that in turn, affect overall population numbers. For example, on August 9, 2011, an overflow of "black liquor" (an extremely alkaline waste byproduct of the paper industry) was accidentally released by a paper mill into the Pearl River near Bogalusa, Louisiana, that may have affected the status and abundance of the Pearl River population. While paper mills regularly use acid to balance the black liquor's pH before releasing the material, as permitted by the Louisiana Department of Environmental Quality, this material released was not treated. The untreated waste byproduct created a low oxygen ("hypoxic") environment lethal to aquatic life. These hypoxic conditions moved downstream of the release site killing fish and mussels in the Pearl River over several days. Within a week after the spill, the dissolved oxygen concentrations returned to normal in all areas of the Pearl River tested by Louisiana Department of Wildlife and Fisheries. The investigation of fish mortality began on August 13, 2011, several days after the spill occurred. Twenty-eight Gulf sturgeon carcasses (38 to 168 centimeters total length) were collected in the Pearl River after the spill (Sanzenbach 2011a; Sanzenbach 2011b) and anecdotal information suggests many other Gulf sturgeon carcasses were not collected. The smaller fish collected represent young-of-year and indicate spawning is likely occurring in the Pearl River. The spill occurred during the time when Gulf sturgeon were still occupying the freshwater habitat. Because the materials moved downriver after the spill, the entire Pearl River population of Gulf sturgeon was likely impacted.

Gene flow is low in Gulf sturgeon stocks, with each stock exchanging less than one mature female per generation (Waldman and Wirgin 1998). Genetic studies confirm that Gulf sturgeon exhibit river-specific fidelity. Stabile et al. (1996) analyzed tissue taken from Gulf sturgeon in eight drainages along the Gulf of Mexico for genetic diversity and noted significant differences among Gulf sturgeon stocks, which suggests region-specific affinities and likely river-specific fidelity. Five regional or river-specific stocks (from west to east) have been identified: (1) Lake Pontchartrain and Pearl River, (2) Pascagoula River, (3) Escambia and Yellow Rivers, (4) Choctawhatchee River, and (5) Apalachicola, Ochlockonee, and Suwannee Rivers (Stabile et al. 1996).

Gulf sturgeon are found in river systems from Louisiana to Florida, in nearshore bays and estuaries, and in the Gulf of Mexico (Figure 77).

4.2.34.3 *Acoustics*

We are not aware of any vocalization and hearing studies directly on Gulf sturgeon, but data from other species are applicable. Sturgeon are known to produce sounds, especially during spawning. Lake sturgeon produce low frequency sounds during spawning bouts, principally consisting of drumming sounds that range from 5 to 8 Hz, but low frequency rumbles and hydrodynamic sounds as well as high frequency sounds have also been reported (Bocast et al.

2014). The pallid sturgeon and shovelnose sturgeon are known to produce at least four types of sounds during the breeding season, ranging from squeaks and chirps from one to two kHz, with low frequency moans ranging in frequency between 90 and 400 Hz (Johnston and Phillips 2003).

While sturgeon have swimbladders, they are not known to be used hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar and goldfish and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of Gulf sturgeon.

4.2.34.4 *Status*

The decline in the abundance of Gulf sturgeon has been attributed to targeted fisheries in the late 19th and early 20th centuries, habitat loss associated with dams and sills, habitat degradation associated with dredging, de-snagging, and contamination by pesticides, heavy metals, and other industrial contaminants, and certain life history characteristics (e.g. slow growth and late maturation). Effects of climate change (warmer water, sea level rise and higher salinity levels) could lead to accelerated changes in habitats utilized by Gulf sturgeon. The rate that climate change and corollary impacts are occurring may outpace the ability of the Gulf sturgeon to adapt given its limited geographic distribution and low dispersal rate. In general, Gulf sturgeon populations in the eastern portion of the range appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty (USFWS 2009).

4.2.34.5 *Critical Habitat*

In 2003, NMFS and the U.S. Fish and Wildlife jointly designated Gulf sturgeon critical habitat in 14 geographic units encompassing 2,783 river kilometers as well as 6,042 square kilometers of estuarine and marine habitat (Figure 77). The physical and biological features (previously called primary constituent elements) necessary for the conservation of Gulf sturgeon found in these areas include: (1) abundant food items within riverine, estuarine, and marine habitats; (2) riverine spawning sites with suitable substrates; (3) riverine aggregation areas (resting, holding, staging areas); (4) suitable flow regime; (5) suitable water quality; (6) suitable sediment quality; and (7) safe and unobstructed migratory pathways.

4.2.34.6 *Recovery Plan*

In 1995, a recovery/ management plan was published for the Gulf Sturgeon. In addition, all United States fisheries for the Gulf sturgeon have been closed. The following are priority-one recovery tasks:

1. Develop and implement standardized population sampling and monitoring techniques.
2. Develop and implement regulatory framework to eliminate introductions of nonindigenous stock or other sturgeon species.
3. Reduce or eliminate incidental mortality.
4. Restore the benefits of natural riverine habitats.
5. Utilize existing authorities to protect habitat and where inadequate, recommend new laws and regulations.

4.2.35 Shortnose Sturgeon

Shortnose sturgeon occur in estuaries and rivers along the east coast of North America (Vladykov and Greeley 1963). Their northerly distribution extends to the Saint John River, New Brunswick, Canada, and their southerly distribution historically extended to the Indian River, Florida (Evermann and Bean 1898; Scott and Scott 1988) (Figure 79).

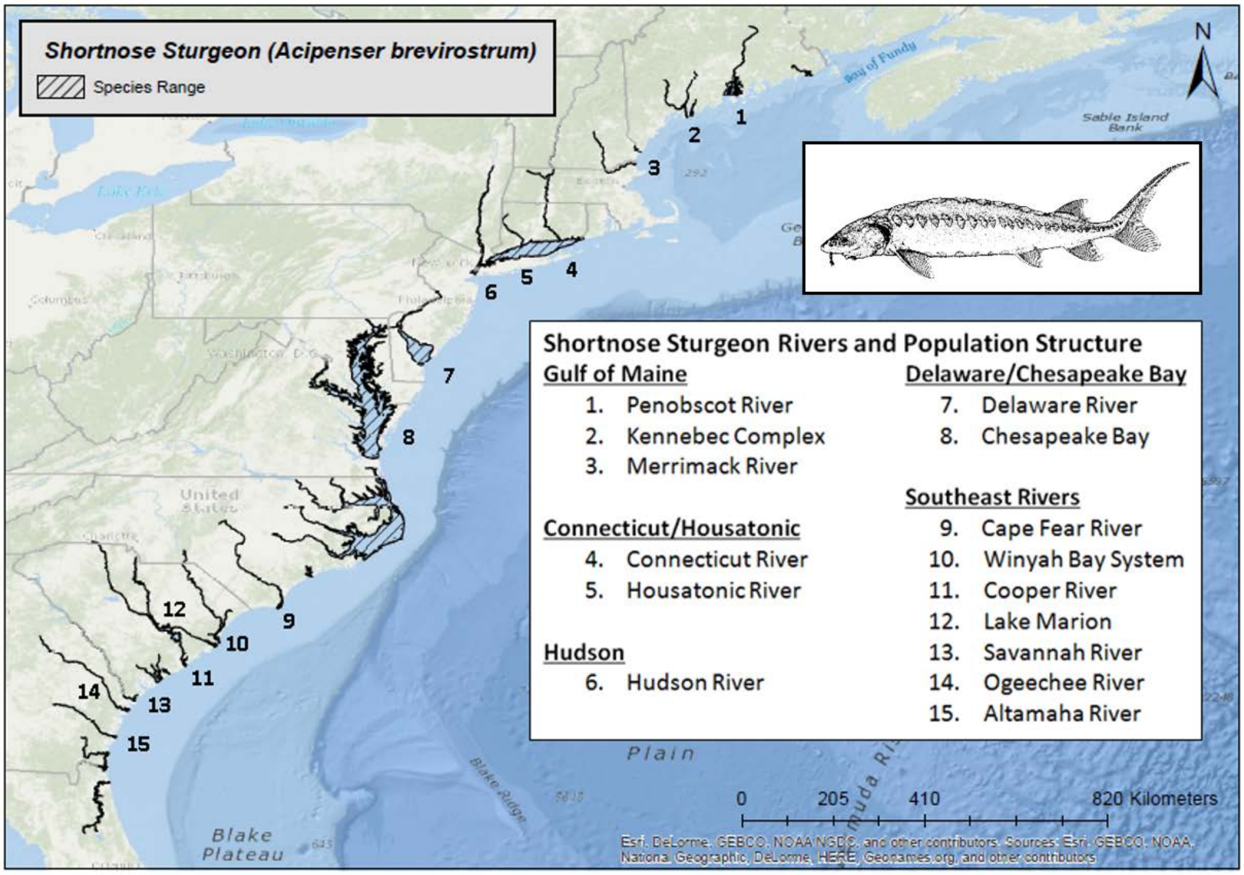

Figure 79. Geographic range of shortnose sturgeon.

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America. It has an elongate, cylindrical body and its head and snout are fairly small relative to Atlantic sturgeon (Dadswell 1984). Shortnose sturgeon vary in color but are generally dark brown to olive/black on the dorsal surface, lighter along the row of lateral scutes and nearly white on the ventral surface (Gilbert 1989) (Figure 79). The shortnose sturgeon was listed as endangered on March 11, 1967 (Table 45). Shortnose sturgeon remained on the endangered species list with enactment of the ESA in 1973.

Table 45. Shortnose sturgeon information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Acipenser brevirosumtrum	Sturgeon, Shortnose	None	Endangered	2010	32 FR 4001	1998	None Designated

We used information available in the final listing the status review (NMFS 2010e) and available literature to summarize the status of green sturgeon as follows.

4.2.35.1 *Life history*

Shortnose sturgeon are relatively slow growing, late maturing and long-lived. Growth rate, maximum age and maximum size vary with latitude; populations in southern areas grow more rapidly and mature at younger ages but attain smaller maximum sizes than those in the north (Dadswell et al. 1984). In general, females reach sexual maturity between ages four and 18, and males between ages two and 11 (NMFS 2010e). Shortnose sturgeon overwinter in the lower portions of rivers and migrate upriver to spawn in the spring. Males spawn every other year while females spawn every three to five years (Dadswell 1979; Kieffer and Kynard 1996). Spawning females deposit their eggs over gravel, rubble, and/or cobble often in the farthest accessible upstream reach of the river (Kynard 1997). After spawning, adult shortnose sturgeon move rapidly to downstream feeding areas where they forage on benthic insects, crustaceans, mollusks, and polychaetes (Buckley and Kynard 1985; Dadswell 1984; Kieffer and Kynard 1993; O'herron et al. 1993).

Upon hatching, shortnose sturgeon shelter in dark substrate or are found in schools swimming against the current. Around four to 12 days after hatching individuals begin to feed exogenously and are dispersed downstream. These larvae are often found in the deepest water, usually within the channel (Kieffer and Kynard 1993; O'Connor et al. 1981; Parker and Kynard 2014; Taubert and Dadswell 1980). Young of the Year remain in freshwater habitats upstream of the salt wedge for about one year (Dadswell et al. 1984; Kynard 1997). The age at which juveniles begin to utilize habitat associated with the salt/fresh water interface varies with river system from age one to eight (Collins et al. 2002; Dadswell 1979; Flournoy et al. 1992). Overwintering habitat and behavior of shortnose sturgeon varies with latitude: fish in northern rivers form tight aggregations with little movement and will inhabit either freshwater or saline reaches of the river, while fish in the south are more active and are found predominantly near the fresh/saltwater interface (Collins and Smith 1993; Kynard et al. 2012; Weber et al. 1998).

The general pattern of coastal migration of shortnose sturgeon indicates movement between groups of rivers proximal to each other across the geographic range (Altenritter et al. 2015; Dionne et al. 2013; Quattro et al. 2002; Wirgin et al. 2005). However, migration/straying is not necessarily resulting in effective gene exchange as indicated by high degree of genetic differentiation among riverine populations. Based on genetic analyses, the shortnose sturgeon population has been grouped into five regional population clusters: Gulf of Maine, Connecticut/Housatonic rivers, Hudson River, Delaware River/Chesapeake Bay, and Southeast. The shortnose sturgeon status review team recommends, however, that recovery and management actions consider each riverine population as a management/recovery unit (NMFS 2010e).

4.2.35.2 *Population dynamics*

The following is a discussion of the species’ population and its variance over time. This section includes: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to shortnose sturgeon.

The 1998 Final Recovery Plan for Shortnose Sturgeon recommended that 19 separate river populations of shortnose sturgeon be managed as DPSs (NMFS 1998c). Upon further analysis, 5 regional population clusters of shortnose sturgeon have been determined. See Table 46 for abundance estimates for populations within each of these population clusters. Precise estimates of population growth rate (intrinsic rates) are unknown due to lack of long-term abundance data.

Table 46. Shortnose sturgeon populations and estimated abundances

Regional Population Cluster	Location[a]	Abundance Estimate (Upper/Lower 95 percent confidence intervals)[b]	(Source) Year of Collection Data
Gulf of Maine	Penobscot River	1,049 (673 / 6,939)	(NMFS 2012c) 2006 – 2007
	Kennebec Complex	9,488 (6,942 / 13,358)	(Squiers 2004) 1998 – 2000
	Merrimack River	2000 (NA)	(NMFS 2010e) 2009
Connecticut and Housatonic Rivers	Connecticut River – upper	143 (14 / 360)	(Kynard et al. 2012) 1994 – 2001
	Connecticut River - lower	1,297 (NA)	(Savoy 2004) 1996 – 2002
Hudson River	Hudson River	30,311 (NA)	(NMFS 2010e) 1980
Delaware River/Chesapeake Bay	Delaware River	12,047 (10,757 / 13,580)	(Brundage III 2006) 1999 – 2003
Southeast Rivers	Cape Fear River	50 (NA)	(NMFS 2010e) NA
	Winyah Bay System	Unknown (NA)	(NMFS 2010e) NA
	Cooper River	301 (150 / 659)	(Cooke et al. 2004) 1996 – 1998
	Lake Marion	Unknown (NA)	(NMFS 2010e) NA
	Savannah River	2,000 (NA)	(NMFS 2010e) NA
	Ogeechee River	147 (104 / 249)	(Fleming et al. 2003) 1999 – 2000
	Altamaha River	6,320 (4,387 / 9,249)	(DeVries 2006) 2004 – 2005

[a]Locations listed here are those for which population estimates are available, and/or those in which spawning has been confirmed. Additional waterbodies with confirmed shortnose sturgeon include Piscataqua River, Housatonic River, Chesapeake Bay, Susquehanna River, Potomac River, Roanoke River, Chowan River, Tar/Pamlico River, Neuse River, New River, North River, Santee River, ACE Basin, Satilla River, St. Mary's River, St. Johns River (NMFS 2010e).

[b]Abundance estimates are established using different techniques and should be viewed with caution. Estimates listed here are those identified by NMFS in the 2010 Biological Assessment of Shortnose Sturgeon (NMFS 2010e).

Genetic diversity estimates for shortnose sturgeon have been shown to be moderately high in both mtDNA (Quattro et al. 2002; Wirgin et al. 2005; Wirgin et al. 2010) and nuclear DNA (King et al. 2013) genomes. The mtDNA and nuclear DNA studies performed to date suggest that dispersal is a very important factor in maintaining these high levels of genetic diversity.

Shortnose sturgeon occur along the East Coast of North America in rivers, estuaries and the sea. They were once present in most major rivers systems along the Atlantic coast (Kynard 1997). Their current distribution extends north to the Saint John River, New Brunswick, Canada, and south to the St. Johns River, FL (NMFS 1998c). Currently, the distribution of shortnose sturgeon across their range is disjunct, with northern populations separated from southern populations by a distance of about 400 kilometers near their geographic center in Virginia. Some river systems host populations which rarely leave freshwater while in other areas coastal migrations between river systems are common. Spawning locations have been identified within a number of river systems (NMFS 2010e).

4.2.35.3 *Acoustics*

We are not aware of any vocalization and hearing studies directly on shortnose sturgeon, but data from other species are applicable. Sturgeon are known to produce sounds, especially during spawning. Lake sturgeon produce low frequency sounds during spawning bouts, principally consisting of drumming sounds that range from 5 to 8 Hz, but low frequency rumbles and hydrodynamic sounds as well as high frequency sounds have also been reported (Bocast et al. 2014). The pallid sturgeon and shovelnose sturgeon are known to produce at least four types of sounds during the breeding season, ranging from squeaks and chirps from one to two kHz, with low frequency moans ranging in frequency between 90 and 400 Hz (Johnston and Phillips 2003).

While sturgeon have swimbladders, they are not known to be used hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar and goldfish and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of shortnose sturgeon.

4.2.35.4 *Status*

The decline in abundance and slow recovery of shortnose sturgeon has been attributed to pollution, overfishing, bycatch in commercial fisheries, and an increase in industrial uses of the nation’s large coastal rivers during the 20th century (e.g., hydropower, nuclear power, treated sewage disposal, dredging, construction) (NMFS 2010e). In addition, the effects of climate change may adversely impact shortnose sturgeon by reducing the amount of available habitat, exacerbating existing water quality problems, and interfering with migration and spawning cues

(NMFS 2010e). Without substantial mitigation and management to improve access to historical habitats and water quality of these systems, shortnose sturgeon populations will likely continue to be depressed. This is particularly evident in some southern rivers that are suspected to no longer support reproducing populations of shortnose sturgeon (NMFS 2010e). The number of river systems in which spawning has been confirmed has been reduced to around 12 locations (NMFS 2010e).

4.2.35.5 *Critical Habitat*

Critical habitat has not been proposed for shortnose sturgeon.

4.2.35.6 *Recovery Goals*

The long-term recovery objective for the shortnose sturgeon is to recover all discrete population segments (as defined in the 1998 shortnose sturgeon recovery plan) to levels of abundance at which they no longer require protection under the ESA. Each population segment may become a candidate for downlisting when it reaches a minimum population size that: 1) is large enough to prevent extinction, and 2) will make the loss of genetic diversity unlikely. The minimum population size for each population segment has not yet been determined (NMFS 1998c; NMFS 2010e).

4.2.36 Smalltooth Sawfish (United States Distinct Population Segment)

The smalltooth sawfish is a tropical marine and estuarine elasmobranch. Within the United States, smalltooth sawfish have been captured in estuarine and coastal waters from New York southward through Texas, although peninsular Florida has historically been the region of the United States with the largest number of recorded captures (NMFS 2010g) (Figure 80).

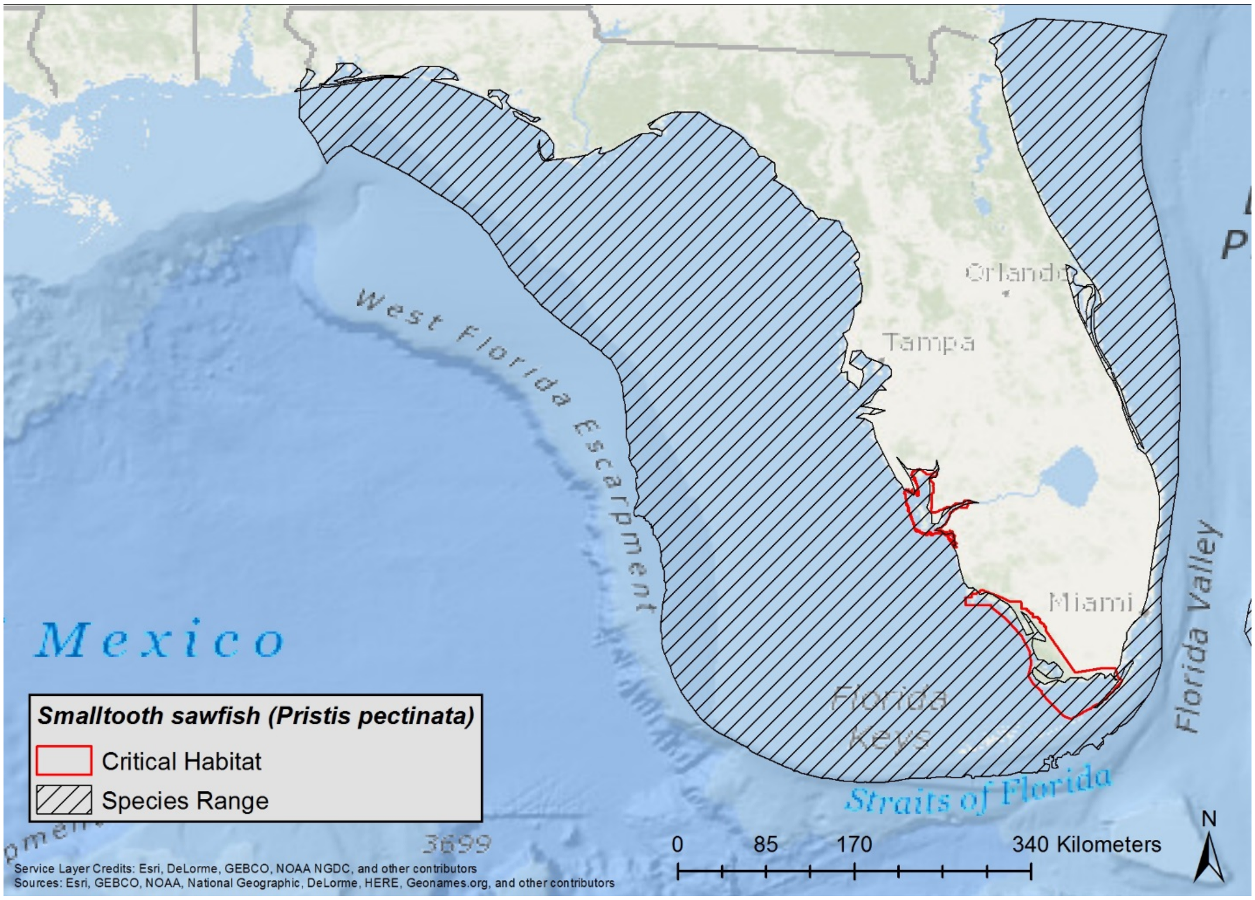

Figure 80: Map depicting the range and designated critical habitat for the United States Distinct Population Segment of Smalltooth Sawfish.

Although they are rays, sawfish physically resemble sharks, with only the trunk and especially the head ventrally flattened. Smalltooth sawfish are characterized by their "saw," a long, narrow, flattened rostral blade with a series of transverse teeth along either edge (Figure 81). The U.S. Distinct Population Segment of smalltooth sawfish was listed as endangered under the ESA effective May 1, 2003 (Table 47).

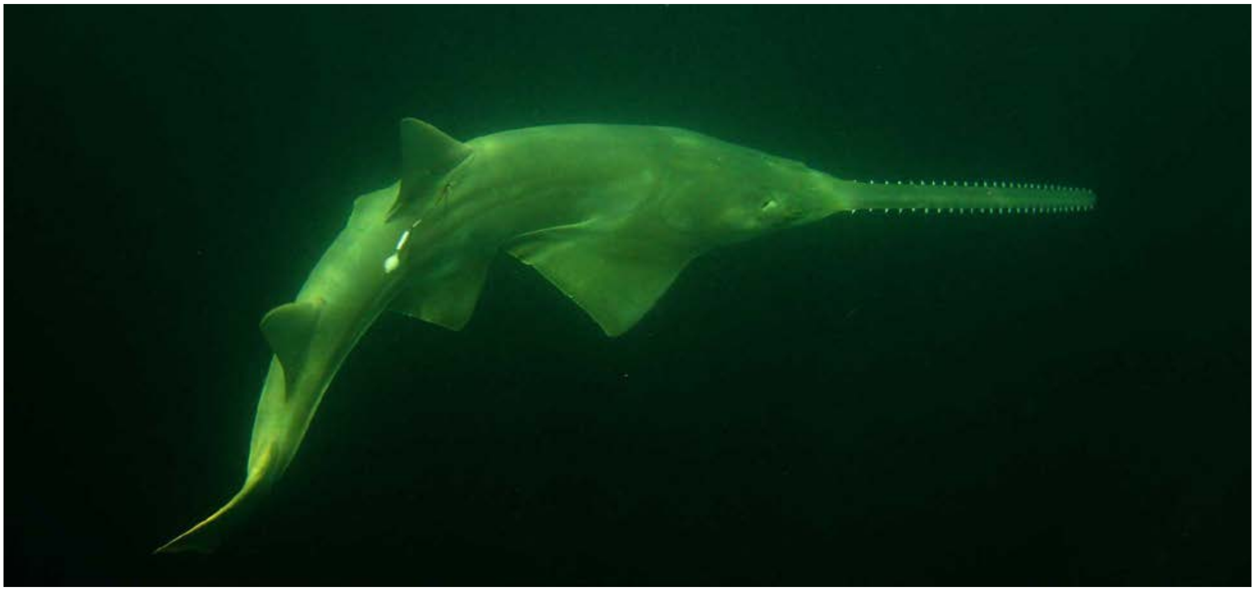

Figure 81: Smalltooth sawfish. Photo: R. Dean, Grubbs.

Table 47: Smalltooth sawfish United States population distinct population segment information bar provides species Latin name, common name and current Federal Register notice of listing status, designated critical habitat, Distinct Population Segment/Evolutionary Significant Unit, recent status review, and recovery plan.

Species	Common Name	Distinct Population Segment	ESA Status	Recent Review Year	Listing	Recovery Plan	Critical Habitat
Pristis pectinata	Smalltooth Sawfish	United States Population	Endangered	2010	68 FR 15674	2009	74 FR 45353

We used information available in the final listing the status review (NMFS 2010g) and available literature to summarize the status of green sturgeon as follows.

4.2.36.1 *Life History*

Smalltooth sawfish size at sexual maturity has been reported as 360 centimeters total length by Simpfendorfer (2005a). Carlson and Simpfendorfer (2015) estimated that sexual maturity for females occurs between seven and 11 years of age. As in many elasmobranchs, smalltooth sawfish are viviparous; fertilization is internal. The gestation period for smalltooth sawfish is estimated at five months based on data from the largetooth sawfish (Thorson 1976). Females move into shallow estuarine and nearshore nursery areas to give birth to live young between November and July, with peak parturition occurring between April and May (Poulakis et al. 2011). Litter sizes range between 10 and 20 individuals (Bigalow and Schroeder 1953; Carlson and Simpfendorfer 2015; Simpfendorfer 2005b).

Neonate smalltooth sawfish are born measuring 67 to 81 centimeters in total length and spend the majority of their time in the shallow nearshore edges of sand and mud banks (Poulakis et al. 2011; Simpfendorfer et al. 2010). Once individuals reach 100 to 140 centimeters total length, they begin to expand their foraging range. Capture data suggests smalltooth sawfish in this size class may move throughout rivers and estuaries within a salinity range of 18 and 30 practical salinity units. Individuals in this size class also appear to have the highest affinity to mangrove habitat (Simpfendorfer et al. 2011). Juvenile sawfish spend the first two to three years of their lives in the shallow waters provided in the lower reaches of rivers, estuaries, and coastal bays (Simpfendorfer et al. 2008; Simpfendorfer et al. 2011). As smalltooth sawfish approach 250 centimeters total length they become less sensitive to salinity changes and begin to move out of the protected shallow-water embayments and into the shorelines of barrier islands (Poulakis et al. 2011). Adult sawfish typically occur in more open-water, marine habitats (Poulakis and Seitz 2004)

4.2.36.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section is broken down into: abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the smalltooth sawfish.

The abundance of smalltooth sawfish in U.S. waters has decreased dramatically over the past century. Efforts are currently underway to provide better estimates of smalltooth sawfish abundance (NMFS 2014e). Current estimates are based on encounter data, genetic sampling, and geographic extent. Carlson and Simpfendorfer (2015) used encounter densities to estimate the female population size to be 600. Chapman et al. (2011) analyzed genetic data from tissue samples (fin clips) to estimate the effective genetic population size as 250 to 350 adults (95 percent confidence intervals 142 to 955). Simpfendorfer (2002) estimated that the U.S. population may number less than five percent of historic levels based on the contraction of the species' range.

The abundance of juveniles encountered in recent studies (Poulakis et al. 2014; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2004) suggests that the smalltooth sawfish population remains reproductively viable. The overall abundance appears to be stable (Wiley and Simpfendorfer 2010). Data analyzed from the Everglades portion of the smalltooth sawfish range suggests that the population growth rate for that region may be around five percent per year (Carlson and Osborne 2012; Carlson et al. 2007). Intrinsic rates of growth for smalltooth sawfish have been estimated at 1.08 to 1.14 per year and 1.237 to 1.150 per year by Simpfendorfer (2000) and Carlson and Simpfendorfer (2015) respectively. However, these intrinsic rates are uncertain due to the lack of long-term abundance data.

Chapman et al. (2011) investigated the genetic diversity within the smalltooth sawfish population. The study reported that the remnant population exhibits high genetic diversity (allelic richness, alleles per locus, heterozygosity) and that inbreeding is rare. The study also suggested that the protected population will likely retain greater than 90 percent of its current genetic diversity over the next century.

Recent capture and encounter data suggests that the current distribution is focused primarily to south and southwest Florida from Charlotte Harbor through the Dry Tortugas (Poulakis and Seitz 2004; Seitz and Poulakis 2002). Water temperatures (no lower than 16 to 18° Celsius) and the availability of appropriate coastal habitat (shallow, euryhaline waters and red mangroves) are the major environmental constraints limiting the distribution of smalltooth sawfish (Bigalow and Schroeder 1953).

4.2.36.3 *Acoustics*

Smalltooth sawfish are elasmobranchs, and like all fish they have an inner ear capable of detecting sound and a lateral line capable of detecting water motion caused by sound (Hastings and Popper 2005; Popper and Schilt 2009). Data for elasmobranchs fishes suggest detection of sounds from 20 Hz to 1.0 kHz with the highest sensitivity to sounds at lower ranges (Casper et al. 2012; Casper et al. 2003; Casper and Mann 2006; Casper and Mann 2009; Ladich and Fay 2013; Myrberg Jr. 2001). However, unlike most teleost fish, elasmobranchs do not have swimbladders, and thus are unable to detect sound pressure (Casper et al. 2012).

4.2.36.4 *Status*

The decline in the abundance of smalltooth sawfish has been attributed to fishing (primarily commercial and recreational bycatch), habitat modification (including changes to freshwater flow regimes as a result of climate change), and life history characteristics (i.e. slow-growing, relatively late-maturing, and long-lived species (NMFS 2009h; Simpfendorfer et al. 2011). These factors continue to threaten the smalltooth sawfish population.

4.2.36.5 *Critical Habitat*

Critical habitat for smalltooth sawfish was designated in 2009 and includes two major units: Charlotte Harbor (221,459 acres) and Ten Thousand Islands/Everglades (619,013 acres) (Figure 80). These two units include essential sawfish nursery areas. The locations of nursery areas were determined by analyzing juvenile smalltooth sawfish encounter data in the context of shark nursery criteria (Heupel et al. 2007; Norton et al. 2012). Within the nursery areas, two features were identified as essential to the conservation of the species: red mangroves (*Rhizophora mangle*), and euryhaline habitats with water depths greater than or equal to 0.9 meters. The Charlotte Harbor unit includes areas which are moderate to highly developed (Cape Coral, Fort Myers) and includes a highly altered, flow-managed system (Caloosahatchee River). In contrast, the Ten Thousand Island/Everglades unit contains relatively undeveloped, pristine smalltooth sawfish habitat (Poulakis et al. 2014; Poulakis et al. 2011).

4.2.36.6 *Recovery Goals*

The 2009 Smalltooth Sawfish Recovery Plan contains complete downlisting/delisting criteria for each of the three following recovery goals (NMFS 2009h).

1. Minimize human interactions and associated injury and mortality.
2. Protect and/or restore smalltooth sawfish habitats.

3. Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had been previously extirpated.

5 Environmental Baseline

The environmental baseline includes the past and present impacts of all Federal, state, or private actions and other human activities in the action area, the anticipated impacts of all proposed Federal projects in the action area that have already undergone formal or early section 7 consultation, and the impact of state or private actions which are contemporaneous with the consultation in process (50 CFR 402.02). Below, we describe the impacts of these actions on ESA-listed species.

5.1 Climate Change

Climate change is projected to have substantial direct and indirect effects on individuals, populations, species, and the structure and function of marine ecosystems in the near future. Climate change is most likely to have its most pronounced effects on species whose populations are already in tenuous positions (Isaac 2008). As such, we expect the extinction risk of ESA-listed species to rise with global warming.

The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 0.85° Celsius over the period 1880 to 2012 (IPCC 2013). Each of the last three decades has been successively warmer at the Earth's surface than any preceding decade since 1850 (IPCC 2013). Burning fossil fuels has increased atmospheric carbon dioxide concentrations by 35 percent with respect to pre-industrial levels, with consequent climatic disruptions that include a higher rate of global warming than occurred at the last global-scale state shift (the last glacial-interglacial transition, approximately 12,000 years ago;(Barnosky et al. 2012)).

Ocean warming dominates the increase in energy stored in the climate system, accounting for more than 90 percent of the energy accumulated between 1971-2010 (IPCC 2013). It is virtually certain that the upper ocean (0-700 m) warmed from 1971-2010 and it likely warmed between the 1870s and 1971 (IPCC 2013). On a global scale, ocean warming is largest near the surface, and the upper 75 meters warmed by 0.11° Celsius per decade over the period 1971-2010 (IPCC 2013). There is high confidence, based on substantial evidence, that observed changes in marine systems are associated with rising water temperatures, as well as related changes in ice cover, salinity, oxygen levels, and circulation. Higher carbon dioxide concentrations have also caused the ocean rapidly to become more acidic, evident as a decrease in pH by 0.05 in the past two decades (Doney 2010).

Primary effects of climate change on individual species include habitat loss or alteration, distribution changes, reduced distribution and abundance of prey, changes in the abundance of competitors and/or predators, and geographic isolation or extirpation of populations that are unable to adapt. Secondary effects include increased stress, disease susceptibility and predation.

The IPCC (2014) reports that warming of the climate has caused, and will continue to cause, shifts in the abundance, geographic distribution, migration patterns, and timing of seasonal activities of species, resulting in changing interactions between species, including competition and predator-prey dynamics. Many fishes, invertebrates, and phytoplankton have already shifted their distribution and/or abundance to deeper, cooler waters as a result of changes to the climate (IPCC 2014). Already observable biotic responses include vast 'dead zones' in the near-shore marine realm(Jackson 2008), as well as the replacement of 40 percent of Earth's formerly biodiverse land areas with agricultural or urban landscapes (Ellis 2011).

Cetaceans with restricted distributions linked to water temperature may be particularly exposed to range restriction (Issac 2009; Learmonth et al. 2006). MacLeod (2009) estimated that, based upon expected shifts in water temperature, 88 percent of cetaceans would be affected by climate change, 47 percent would be negatively affected, and 21 percent would be put at risk of extinction. Of greatest concern are cetaceans with ranges limited to non-tropical waters and preferences for shelf habitats (Macleod 2009). For pinnipeds, the major threats of climate change are reduced prey availability and loss of habitat. Warming sea surface temperatures and ocean acidification are likely to further reduce the availability of prey (Polovina et al. 2008). Sea level rise would reduce available beach habitat for Hawaiian monk seals. For the ice seals (i.e., ringed and bearded seals), climate change is the greatest threat to species survival because of their dependence upon pack ice for breeding, nursing, and resting.

5.2 Environmental Baseline Specific to Cetaceans

The environmental baseline for cetaceans includes the impacts of whaling, fisheries, commercial shipping, ocean sound, military activities, pollution, whale watching, scientific research and climate change.

5.2.1 Whaling

It is not known how many whales were taken by aboriginal hunting and early commercial whaling, though some stocks were already reduced by 1864 (the beginning of the era of modern commercial whaling using harpoon guns as opposed to harpoons simply thrown by men). From 1864-1985, at least 2.4 million baleen whales (excluding minke whales) and sperm whales were killed (Gambell 1999). In 1982, the IWC issued a moratorium on commercial whaling beginning in 1986. There is currently no legal commercial whaling by IWC Member Nations party to the moratorium; however, whales are still killed commercially by countries that filed objections to the moratorium (i.e. Iceland and Norway). Since the moratorium on commercial whaling in 1985, 802 ESA-listed whales (388 sperm and 414 fin whales) have been documented as killed for commercial purposes (IWC 2014b). Additionally, the Japanese whaling fleet carries out whale hunts under the guise of "scientific research," though very few peer-reviewed papers have been published as a result of the program, and meat from the whales killed under the program is processed and sold at fish markets. Since 1985, 1,525 ESA-listed whales have been documented as killed for "scientific research" under these IWC special permits (IWC 2014c). Whales are also killed for subsistence purposes; since 1985, an estimated 1,873 ESA-listed whales (1,428 bowhead, 344 fin, 98 humpback, and three sei whales) have been killed for subsistence purposes (IWC 2014a).

Whales are not currently killed in the action area for commercial purposes, nor for "scientific research" purposes, though prior exploitation is likely to have altered the population structure and social cohesion of species, such that effects on abundance and recruitment continued for years after harvesting has ceased. Bowhead whaling for subsistence purposes does occur in Alaskan waters at an average of 47 whales per year. Though the full impact of this whaling is not known, the Western Arctic stock population trend is positive (Allen and Angliss 2014). As described above, a subsistence hunt for Cook Inlet beluga whales exists in Alaskan waters, but no whales have been killed since 2008.

5.2.2 Shipping

Ships have the potential to affect cetaceans via collisions, sound (discussed below), and disturbance by their physical presence. Ship strikes are considered a serious and widespread threat to ESA-listed whales. The vast majority of ship strike mortalities of cetaceans are likely undocumented, as most are likely never reported and most whales killed by ships strike likely end up sinking rather than washing up on shore; (Kraus et al. 2005) estimated that 17 percent of ship strikes are actually detected. Of 11 species known to be hit by ships, fin whales are struck most frequently; right whales, humpback whales, sperm whales, and gray whales are hit commonly (Laist et al. 2001; Vanderlaan and Taggart 2007). In some areas, one-third of all fin whale and right whale strandings appear to involve ship strikes (Laist et al. 2001). All sizes and types of vessels can hit whales; most lethal or severe injuries are caused by ships 80 meters or longer; whales usually are not seen beforehand or are seen too late to be avoided; and most lethal or severe injuries involve ships travelling 14 knots or faster (Laist et al. 2001). The effects of ship strikes are particularly profound on species with particularly low abundance, such as North Atlantic right whales.

Cetacean responses to vessel presence can include interruption of vital behaviors and social groups, separation of mothers and young, and abandonment of resting areas (Bejder et al. 1999; Boren et al. 2001; Colburn 1999; Constantine 2001; Cope et al. 1999; Kovacs and Innes. 1990; Kruse 1991; Mann et al. 2000; Nowacek et al. 2001; Samuels et al. 2000; Samuels and Gifford. 1998; Wells and Scott 1997).

This threat is increasing as commercial shipping lanes cross important breeding and feeding habitats and as whale populations recover and populate new areas or areas where they were previously extirpated (Swingle et al. 1993; Wiley et al. 1995). As ships continue to become faster and more widespread, an increase in ship interactions with cetaceans is to be expected.

5.2.3 Whale Watching

Although considered by many to be a non-consumptive use of cetaceans with economic, recreational, educational and scientific benefits, whale watching has the potential to harass whales by altering feeding, breeding, and social behavior, or to injure whales if vessels do not maintain a safe distance. Another concern is that preferred habitats may be abandoned if disturbance levels are too high. Several studies have specifically examined the effects of whale watching, and investigators have observed a variety of short-term responses from whales, including: changes in vocalizations; duration of time spent at the surface; swimming speed, angle, or direction; respiration rate; dive time; feeding behavior; social behavior; and, no apparent response (NMFS 2006b). Responses appear to be dependent on factors such as vessel proximity, speed, and direction, as well as the number of vessels in the vicinity (Au and Green. 2000; Corkeron 1995; Erbe 2002b; Magalhaes et al. 2002; Richter et al. 2003; Scheidat et al. 2004; Watkins 1986; Williams et al. 2002a; Williams et al. 2002b). Foote et al. (2004) reported that Southern Resident killer whale call duration in the presence of whale watching boats increased by 10-15 percent between 1989-1992 and 2001-2003, possibly indicating compensation for a noisier environment.

Disturbance by whale watch vessels has also been noted to cause newborn calves to separate briefly from their mothers' sides, which leads to greater energy expenditures by the calves (NMFS 2006b). Although numerous short-term behavioral responses to whale watching vessels are documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006b). Whale watching is a rapidly-growing business with more than 3,300 operators worldwide, serving 13 million participants in 119 countries and territories (O'Connor et al. 2009).

5.2.4 Sound

Sound generated by human activity adversely affects cetaceans in the action area. Sound is generated by commercial and recreational vessels, aircraft, commercial sonar, military activities, seismic exploration, in-water construction activities, and other human activities. These activities occur within the action area to varying degrees throughout the year. Whales generate and rely on sound to navigate, hunt, and communicate with other individuals. Anthropogenic sound can interfere with these important activities. The effects of sound on whales can range from behavioral disturbance to physical damage (Richardson et al. 1995a).

Commercial shipping traffic is a major source of low frequency anthropogenic sound in the oceans (NRC 2003). Although large vessels emit predominantly low frequency sound, studies report broadband sound from large cargo ships above 2 kHz, which may interfere with important biological functions of cetaceans (Holt 2008). Commercial sonar systems are used on recreational and commercial vessels and may affect marine mammals (NRC 2003). Although little information is available on potential effects of multiple commercial sonars to marine mammals, the distribution of these sounds would be small because of their short durations and the fact that the high frequencies of the signals attenuate quickly in seawater (Richardson et al. 1995a).

Seismic surveys using towed airguns also occur within the action area and are the primary exploration technique to locate oil and gas deposits, fault structure, and other geological hazards. Airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of 10-20 seconds for extended periods (NRC 2003). Most of the energy from the guns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235-240 dB at dominant frequencies of 5-300 Hz (NRC 2003). Most of the sound energy is at frequencies below 500 Hz.

5.2.5 Military Activities

The U.S. Navy conducts military readiness activities, which can be categorized as either training or testing exercises, throughout the action area. During training, existing and established weapon systems and tactics are used in realistic situations to simulate and prepare for combat. Activities include: routine gunnery, missile, surface fire support, amphibious assault and landing, bombing, sinking, torpedo, tracking, and mine exercises. Testing activities are conducted for different purposes and include at-sea research, development, evaluation, and experimentation. The U.S. Navy performs testing activities to ensure that its military forces have the latest technologies and techniques available to them. U.S. Navy activities are likely to produce sound and visual disturbance to cetaceans throughout the action area.

5.2.6 Fisheries

Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in marine mammals (see Dietrich et al. 2007). Materials entangled tightly around a body part may cut into tissues, enable infection, and severely compromise an individual's health (Derraik 2002). Entanglements also make animals more vulnerable to additional threats (e.g., predation and ship strikes) by restricting agility and swimming speed. The majority of cetaceans that die from entanglement in fishing gear likely sink at sea rather than strand ashore, making it difficult to accurately determine the extent of such mortalities. Cetaceans are also known to ingest fishing gear, likely mistaking it for prey, which can lead to fitness consequences and mortality. Necropsies of stranded whales have found that ingestion of net pieces, ropes, and other fishing debris has resulted in gastric impaction and ultimately death (Jacobsen et al. 2010).

Whales are also known to feed on several species of fish that are harvested by humans (Waring et al. 2008). Thus competition with humans for prey is a potential concern. Reductions in fish populations, whether natural or human-caused, may affect the survival and recovery of several populations.

5.2.7 Pollution

Contaminants cause adverse health effects in cetaceans. Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation (Garrett 2004; Grant and Ross 2002; Hartwell 2004). The accumulation of persistent organic pollutants, including polychlorinated-biphenyls (PCBs), dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and related compounds, through trophic transfer may cause mortality and sub-lethal effects in long-lived higher trophic level animals such as marine mammals (Waring et al. 2008), including immune system abnormalities, endocrine disruption, and reproductive effects (Krahn et al. 2007). Persistent organic pollutants may also facilitate disease emergence and lead to the creation of susceptible "reservoirs" for new pathogens in contaminated marine mammal populations (Ross 2002). Among striped dolphins in the Mediterranean Sea, PCB levels were found to be significantly higher in animals affected by the 1990 morbillivirus epizootic than in the 'healthy' populations sampled before or after the event (Aguilar and Borrell 1994). There is evidence that previous mass mortalities of northwest Atlantic bottlenose dolphins (*Tursiops truncatus*) and Hawaiian monk seals may have resulted from an interaction between morbillivirus infection and other external stressors such as toxic algal blooms and environmental contaminants (Ross 2002). Recent efforts have led to improvements in regional water quality and monitored pesticide levels have declined, although the more persistent chemicals are still detected and are expected to endure for years (Grant and Ross 2002; Mearns 2001).

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Cetaceans are generally able to metabolize and excrete limited amounts of hydrocarbons, but exposure to large amounts of hydrocarbons and chronic exposure over time pose greater risks (Grant and Ross 2002). Cetaceans have a thickened epidermis that greatly reduces the likelihood of petroleum toxicity from skin contact with oils (Geraci 1990), but they may inhale these compounds at the water's surface and ingest them while feeding (Matkin and Saulitis 1997). Hydrocarbons also have the potential to impact prey populations, and therefore may affect ESA-listed species indirectly by reducing food availability.

Cetaceans are also impacted by marine debris, which includes: plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear (Laist 1997). Marine debris is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources. Even natural phenomena, such as tsunamis and continental flooding, can cause large amounts of debris to enter the ocean environment. Cetaceans often become entangled in marine debris (Johnson et al. 2005). The ingestion of marine debris has been documented to result in blockage or obstruction of the digestive tract, mouth, and stomach lining of various species and can lead to serious internal injury or mortality (Derraik 2002). In addition to interference with alimentary processes, plastics lodged in the alimentary tract could facilitate the transfer of pollutants into the bodies of whales and dolphins (Derraik 2002).

Aquatic nuisance species are aquatic and terrestrial organisms, introduced into new habitats throughout the United States and other areas of the world, that produce harmful impacts on aquatic ecosystems and native species (http://www.anstaskforce.gov). They are also referred to as invasive, alien, or nonindigenous species. Introduction of these species is cited as a major threat to biodiversity, second only to habitat loss (Wilcove et al. 1998). They have been implicated in the endangerment of 48 percent of ESA-listed species (Czech and Krausman 1997). Over 250 nonindigenous species of invertebrates, algae, and microorganisms have established themselves in the coastal marine ecosystems of California, whose waters have been the subject of most in-depth analyses of aquatic invasions in the U.S.

5.2.8 Scientific Research

Scientific research permits, issued by NMFS, authorize the study of ESA-listed cetaceans in the action area (Table 48). The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. Activities authorized include: aerial and vessel surveys, photo-identification, biopsy sampling, and attachment of scientific instruments. These activities may result in harassment, stress, and injury. It should be noted that the proposed action includes scientific research as a component of the Program and the scientific research described in this section is additional to the research that is proposed. The MMHSRP will coordinate with other permitted researchers whenever possible to reduce impacts on animals (see description of "piggy-backing"; Section 2.2.2).

Table 48: Takes of ESA-listed cetaceans authorized by NMFS for scientific research in 2015.

	Mortality	Approach /harass	Biopsy	Implantable tag	Suction cup tag	Belt tag	Exhal-ation	Acoustic playback	Ultra-sound	Underwater video
Killer whale (Southern Resident DPS)		24304	84	39	79		1105	880	25	
Beluga whale (Cook Inlet DPS)		12812	300		300					
False killer whale (Hawaiian Islands Insular DPS)		3609	65	65	65		3065			3415
Sperm whale		39309	5460	1300	3730		2000	170		
Sei whale		17946	2848	845	1593		1325			
Fin whale		41408	6649	1334	5780		1520	85		
Blue whale		26717	3845	1925	4975		3280	21		
Humpback whale		80529	10045	2175	8847	250	3660	280		
Bowhead whale		22944	1835	410	1495					
North Atlantic right whale		13918	330	65	690		80			
North Pacific right whale		2561	290	199	314			50		
TOTAL	0	286609	31833	8429	27940	250	16035	1486	25	3415

5.2.9 Environmental Variability

Periodic weather patterns such as El Niño, La Niña, and the Pacific decadal oscillation can fundamentally change oceanographic conditions in the northeastern Pacific and the biology that is based upon it (Mundy and Cooney 2005; Mundy and Olsson 2005; Stabeno et al. 2004). Roughly every 3-7 years, El Niño can influence the northeastern Pacific (JOI/USSSP 2003; Stabeno et al. 2004). Typical changes include increased winter air temperature, precipitation, sea level, and downwelling favorable conditions (Royer and Weingartner 1999; Whitney et al. 1999). La Niña events tend to swing these conditions in the negative direction (Stabeno et al. 2004). The 1982/1983 El Niño and other downwelling events are generally regarded to have reduced food supplies for marine mammals along the U.S. west coast (Feldkamp et al. 1991; Hayward 2000; Le Boeuf and Crocker 2005). During La Niña conditions in the Gulf of California, Bryde's whales were found to be more abundant, possibly due to increased availability of their prey under La Niña conditions (Salvadeo et al. 2011). Marine mammal distribution and group size is also believed to have shifted northward in response to persistent or extralimital prey occurrence in more northerly waters during El Niño events (Benson et al. 2002; Danil and Chivers 2005; Lusseau et al. 2004; Norman et al. 2004; Shane 1994; Shane 1995). Low reproductive success and body condition in humpback whales have also been suggested to have resulted from the 1997/1998 El Niño (Cerchio et al. 2005). Plankton diversity also shifts with El Niño events, as smaller plankton are better able to cope with reduced nutrient availability (Corwith and Wheeler 2002; Sherr et al. 2005).

5.2.10 Summary of Environmental Baseline for Cetaceans

Numerous natural and anthropogenic factors have contributed to the baseline status of cetaceans, including: whaling, shipping, sound, military activities, fisheries, pollution, scientific research, marine mammal viewing, and climate change. Though the threat of whaling has declined substantially over time, the impacts of whaling on cetacean populations remains profound, and the other threats described above continue to impact cetaceans and are expected to continue into the future. Such threats must be considered as part of the baseline when evaluating the effects of the action on the viability of the species.

5.3 Environmental Baseline Specific to Pinnipeds

The environmental baseline for ESA-listed pinnipeds in the action area includes fisheries interactions, pollution, marine debris, environmental variability, scientific research, climate change, and the impacts of hunting.

5.3.1 Hunting

Seals, sea lions, and fur seals have been hunted by humans for centuries for their fur, meat, and oil. Two species (Caribbean monk seal and Japanese sea lion) were hunted to extinction in the twentieth century, while other species were hunted to near extinction (including the Hawaiian monk seal and Guadalupe fur seal), and many species were severely depleted. While hunting was previously the primary cause of population decline among ESA-listed pinnipeds, it no longer represents a major threat. Hunting of Hawaiian monk seals and Guadalupe fur seals is illegal, while limited subsistence hunting of Steller sea lions, bearded seals, and ringed seals is permitted.

5.3.2 Fisheries Interactions

Fisheries interactions are a major threat to pinnipeds through several mechanisms: prey reduction, intentional shootings, incidental bycatch, and entanglement in fishing gear. Reduced quantity or quality of prey appears to be a major threat to several pinniped species, as evidenced by population declines, reduced body size/condition, low birth rates, and high juvenile mortality rates (Baker 2008; Trites and Donnelly 2003). Pinnipeds are also intentionally shot by fishermen as a result of actual or perceived competition for fish. An estimated 50-1,180 Steller sea lions are shot annually (Atkinson et al. 2008); six monk seals have been killed in recent years. Pinnipeds are also injured and killed accidentally as a result of being hooked by longline fisheries, entangled in fishing line, and entangled in gillnet, trawl, and other net-based fisheries. Commercial fishing is estimated to incidentally kill approximately 30 Steller sea lions annually (Atkinson et al. 2008). Hookings and entanglement in fishing gear represent major threats to Hawaiian monk seals. Aside from actively fished gear, derelict fishing gear (accidentally lost or intentionally discarded or abandoned fishing lines, nets, pots, traps, or other gear associated with commercial or recreational fishing) also represents an entanglement risk for pinnipeds. Derelict gear is one of the primary threats to the Hawaiian monk seal, with annual rates of entanglement in fishing gear ranging from four percent to 78 percent of the total estimated population (Donohue and Foley 2007). In the Northwest Hawaiian Islands, an estimated 52 tons of derelict fishing gear accumulate annually (Dameron et al. 2007).

5.3.3 Pollution

As described above for cetaceans, pollutants and contaminants cause adverse health effects in pinnipeds. Acute toxicity events may result in mass mortalities; repeated exposure to lower levels of contaminants may result in immune suppression and/or endocrine disruption (Atkinson et al. 2008). In addition to hydrocarbons and other persistent chemicals, pinnipeds may become exposed to infectious diseases (e.g., Chlamydia and leptospirosis) through polluted waterways (Aguirre et al. 2007). As described above for cetaceans, entanglement in marine debris can affect pinnipeds by restricting movement, potentially impacting their ability to migrate, feed, escape prey, reproduce, or surface to breathe (Derraik 2002). Ultimately entanglement in marine debris can result in injury, reductions in fitness, and mortality.

5.3.4 Scientific Research

Scientific research permits, issued by NMFS, authorize the study of ESA-listed resources in the action area (Table 49). The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. Activities authorized include: surveys, marking, tagging, biopsy sampling, and attachment of scientific instruments. These activities may result in harassment, stress, and, in limited cases, injury or morality. It should be noted that the proposed action includes scientific research as a component of the Program and the scientific research described in this section is additional to the research that is proposed; however the MMHSRP will coordinate with other permitted researchers whenever possible to reduce impacts on animals (see description of “piggy-backing”; Section 2.2.2).

Table 49: Takes of ESA-listed pinnipeds authorized by NMFS for scientific research in 2015.

	mortality	capture/ restraint/ handle	approach/ harass	biopsy	external tagging	Medication/ anesthesia	mark/ brand	lavage	blood / tissue/tooth /vibrissae/ other sample	ultra-sound	morpho-metrics
Steller sea lion (Western DPS)	15	1310	347871	1260	910	1110	810	940	1010	960	
Ringed seal	0	200	100451	200	200	200			600	200	200
Guadalupe fur seal	1	140	4010								
Bearded seal											
Hawaiian monk seal	12***	*	*	*	*	*	1495		*		
TOTAL**	28	1650	452332	1460	1110	1310		940	1160	1160	200

* Takes are “as warranted”

** Totals do not include “as warranted” takes of Hawaiian monk seals

*** two research-related mortalities (not to exceed four over five yrs); 10 euthanasia procedures on adult males over five yrs

5.3.5 Environmental Variability

Limited prey availability, which is a major threat to several pinniped species, may be the result of reduced ecosystem productivity, caused by cyclic climate events. Declines in Steller sea lion populations overlap temporally and geographically with oceanic regime shifts (Trites et al. 2007). Reduction in juvenile monk seal survival is also correlated with large-scale climate events (Polovina et al. 1994).

5.3.6 Summary of Environmental Baseline for Pinnipeds

Numerous factors have contributed to the endangered status of pinnipeds, including: hunting, fisheries interactions, environmental variability, climate change, pollution, and scientific research. Though the threat of hunting was once the primary cause of population declines, it is no longer a major threat. Instead, fisheries interactions, environmental variability, and climate change appear to be the major threats to the survival and recovery of pinniped species. These threats are likely to continue, and worsen, in the future. Such threats must be considered as part of the baseline when evaluating the effects of the action on the viability of the species.

5.4 Environmental Baseline Specific to Turtles, Sturgeon, and Sawfish

The environmental baseline for sea turtles, sturgeon, and sawfish includes a multitude of conditions including habitat degradation, entrapment in fishing gear, dredging, pollutants, and vessel strikes among others. These are discussed below.

5.4.1 Habitat degradation

A number of factors may be directly or indirectly affecting ESA-listed species in the action area by degrading habitat. In-water construction activities (e.g., pile driving associated with shoreline projects) in both inland waters as well as coastal waters in the action area can produce sound levels sufficient to disturb sea turtles under some conditions. Disturbance of sturgeon and sawfish by environmental sound is generally unstudied. Pressure levels from 190-220 decibels (dB) re 1 micropascal were reported for piles of different sizes in a number of studies (NMFS 2006b). The majority of the sound energy associated with pile driving is in the low frequency range (less than 1,000 Hertz; Illingworth and Rodkin Inc. 2001; Illingworth and Rodkin Inc. 2004; Reyff 2003), which is the frequency range at which sea turtles hear best. Dredging operations also have the potential to emit sounds at levels that could disturb sea turtles. Depending on the type of dredge, peak sound pressure levels from 100-140 dB re 1 micropascal were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, less than 1,000 Hertz (Clarke et al. 2003).

Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of sea turtles to sound. For example, a six-inch block of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 dB (NMFS 2008a). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when sea turtles may be present; monitoring for sea turtles during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when sea turtles enter the zone (NMFS 2008a).

Marine debris is a significant concern for ESA-listed species and their habitats. Marine debris accumulates in gyres throughout the oceans. The input of plastics into the marine environment also constitutes a significant degradation to the marine environment. In 2010, an estimated 4.8-12.7 million metric tons of plastic entered the ocean globally (Baulch and Simmonds 2015). Law et al. (2010) presented a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986-2008. More than 60 percent of 6,136 surface plankton net tows collected small, buoyant plastic pieces. The data identified an accumulation zone east of Bermuda that is similar in size to the accumulation zone in the Pacific Ocean and is a major accumulation center for anthropogenic debris (Schuyler et al. 2015).

For sea turtles, marine debris is a problem due primarily to individuals ingesting debris and blocking the digestive tract, causing death or serious injury (Laist et al. 1999; Lutcavage et al. 1997). Schuyler et al. (2015) estimated that, globally, 52 percent of individual sea turtles have ingested marine debris. Of Pacific green sea turtles, 91 percent had marine debris (mostly plastics) in their guts (Wedemeyer-Strombel et al. 2015). Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives; this figure is supported by data from Lazar and Gracan (2010), who found 35 percent of loggerheads had plastic in their gut. Over 50 percent of loggerheads had marine debris in their guts (greater than 96 percent of which was plastic) in the Indian Ocean (Hoarau et al. 2014). One study found 37 percent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al. 2009). A Brazilian study found that 60 percent of stranded green sea turtles had ingested marine debris (primarily plastic and oil; Bugoni et al. 2001). Loggerhead sea turtles had a lesser frequency of marine debris ingestion. Plastic is possibly ingested out of curiosity or due to confusion with prey items; for example, plastic bags can resemble jellyfish (Milton and Lutz 2003). Marine debris consumption has been shown to depress growth rates in post-hatchling loggerhead sea turtles, elongating the time required to reach sexual maturity and increasing predation risk (McCauley and Bjorndal 1999). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997; NRC 1990; O'Hara et al. 1988). Studies of shore cleanups have found that marine debris washing up along the northern Gulf of Mexico shoreline amounts to about 100 kilograms/kilometers (ACC 2010; LADEQ 2010; MASGC 2010; TGLO 2010). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997; NRC 1990; O'Hara et al. 1988).

Modification and loss of smalltooth sawfish habitat, especially nursery habitat, is another contributing factor in the decline of the species. Activities such as agricultural and urban development, commercial activities, dredge-and-fill operations, boating, erosion, and diversions of freshwater runoff contribute to these losses (SAFMC 1998). Large areas of coastal habitat were modified or lost between the mid-1970s and mid-1980s within the United States (Dahl and Johnson 1991). Since then, rates of loss have decreased, but habitat loss continues. From 1998-2004, approximately 64,560 acres of coastal wetlands were lost along the Atlantic and Gulf coasts of the United States, of which approximately 2,450 acres were intertidal wetlands consisting of mangroves or other estuarine shrubs (Stedman and Dahl 2008). Further, Orlando et al. (1994) analyzed 18 major southeastern estuaries and recorded over 703 miles of navigation channels and 9,844 miles of shoreline with modifications. In Florida, coastal development often involves the removal of mangroves and the armoring of shorelines through seawall construction. Changes to the natural freshwater flows into estuarine and marine waters through construction of canals and other water control devices have also altered the temperature, salinity, and nutrient regimes; reduced both wetlands and submerged aquatic vegetation; and degraded vast areas of coastal habitat utilized by smalltooth sawfish (Gilmore 1995; Reddering 1988; Whitfield and Bruton 1989). While these modifications of habitat are not the primary reason for the decline of smalltooth sawfish abundance, it is likely a contributing factor and almost certainly hampers the recovery of the species. Juvenile sawfish and their nursery habitats are particularly likely to be affected by these kinds of habitat losses or alternations, due to their affinity for shallow, estuarine systems. Although many forms of habitat modification are currently regulated, some permitted direct and/or indirect damage to habitat from increased urbanization still occurs and is expected to continue to threaten survival and recovery of the species in the future.

5.4.2 Entrapment and entanglement in fishing gear

Globally, 6.4 million tons of fishing gear is lost in the oceans every year (Wilcox et al. 2015). Fishery interaction remains a major factor in sea turtle recovery and, frequently, the lack thereof. NMFS (2002) estimated that 62,000 loggerhead sea turtles have been killed as a result of incidental capture and drowning in shrimp trawl gear. Although turtle excluder devices and other bycatch reduction devices have significantly reduced the level of bycatch to sea turtles and other marine species in U.S. waters, mortality still occurs in Gulf of Mexico waters. This is discussed further in the *Status of ESA-listed Species* section.

In addition to commercial bycatch, recreational hook-and-line interaction also occurs. Cannon and Flanagan (1996) reported that from 1993-1995, at least 170 Kemp's ridley sea turtles were hooked or tangled by recreational hook-and-line gear in the northern Gulf of Mexico. Of these, 18 were dead stranded turtles, 51 were rehabilitated turtles, five died during rehabilitation, and 96 were reported as released by fishermen.

Directed harvest of shortnose and Atlantic sturgeon is prohibited. In 1998, the Atlantic States Marine Fisheries Commission (ASMFC) imposed a coast-wide fishing moratorium on Atlantic sturgeon until 20-year classes of adult females could be established (ASMFC 1998). NMFS followed this action by closing the U.S. exclusive economic zone to Atlantic sturgeon take in 1999. Shortnose sturgeon has likely benefitted from this closure as any bycatch in the fishery targeting Atlantic sturgeon has been eliminated.

Although directed harvest of shortnose and Atlantic sturgeon are prohibited, bycatch of this species has been documented in other fisheries throughout its range. Adults are believed to be especially vulnerable to fishing gears for other anadromous species (such as shad, striped bass and herring) during times of extensive migration, particularly the spawning migration upstream, followed by movement back downstream (Litwiler 2001). Additionally, bycatch of shortnose sturgeon in the southern trawl fishery for shrimp *Penaeus* spp. was estimated at 8 percent in one study (Collins et al. 1996).

Although shortnose sturgeon are primarily captured in gill nets, they have also been documented in the following gears: pound nets, fyke/hoop nets, catfish traps, shrimp trawls, and hook and line fisheries (recreational). The NMFS (1998a) Recovery Plan for shortnose sturgeon lists commercial and recreational shad fisheries as a source of shortnose bycatch. Shad and river herring (blueback herring (*Alosa aestivalis*)) and alewives (*Alosa pseudoharengus*) are managed under an ASMFC Interstate Fishery Management Plan.

Bycatch mortality is cited as the primary cause for the decline in smalltooth sawfish in the United States (NMFS 2010f). While there has never been a large-scale directed fishery, smalltooth sawfish easily become entangled in fishing gears (gillnets, otter trawls, trammel nets, and seines) directed at other commercial species, often resulting in serious injury or death (NMFS 2009g). This has historically been reported in Florida (Snelson and Williams 1981), Louisiana (Simpfendorfer 2002), and Texas (Baughman 1943). For instance, one fisherman interviewed by Evermann and Bean (1898) reported taking an estimated 300 smalltooth sawfish in just one netting season in the Indian River Lagoon, Florida. In another example, smalltooth sawfish landings data gathered by Louisiana shrimp trawlers from 1945-1978, which contained both landings data and crude information on effort (number of vessels, vessel tonnage, number of gear units), indicated declines in smalltooth sawfish landings from a high of 34,900 pounds in 1949 to less than 1,500 pounds in most years after 1967. The Florida net ban passed in 1995 has led to a reduction in the number of smalltooth sawfish incidentally captured, "…by prohibiting the use of gill and other entangling nets in all Florida waters, and prohibiting the use of other nets larger than 500 square feet in mesh area in nearshore and inshore Florida waters[5]" (FLA. CONST. art. X, § 16). However, the threat of bycatch currently remains in commercial fisheries (e.g., South Atlantic shrimp fishery, Gulf of Mexico shrimp fishery, federal shark fisheries of the

[5] *"nearshore and inshore Florida waters" means all Florida waters inside a line three miles seaward of the coastline along the Gulf of Mexico and inside a line one mile seaward of the coastline along the Atlantic Ocean.*

South Atlantic, and the U.S. Gulf of Mexico reef fish fishery), though anecdotal information collected by NMFS ports agents suggest smalltooth sawfish captures are now rare.

In addition to incidental bycatch in commercial fisheries, smalltooth sawfish have historically been and continue to be captured by recreational fishermen. Encounter data (NSED 2012) and past research (Caldwell 1990) document that rostrums are sometimes removed from smalltooth sawfish caught by recreational fishermen, thereby reducing their chances of survival. While the current threat of mortality associated with recreational fisheries is expected to be low given that possession of the species in Florida has been prohibited since 1992, bycatch in recreational fisheries remains a potential threat to the species.

Smalltooth sawfish occasionally are caught as bycatch in the following federally managed fisheries operating in and around the action area: highly migratory species such as Atlantic shark, coastal migratory pelagics, U.S. Gulf of Mexico reef fish, South Atlantic snapper-grouper, Gulf of Mexico stone crab, Gulf of Mexico/South Atlantic spiny lobster, and the Gulf of Mexico/South Atlantic shrimp trawl fisheries. The highest interaction with the species is reported for the highly migratory species Atlantic shark, Gulf of Mexico reef fish, and the Gulf of Mexico and South Atlantic shrimp trawl fisheries.

5.4.3 Dredging

Marine dredging vessels are common within U.S. coastal waters. Construction and maintenance of federal navigation channels and dredging in sand mining sites have been identified as sources of sea turtle mortality and are currently being undertaken along the U.S. East Coast, such as in Port Everglades, Florida. Hopper dredges in the dredging mode are capable of moving relatively quickly compared to sea turtle swimming speed and can thus overtake, entrain, and kill sea turtles as the suction draghead(s) of the advancing dredge catch up to resting or swimming turtles. Entrained sea turtles rarely survive. Relocation trawling frequently occurs in association with dredging projects to reduce the potential for dredging to injure or kill sea turtles (Dickerson et al. 2007). Dredging has been documented to capture or kill 168 sea turtles from 1995-2009 in the Gulf of Mexico, including 97 loggerheads, 35 Kemp’s ridleys, 32 greens, and three unidentified sea turtles (USACOE 2010).

Sturgeon are also bycaught in dredging operations along the U.S. East Coast (ASSRT 2007). Most of these activities are permitted by the U.S. Army Corps of Engineers, who have reported 24 sturgeon (11 shortnose and 11 Atlantic sturgeon) from 1990-2005 (ASSRT 2007). Dredging is not a known threat to smalltooth sawfish (NMFS 2003; NMFS 2005; NMFS 2007c).

5.4.4 United States Navy training and testing activities

Naval activities conducted during training exercises in designated naval operating areas and training ranges have the potential to adversely harm sea turtles and sturgeon. Species occurring in the action area could experience stressors from several naval training ranges or facilities listed below. ESA-listed animals travel widely in the North Atlantic and could be exposed to naval activities in several ranges.

- The Virginia Capes, Cherry Point, and Jacksonville-Charleston Operating Areas, which are situated consecutively along the migratory corridor for sea turtles, and
- The Key West, Gulf of Mexico, Bermuda, and Puerto Rican Complexes have the potential to overlap the range of sea turtles species.

Naval activities to which individuals could be exposed include, among others, vessel and aircraft transects, munition detonations, and sonar use.

Anticipated impacts from harassment include changes from foraging, resting, and other behavioral states that require lower energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures and, therefore, would represent significant disruptions of the normal behavioral patterns of the animals that have been exposed. Behavioral responses that result from stressors associated with these training activities are expected to be temporary and would not affect the reproduction, survival, or recovery of these species.

From 2009-2012, NMFS issued a series of biological opinions to the U.S. Navy for training activities occurring within their Virginia Capes, Cherry Point, and Jacksonville Range Complexes that anticipated annual levels of take of ESA-listed species incidental to those training activities through 2014. During the proposed activities, 344 hardshell sea turtles (any combination of green, hawksbill, Kemp's ridley, or northwest Atlantic loggerhead sea turtles) per year were expected to be harassed as a result of their behavioral responses to mid- and high-frequency active sonar transmissions.

In 2014, NMFS issued a biological opinion to the U.S. Navy on all testing and training activities in the Atlantic basin (Table 50 and Table 51). These actions would include the same behavioral and hearing loss effects as described above, but would also include other sub-lethal injuries that lead to fitness consequences and mortality that can lead to the loss of individuals from their populations.

Table 50. Annual take authorized for U.S. Navy testing activities in the North Atlantic.

Sea turtle species	Behavioral and temporary threshold shift	Permanent threshold shift	Organ injury	Mortality
Hardshell sea turtles	5,132	10	242	49
Kemp's ridley	292	0	17	4
Leatherback	6,362	29	162	57
Loggerhead	1,017	15	578	81

Table 51. Annual take authorized for U.S. Navy training activities in the North Atlantic.

Sea turtle species	Behavioral and temporary threshold shift	Permanent threshold shift	Organ injury	Mortality
Hardshell sea turtles	12,216	22	4	2
Kemp's ridley	302	2	1	1
Leatherback	8,909	23	2	1
Loggerhead	16,812	34	7	4

5.4.5 Pollutants

The Gulf of Mexico is a sink for massive levels of pollution from a variety of marine and terrestrial sources, which ultimately can interfere with ecosystem health and particularly that of sea turtles, sturgeon, and sawfish (see *Status of the Species* section). Sources include the petrochemical industry in and along the Gulf of Mexico, wastewater treatment plants, septic systems, industrial facilities, agriculture, animal feeding operations, and improper refuse disposal. The Mississippi River drains 80 percent of United States cropland (including the fertilizers, pesticides, herbicides, and other contaminants that are applied to it) and discharges into the Gulf of Mexico (MMS 1998). Agricultural discharges and discharges from large urban centers (e.g., Tampa) contribute contaminants as well as coliform bacteria to Gulf of Mexico habitats (Garbarino et al. 1995). These contaminants can be carried long distances from terrestrial or nearshore sources and ultimately accumulate in offshore pelagic environments (USCOP 2004). The ultimate impacts of this pollution are poorly understood.

Significant attention has been paid to nutrient enrichment of Gulf of Mexico waters, which leads to algal blooms (including harmful algal blooms), oxygen depletion, loss of seagrass and coral reef habitat, and the formation of a hypoxic "dead zone" (USCOP 2004). This hypoxic event occurs annually from as early as February to as late as October, spanning roughly 12,700 square kilometers (although in 2005 the "dead zone" grew to a record size of 22,000 square kilometers) from the Mississippi River Delta to Galveston, Texas (LUMCON 2005; MMS 1998; Rabalais et al. 2002; USGS 2010). Although sea turtles do not extract oxygen from sea water, numerous staple prey items of sea turtles, such as fish, shrimp, and crabs, do and are killed by the hypoxic conditions (Craig et al. 2001). More generally, the "dead zone" decreases biodiversity, alters marine food webs, and destroys habitat (Craig et al. 2001; Rabalais et al. 2002). High nitrogen loads entering the Gulf of Mexico from the Mississippi River is the likely culprit; nitrogen concentrations entering the Gulf of Mexico have increased three fold over within 60 years (Rabalais et al. 2002).

5.4.6 Oil spills and releases

Oil pollution has been a significant concern in the Gulf of Mexico for several decades due to the large amount of extraction and refining activity in the region. Routine discharges into the northern Gulf of Mexico (not including oil spills) include roughly 88,200 barrels of petroleum per year from municipal and industrial wastewater treatment plants and roughly 19,250 barrels from produced water discharged overboard during oil and gas operations (MMS 2007b; USN 2008). These sources amount to over 100,000 barrels of petroleum discharged into the northern Gulf of Mexico annually. Although this is only 10 percent of the amount discharged in a major oil spill, such as the Exxon *Valdez* spill (roughly one million barrels), this represents a significant and "unseen" threat to Gulf of Mexico wildlife and habitats. Generally, accidental oil spills may amount to less than 24,000 barrels of oil discharged annually in the northern Gulf of Mexico, making non-spilled oil normally one of the leading sources of oil discharge into the Gulf of Mexico, although incidents such as the 2010 *Deepwater Horizon* incident are exceptional (MMS 2007a). The other major source from year to year is oil naturally seeping into the northern Gulf of Mexico. Although exact figures are unknown, natural seepage is estimated at between 120,000 and 980,000 barrels of oil annually (MacDonald et al. 1993; MMS 2007b).

Although non-spilled oil is the primary contributor to oil introduced into the Gulf of Mexico, concern over accidental oil spills is well-founded (Campagna et al. 2011). Over five million barrels of oil and one million barrels of refined petroleum products are transported in the northern Gulf of Mexico daily (MMS 2007b); worldwide, it is estimated that 900,000 barrels of oil are released into the environment as a result of oil and gas activities (Epstein and (Eds.). 2002). Even if a small fraction of the annual oil and gas extraction is released into the marine environment, major, concentrated releases can result in significant environmental impacts. Because of the density of oil extraction, transport, and refining facilities in the Houston/Galveston and Mississippi Delta areas (and the extensive activities taking place at these facilities), these locations have the greatest probability of experiencing oil spills. Oil released into the marine environment contains aromatic organic chemicals known to be toxic to a variety of marine life; these chemicals tend to dissolve into the air to a greater or lesser extent, depending on oil type and composition (Yender et al. 2002). Solubility of toxic components is generally low, but does vary and can be relatively high (0.5-167 parts per billion; Yender et al. 2002).

Several oil spills have affected the northern Gulf of Mexico over the past few years, largely due to hurricanes. The impacts of Hurricane Ivan in 2004 on the Gulf Coast included pipeline damage causing 16,000 barrels of oil to be released and roughly 4,500 barrels of petroleum products from other sources (BOEMRE 2010; USN 2008). The next year, Hurricane Katrina caused widespread damage to onshore oil storage facilities, releasing 191,000 barrels of oil (LHR 2010). Another 4,530 barrels of oil were released from 70 other smaller spills associated with hurricane damage. Shortly thereafter, Hurricane Rita damaged offshore facilities resulting in 8,429 barrels of oil released (USN 2008).

Major oil spills have impacted the Gulf of Mexico for decades (NMFS 2010c). Until 2010, the largest oil spill in North America (Ixtoc oil spill) occurred in the Bay of Campeche (1979), when a well "blew out," allowing oil to flow into the marine environment for nine months, releasing 2.8-7.5 million barrels of oil. Oil from this release eventually reached the Texas coast, including the Kemp's ridley sea turtle nesting beach at Rancho Nuevo, where 9,000 hatchlings were airlifted and released offshore (NOAA 2003). Over 7,600 cubic meters of oiled sand was eventually removed from Texas beaches, and 200 gallons of oil were removed from the area around Rancho Nuevo (NOAA 2003). Eight dead and five live sea turtles were recovered during the oil spill event; although cause of deaths were not determined, oiling was suspected to play a part (NOAA 2003). Also in 1979, the oil tanker *Burmah Agate* collided with another vessel near Galveston, Texas, causing an oil spill and fire that ultimately released 65,000 barrels of oil into estuaries, beachfronts, and marshland along the northern and central Texas coastline (NMFS 2010c). Clean up of these areas was not attempted due to the environmental damage such efforts would have caused. Another 195,000 barrels of oil are estimated to have been burned in a multi-month-long fire aboard the *Burmah Agate* (NMFS 2010c). The tanker *Alvenus* grounded in 1984 near Cameron, Louisiana, spilling 65,500 barrels of oil, which spread west along the shoreline to Galveston (NMFS 2010c). One oiled sea turtle was recovered and released (NOAA 2003). In 1990, the oil tanker *Megaborg* experienced an accident near Galveston during the lightering process and released 127,500 barrels of oil, most of which burned off in the ensuing fire (NMFS 2010c).

On April 20 2010, a fire and explosion occurred aboard the semisubmersible drilling platform *Deepwater Horizon* roughly 80 kilometers southeast of the Mississippi Delta (NOAA 2010a). The platform had 17,500 barrels of fuel aboard, which likely burned, escaped, or sank with the platform (NOAA 2010a). However, once the platform sank, the riser pipe connecting the platform to the wellhead on the seafloor broke in multiple locations, initiating an uncontrolled release of oil from the exploratory well. Over the next three months, oil was released into the Gulf of Mexico, resulting in oiled regions of Texas, Louisiana, Mississippi, Alabama, and Florida and widespread oil slicks throughout the northern Gulf of Mexico that closed more than one-third of the U.S. Gulf of Mexico exclusive economic zone to fishing due to contamination concerns. Apart from the widespread surface slick, massive undersea oil plumes formed, possibly through the widespread use of dispersants and reports of tarballs washing ashore throughout the region were common. Although estimates vary, roughly 4.1 million barrels of oil were released directly into the Gulf of Mexico (USDOI 2012). During surveys in offshore oiled areas, 1,050 sea turtles were seen and half of these were captured (Witherington et al. 2012). Of the 520 sea turtles captured, 394 showed signs of being oiled (Witherington et al. 2012). A large majority of these were juveniles, mostly green (311) and Kemp's ridley sea turtles (451) (Witherington et al. 2012). An additional 78 adult or subadult loggerheads were observed (Witherington et al. 2012). Captures of sea turtles along the Louisiana's Chandeleur Islands in association with emergency sand berm construction resulted in 185 loggerheads, eight Kemp's ridley, and a single green sea turtle being captured and relocated (Dickerson and Bargo 2012). In addition, 274 nests along the Florida panhandle were relocated that ultimately produced 14,700 hatchlings, but also had roughly two percent mortality associated with the translocation (MacPherson et al. 2012). Females that laid these nests continued to forage in the area, which was exposed to the footprint of the oil spill (Hart et al. 2014). Large areas of *Sargassum* were affected, with some heavily oiled or dispersant-coated *Sargassum* sinking and other areas accumulating oil where sea turtles could inhale, ingest, or contact it (Powers et al. 2013; USDOI 2012). Of 574 sea turtles observed in these *Sargassum* areas, 464 were oiled (USDOI 2012).

Specific causes of injury or death have not yet been established for many of these individuals as investigations into the role of oil in these animals' health status continue. Investigations are ongoing by the MMHSRP. Above average fisheries bycatch may also have played a role in the large numbers of strandings observed in the central northern Gulf of Mexico. Large numbers of sea turtles also stranded in the region in 2011. Investigations, including necropsies, were undertaken by NMFS to attempt to determine the cause of those strandings. Based on the findings, the two primary considerations for the cause of death of the turtles that were necropsied are forced submergence or acute toxicosis. With regard to acute toxicosis, sea turtle tissue samples were tested for biotoxins of concern in the northern Gulf of Mexico. Environmental information did not indicate a harmful algal bloom of threat to marine animal health was present in the area. With regard to forced submergence, the only known plausible cause of forced submergence that could explain this event is incidental capture in fishing gear.

Use of dispersants can increase oil dispersion, raising the levels of toxic constituents in the water column, but speeding chemical degradation overall (Yender et al. 2002). Although the effects of dispersant chemicals on sea turtles is unknown, testing on other organisms have found currently used dispersants to be less toxic than those used in the past (NOAA 2003). It is possible that dispersants can interfere with surfactants in the lungs (surfactants prevent the small spaces in the lungs from adhering together due to surface tension, facilitating large surface areas for gas exchange), as well as interfere with digestion, excretion, and salt gland function (NOAA 2003). After dispersion, the remaining oil becomes tar, which forms floating balls that can be transported thousands of kilometers into the North Atlantic. The most toxic chemicals associated with oil can enter marine food chains and bioaccumulate in invertebrates such as crabs and shrimp to a small degree (prey of some sea turtles; Law and Hellou 1999; Marsh et al. 1992), but generally do not bioaccumulate or biomagnify in finfish (Baussant et al. 2001; Meador et al. 1995; Varanasi et al. 1989; Yender et al. 2002). Sea turtles are known to ingest and attempt to ingest tar balls, which can block their digestive systems, impairing foraging or digestion and potentially causing death (NOAA 2003), ultimately reducing growth, reproductive success, as well as increasing mortality and predation risk (Fraser 2014). Tarballs were found in the digestive tracts of 63 percent of post hatchling loggerheads in 1993 following an oil spill and 20 percent of the same species and age class in 1997 (Fraser 2014). Oil exposure can also cause acute damage on direct exposure to oil, including skin, eye, and respiratory irritation, reduced respiration, burns to mucous membranes such as the mouth and eyes, diarrhea, gastrointestinal ulcers and bleeding, poor digestion, anemia, reduced immune response, damage to kidneys or liver, cessation of salt gland function, reproductive failure, and death (NOAA 2003; NOAA 2010b; Vargo et al. 1986). Nearshore spills or large offshore spills can oil beaches on which sea turtles lay their eggs, causing birth defects or mortality in the nests (NOAA 2003; NOAA 2010b).

Oil can also cause indirect effects to sea turtles through impacts to habitat and prey organisms. Seagrass beds may be particularly susceptible to oiling as oil contacts grass blades and sticks to them, hampering photosynthesis and gas exchange (Wolfe et al. 1988). If spill cleanup is attempted, mechanical damage to seagrass can result in further injury and long-term scarring. Loss of seagrass due to oiling would be important to green sea turtles, as this is a significant component of their diets (NOAA 2003). The loss of invertebrate communities due to oiling or oil toxicity would also decrease prey availability for hawksbill, Kemp's ridley, and loggerhead sea turtles (NOAA 2003). Furthermore, Kemp's ridley and loggerhead sea turtles, which commonly forage on crustaceans and mollusks, may ingest large amounts of oil due oil adhering to the shells of these prey and the tendency for these organisms to bioaccumulate the toxins found in oil (NOAA 2003). It is suspected that oil adversely affected the symbiotic bacteria in the gut of herbivorous marine iguanas when the Galapagos Islands experienced an oil spill, contributing to a more than 60 percent decline in local populations the following year. The potential exists for green sea turtles to experience similar impacts, as they also harbor symbiotic bacteria to aid in their digestion of plant material (NOAA 2003). Dispersants are believed to be as toxic to marine organisms as oil itself.

Marine and anadromous fish species can be impacted by oil contamination directly through uptake by the gills, ingestion of oil or oiled prey, effects on eggs and larval survival, and through contamination of foraging and spawning sites. Studies after the Exxon *Valdez* oil spill demonstrated that fish embryos exposed to low levels of polyaromatic hydrocarbons in weathered crude oil develop a syndrome of edema and craniofacial and body axis defects (Incardona et al. 2005).

5.4.7 Entrainment, entrapment, and impingement in power plants

There are dozens of power plants in coastal areas of the action area, from South Carolina to Texas (Muyskens et al. 2015). Sea turtles, sturgeon, and sawfish have been affected by entrainment, entrapment, and impingement in the cooling-water systems of electrical generating plants. We do not have data for many of these, but have reason to believe that impacts to particularly loggerhead and green sea turtles may be important. Over 40 years of operation at the St. Lucie Nuclear Power Plant in Florida, 16,600 sea turtles have been captured to avoid being drawn into cooling structures (which likely would kill sea turtles that enter), and 297 have died (NMFS 2016c). These included: 9,552 loggerheads (including 180 mortalities), 6,886 green (including 112 mortalities), 42 leatherback (no mortalities), 67 Kemp's ridley (including four mortalities), and 65 hawksbill sea turtles (including one mortality) (NMFS 2016c). Only since 2001 have the mortalities been classified as causally (or non-causally) related to operation of St. Lucie Nuclear Power Plant, and not all mortalities were causal to St. Lucie Nuclear Power Plant operations: 59 percent of dead loggerheads were causal to St. Lucie Nuclear Power Plant operation, 46 percent of greens, and none of hawksbills (no leatherback or Kemp's ridley mortalities occurred since 2001) (NMFS 2016c).

A comprehensive biological opinion that covers all power plant cooling water intakes was issued by the U.S. Fish and Wildlife Service and NMFS in May, 2014. Effects would generally involve stress, injury, and mortality from being captured, entrained, or impinged by cooling water intake systems. Cooling water discharge (which is warmer than the surrounding water temperature) can alter habitat around the outflow pipe. This can present advantages (such as shelter from cold water temperatures that may stun sea turtles and allow for unseasonal growth of marine plants that green sea turtles may forage upon) and disadvantages (such as altering normal ecology sea turtles and sturgeon rely upon and result in individuals depending on unnatural conditions that can be problematic if a plant is decommissioned or goes offline) for ESA-listed species.

While power plants have not been identified as a major threat to Gulf Sturgeon, they do pose threats to Atlantic and shortnose sturgeon as they are susceptible to impingement on cooling water intake screens at power plants (ASSRT 2007; NMFS 1998a). In general, electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. Similarly, power plants do not appear to be a major threat to smalltooth sawfish. However, a smalltooth sawfish was impinged upon cooling water intake structures at the St. Lucie Nuclear Power Plant, but released alive and in apparently good condition (NMFS 2016c).

5.4.8 Seismic surveys and oil and gas development

The northern U.S. Gulf of Mexico is the location of massive industrial activity associated with oil and gas extraction and processing. Over 4,000 oil and gas structures are located outside of state waters in the northern Gulf of Mexico; 90 percent of these occur off Louisiana and Texas (USN 2009). This is both detrimental and beneficial for sea turtles. These structures appreciably increase the amount of hard substrate in the marine environment and provide shelter and foraging opportunities for species like loggerhead sea turtles (Parker et al. 1983; Stanley and Wilson 2003). However, the Bureau of Ocean Energy Management requires that structures must be removed within one year of lease termination. Many of these structures are removed by explosively severing the underwater supportive elements, which produces a shock wave that kills, injures, or disrupts marine life in the blast radius (Gitschlag et al. 1997). For sea turtles, this means death or serious injury for individuals within a few hundred meters of the structure and overt behavioral (potentially physiological) impacts for individuals further away from the structure (Duronslet et al. 1986; Klima et al. 1988). Although observers and procedures are in place to mitigate impacts to sea turtles (i.e., not blasting when sea turtles are present), not all sea turtles are observed all the time, and low-level sea turtle injury and mortality still occurs (Gitschlag and Herczeg 1994; Gitschlag et al. 1997). Two loggerheads were killed in August 2010, and one Kemp’s ridley was killed in July 2013, along with several additional stunning or sub-lethal injuries reported over the past five years (Gitschlag 2015). In an August 28, 2006 opinion, NMFS issued incidental take for Bureau of Ocean Energy Management-permitted explosive structure removals (NMFS 2006c). These levels were far surpassed by the *Deepwater Horizon* incident.

5.4.9 Hurricanes

The Gulf of Mexico is prone to major tropical weather systems, including tropical storms and hurricanes. The impacts of these storms on sea turtles in the marine environment is not known, but storms can cause major impacts to sea turtle eggs on land, as nesting frequently overlaps with hurricane season, particularly Kemp's ridley sea turtles (NRC 1990). Embryos (in eggs) or hatchlings can drown during heavy rainfalls, and major topographic alteration to beaches can cause hatchlings to die by preventing their entry to marine waters (NRC 1990). Kemp's ridley sea turtles are likely highly sensitive to hurricane impacts, as their only nesting locations are in a limited geographic area along southern Texas and northern Mexico (Milton et al. 1994).

5.4.10 Vessel strikes

Vessel strikes are a poorly-studied threat, but have the potential to be an important source of mortality to sea turtle populations (Work et al. 2010). All sea turtles must surface to breathe, and several species are known to bask at the surface for long periods. Although sea turtles can move rapidly, sea turtles apparently are not able to avoid vessels moving at more than 4 kilometers per hour; most vessels move faster than this in open water (Hazel et al. 2007; Work et al. 2010). Given the high level of vessel traffic in the Gulf of Mexico, frequent injury and mortality could affect sea turtles in the region (MMS 2007b). Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. Each state along the Gulf of Mexico has several hundred thousand recreational vessels registered, including Florida with nearly one million—the highest number of registered boats in the United States—and Texas with over 600,000 (ranked sixth nationally; NMMA 2007; USCG 2003; USCG 2005). Commercial vessel operations are also extensive. Vessels servicing the offshore oil and gas industry are estimated to make 115,675 to 147,175 trips annually, and many commercial vessels travel to and from some of the largest ports in the U.S. (such as New Orleans and Houston; MMS 2007a; USN 2008).

Sea turtles may also be harassed by the high level of helicopter activity over Gulf of Mexico waters. It is estimated that between roughly 900,000 and 1.5 million helicopter take-offs and landings are undertaken in association with oil and gas activities in the Gulf of Mexico annually (NRC 1990; USN 2008). This likely includes numerous overflights of sea turtles, an activity which has been observed to startle and at least temporarily displace sea turtles (USN 2009).

5.4.11 Scientific research and permits

Scientific research permits issued by the NMFS currently authorize studies of ESA-listed species in the North Atlantic Ocean, some of which extend into portions of the action area for the proposed project. Authorized research on ESA-listed sea turtles includes capture, handling, and restraint; satellite, sonic, and PIT tagging; blood and tissue collection; lavage; ultrasound; captive experiments; laparoscopy; and imaging. Research activities involve "takes" by harassment, harm, pursuit, wound, entrapment, capture, and some mortality. It is noteworthy that although the numbers tabulated below represent the maximum number of "takes" authorized in a given year, monitoring and reporting indicate that the actual number of “takes” rarely approach the number authorized. Therefore, it is unlikely that the level of exposure to research techniques indicated below has or will occur in the near term. However, our analysis assumes that these “takes” will occur since they have been authorized. It is also noteworthy that these “takes” are distributed across the Atlantic Ocean, mostly from Florida to Maine, and in the eastern Gulf of Mexico. Although sea turtles are generally wide-ranging, we do not expect many of the authorized “takes” to involve individuals who would also be “taken” under the proposed research considered in this opinion. There are numerous permits issued since 2009 under the provisions of the ESA authorizing scientific research on sea turtles. The consultations, which took place on the issuance of these ESA scientific research permits, each found that the authorized activities would not result in jeopardy to the species or adverse modification of designated critical habitat.

Table 52 to Table 61 show the number of scientific research permit takes authorized for green, Kemp’s ridley, hawksbill, leatherback, and loggerhead sea turtles as well as smalltooth sawfish and shortnose and Atlantic sturgeon in the action areas.

Table 52. Green turtle takes in the Atlantic Ocean (all distinct population segments; mostly North Atlantic distinct population segment).

Year	Capture/handling /restraint	Satellite, sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Laparoscopy	Imaging	Mortality
2009	3,093	3,093	3,009	1,860	555	66	74	72	6
2010	3,753	3,753	3,669	2,480	555	66	74	72	6
2011	4,255	4,255	3,505	2,990	564	66	74	72	20
2012	3,354	3,354	2,622	2,210	704	66	74	72	18.2
2013	5,001	5,001	4,325	3,654	1,903	91	398	396	4.2
2014	4,336	3,686	3,660	3,044	1,408	65	324	324	4.2
2015	4,280	3,630	3,610	3,044	1,408	65	324	324	4.2
2016	2,960	2,960	2,940	1,734	1,408	65	324	324	4.2
Total	**31,032**	**29,732**	**27,340**	**21,016**	**8,505**	**550**	**1666**	**1656**	**67**

Permit numbers: 1450, 1462, 1501, 1506, 1507, 1518, 1522, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 10014, 10022, 13306, 13307, 13543, 13544, 13573, 14506, 14508,14622, 14655, 14726, 14949, 15112, 15135, 15552, 15556, 15575, 15606, 15802, 16134, 16146, 16174, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

Table 53. Hawksbill sea turtle takes in the Atlantic Ocean.

Year	Capture/handling /restraint	Satellite, sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Mortality
2009	1,088	1,088	1,081	464	254	0	3
2010	1,424	1,424	1,417	534	254	0	3
2011	1,959	1,959	1,955	914	255	0	4.4
2012	1,462	1,456	1,452	904	255	0	3.6
2013	1,423	1,417	1,415	844	320	39	1.6
2014	1,114	1,108	1,106	550	66	39	1.6
2015	1,032	1,026	1,026	550	66	39	1.6
2016	1,106	1,050	1,013	500	66	39	1.6
Total	**10,608**	**10,528**	**10,465**	**5260**	**1536**	**156**	**20.4**

Permit numbers: 1462, 1501, 1506, 1507, 1518, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 1599, 10014, 10022, 13306, 13307, 13543, 13544, 14272, 14508, 14726, 14506, 14508, 14622, 14655, 14726, 14949, 15112, 15135, 15552, 15566, 15575, 15606, 15802, 16134, 16146, 16194, 16253, 16598, 16733, 17183, 17304, 17355, 17381, and 17506.

Table 54. Kemp's ridley sea turtle takes in the Atlantic Ocean.

Year	Capture/handling /restraint	Satellite, sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Laparoscopy	Imaging	Mortality
2009	1,394	1,394	1,195	425	371	56	53	53	5
2010	1,402	1,402	1,203	426	371	56	53	53	5
2011	2,210	2,210	1,368	976	400	56	53	53	9
2012	2,229	2,219	1,561	972	450	56	53	53	7.2
2013	2,836	2,852	2,190	1,627	990	116	213	218	3.2
2014	2,010	2,026	1,964	706	619	60	160	165	3.2
2015	1,833	1,849	1,819	706	619	60	160	165	3.2
2016	1,420	1,436	1,406	300	264	40	125	125	3.2
Total	**15,334**	**15,388**	**12,706**	**6,138**	**4084**	**500**	**870**	**885**	**39**

Permit numbers: 1462, 1501, 1506, 1507, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 10014, 10022, 13306, 13543, 13544, 14508, 14726, 14506, 14622, 14655, 14726, 15112, 15135, 15552, 15566, 15575, 15606, 15802, 16134, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

Table 55. Leatherback sea turtle takes in the North Atlantic Ocean.

Year	Capture/handling/restraint	Satellite, sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Imaging	Laparoscopy	Mortality
2009	1,357	1,357	1,331	197	188	0	0	2
2010	1,421	1,421	1,394	197	188	0	0	1
2011	1,709	1,709	1,682	197	189	0	0	3.4
2012	736	736	709	187	189	0	0	2.6
2013	842	835	808	312	254	65	65	1.6
2014	653	646	620	135	66	65	65	1.6
2015	647	640	620	135	66	65	65	1.6
2016	634	627	617	125	66	65	65	1.6
Total	**7,999**	**7,971**	**7,781**	**1485**	**1206**	**260**	**260**	**15.4**

Permit numbers: 1506, 1527, 1540, 1544, 1551, 1552, 1557, 1570, 1571, 1576, 10014, 13543, 14506, 14586, 14655, 14726, 15112, 15552, 15556, 15575, 15672, 15802, 16109, 16194, 16253, 16556, 16733, 17355, and 17506.

Table 56. Loggerhead sea turtle takes in the North Atlantic Ocean (all distinct population segments, mostly Northwest Atlantic Ocean distinct population segment).

Year	Capture/handling /restraint	Satellite, sonic, or pit tagging	Blood/tissue collection	Lavage	Ultrasound	Captive experiment	Laparoscopy	Imaging	Mortality
2009	5,462	5,462	5,044	1,165	1,322	200	109	123	111
2010	5,464	5,464	5,046	1,205	1,322	200	109	116	111
2011	7,165	7,165	6,097	1,420	1,667	200	148	114	122.2
2012	4,791	4,791	3,741	1,370	1,429	200	161	114	29.8
2013	5,909	5,909	4,859	2,609	2,519	305	401	354	24.8
2014	4,052	3,912	3,862	1,460	1,543	105	292	240	24.8
2015	3,935	3,795	3,795	1,470	1,543	105	292	240	7.8
2016	3,510	3,510	3,510	1,255	1,543	105	292	240	7.8
Total	**40,288**	**40,008**	**35,954**	**11,954**	**12,888**	**1420**	**1804**	**1541**	**439.2**

Permit numbers: 1450, 1462, 1501, 1506, 1507, 1522, 1526, 1527, 1540, 1544, 1551, 1552, 1570, 1571, 1576, 1599, 10014, 10022, 13306, 13307, 13543, 13544, 14249, 14622, 14506, 14508, 14622, 14655, 14726, 15112, 15552, 15566, 15575, 15606, 15802, 16134, 16146, 16194, 16253, 16556, 16598, 16733, 17183, 17304, 17355, 17381, 17506, and 18069.

Table 57. Smalltooth sawfish (United States Distinct Population Segment) takes in the North Atlantic Ocean.

Year	Capture-rod and reel	Capture-longline	Capture-seine, gill, or rod and reel	Tagging	Tissue sample	Morphometrics	Ultrasound
2009	45	5	200	250	250	10	200
2010	45	5	200	250	250	10	200
2011	45	5	200	250	250	10	200
2012	45	65	340	450	450	5	200
2013	45	65	220	330	330	85	0
2014	0	105	320	425	425	225	0
2015	0	105	320	425	425	225	0
2016	0	105	320	425	425	220	0
Total	**225**	**460**	**2120**	**2805**	**2805**	**790**	**800**

Permit numbers: 1475, 1538, 13330, 15802, 17316, and 17787.

Table 58. Atlantic sturgeon takes in the North Atlantic Ocean (all distinct population segments).

Year	Capture/handling /restraint	Anesthetize	Boroscope	Laparoscopy	Lavage	Gonad sample	Fin/barble sample	Prophylactic	PIT/flow tag
2009	0	0	0	0	0	0	0	0	0
2010	0	0	0	0	0	0	0	0	0
2011	0	0	0	0	0	0	0	0	0
2012	9,556	2,039	930	124	245	330	9,511	30	9,506
2013	9,431	1,914	930	124	245	330	9,386	30	9,381
2014	10,178	1,914	930	184	265	320	7,886	30	9,941
2015	10,178	1,914	930	184	265	320	7,886	30	9,941
2016	9,653	1,389	930	184	265	320	7,361	30	9,416
Total	**48,996**	**9,170**	**4650**	**800**	**1285**	**1620**	**42,030**	**150**	**48,185**

Permit numbers: 16253, 16323, 16375, 16422, 16431, 16436, 16438, 16442, 16482, 16507, 16508, 16526, 16547, and 17095.

Table 59. Atlantic sturgeon takes in the North Atlantic Ocean, continued.

Year	Satellite/sonic tagging	Dart Marking	Egg/larvae mortality	Other lifestage mortality	Blood sampling
2009	0	0	0	0	0
2010	0	0	0	0	0
2011	0	0	0	0	0
2012	1,470	867	965	11	0
2013	1,345	867	1,065	11	0
2014	1,395	867	1,125	16	120
2015	1,395	867	1,125	16	120
2016	1,075	342	1,125	16	120
Total	**6,680**	**3810**	**5,405**	**70**	**360**

Permit numbers: 16253, 16323, 16375, 16422, 16431, 16436, 16438, 16442, 16482, 16507, 16508, 16526, 16547, and 17095.

Table 60. Shortnose sturgeon takes in the North Atlantic Ocean.

Year	Capture/handling /restraint	Anesthetize	Laparoscopy	Lavage	Boroscope	Fin/barble sample	Gonad sample	PIT/flow tag	Satellite/ radio tagging
2009	6,174	2,076	185	350	473	3,627	99	5,790	331
2010	7,361	1,933	221	450	888	4,770	147	6,957	595
2011	5,551	1,909	197	450	888	4,580	123	5,181	515
2012	9,290	2,086	309	385	2,703	8,569	75	8,765	820
2013	8,615	1,723	289	385	2,430	8,106	75	8,130	685
2014	10,311	1,159	238	445	2,030	7,436	48	9,820	710
2015	7,336	758	188	375	1,815	4,461	48	6,845	575
2016	6,412	644	164	375	1,815	3,537	24	5,921	485
Total	**61,050**	**12,288**	**1791**	**3215**	**13,042**	**45,086**	**639**	**57,409**	**4716**

Permit numbers: 1420, 1447, 1449, 1486, 1505, 1516, 1542, 1544, 1547, 1549, 1575, 1578, 1580, 1595, 10037, 10115, 14176, 14394, 14396, 14604, 14759, 15614, 15677, 16306, 16436, 16482, 16507, 16549, and 17095.

Table 61. Shortnose sturgeon takes in the North Atlantic Ocean, continued.

Year	Prophylactic	Egg/larvae mortality	Other lifestage mortality	Breeding	Captive experiments
2009	300	9,001	55	0	0
2010	500	9,541	56.2	0	0
2011	500	8,540	18.2	0	0
2012	800	7,303	21	10	80
2013	800	1,283	16	10	80
2014	800	1,103	15	10	80
2015	300	1,043	12	10	80
2016	300	423	11	10	80
Total	**4300**	**38,237**	**204.4**	**50**	**400**

Permit numbers: 1420, 1447, 1449, 1486, 1505, 1516, 1542, 1544, 1547, 1549, 1575, 1578, 1580, 1595, 10037, 10115, 14176, 14394, 14396, 14604, 14759, 15614, 15677, 16306, 16436, 16482, 16507, 16549, and 17095.

6 EFFECTS OF THE ACTION

Under the ESA, "effects of the action" means the direct and indirect effects of an action on the species or critical habitat, together with the effects of other activities that are interrelated or interdependent with that action, that will be added to the environmental baseline (50 CFR 402.02). Indirect effects are those that are caused by the proposed action and are later in time, but still are reasonably certain to occur.

In this section, we describe the following:

- The potential physical, chemical, or biotic stressors associated with the proposed action.
- The probability of individuals of ESA-listed species being exposed to these stressors based on the best scientific and commercial evidence available.
- The probable responses of those individuals (given probable exposures) based on the available evidence.

Any responses that would be expected to reduce an individual's fitness (i.e., growth, survival, annual reproductive success, and lifetime reproductive success) are then assessed to consider the risk posed to the viability of the ESA-listed population. The purpose of this assessment is to determine if it is reasonable to expect that the proposed action could appreciably reduce the likelihood of survival and recovery in the wild among ESA-listed species.

6.1 Stressors Associated with the Proposed Action

The Permits Division proposes to authorize, and the MMHSRP proposes to implement and oversee, the enhancement and baseline health research activities associated with the Program. Enhancement activities associated with the Program include responses to health emergencies involving marine mammals that were caused by natural or anthropogenic phenomena. The resulting physical, chemical, or biotic stressors from the implementation of enhancement activities are likely to be less severe than the stressors that caused the health emergency in the first place (this is further described in the Response section, below). However, emergency response activities may pose risk to new or additional risks to non-target ESA-listed fish and turtle species, if they involve the deployment of nets to encircle marine mammals. Baseline health research activities associated with the Program include studies and other investigations that may or may not be conducted on animals that are in distress. Because they may be conducted on animals that are not in distress, these investigations pose new or additional risks to endangered or threatened marine mammals. Similar to emergency response activities, if baseline research activities involve the deployment of nets to encircle marine mammals, they may also pose a risk to non-target ESA-listed fish and turtle species.

While the purpose of each activity is to either study or enhance the survival of marine mammal species, several activities are likely to produce stressors to individual animals. These stressors and the anticipated responses to these stressors are described in detail below. One common stressor is simulation of predatory behavior ("predation"), in that the activity (e.g., close approach, capture/handling/restraint) is likely to resemble predatory behavior from the perspective of the animal. Such behavior includes focused observation, pursuit, approach, and capture. We also identify activities that are not likely to cause stressors; we do not consider these activities further.

6.2 Response Analysis

In this section, we describe the potential behavioral and physiological responses among ESA-listed marine mammals and non-target ESA-listed turtle and fish species to the stressors associated with the proposed action. For marine mammals, stressors may include harassment via close approaches, aerial and vessel surveys, active acoustic playbacks, hazing and attractants, capture, restraint, handling, transport, attachment of tags and scientific instruments, marking, diagnostic imaging, sample collection, administration of medications, hearing tests, disentanglement, euthanasia, permanent captivity, and import/export of parts and tissue samples. For turtles and fishes, the stressors include vessel traffic, entanglement, capture, restraint, and handling.

6.2.1 Potential Response to Close Approach, Aerial Surveys, Vessel Surveys, and Documentation

As described above in the *Description of the Proposed Action*, the MMHSRP may approach marine mammals by manned or unmanned aircraft, surface vessel, and on foot. Close approaches could occur during either enhancement or baseline health research activities and allow for documentation, assessment, disentanglement, biopsy sampling, breath sampling, tagging, and collection of sloughed skin and feces. The potential response of all activities that would follow a close approach except documentation are further described below. Documentation of animals (e.g., photography, videography, recording of observations, etc.) is not expected to produce any response beyond that caused by a close approach. Close approaches increase the potential for collisions with animals and for stress responses among animals that are closely approached. Incidental takes of non-targeted animals from close approaches are likely if they are in the vicinity of the targeted animal(s).

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976). Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The stress response of fish and reptiles involves the hypothalamic-pituitary-adrenal axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Atkinson et al. 2015; Barton 2002; Bayunova et al. 2002; Busch and Hayward 2009; Lankford et al. 2005; McConnachie et al. 2012; Wagner et al. 2002). These hormones subsequently can cause short-term weight loss, the release of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, fatigue, cardiovascular damage, and alertness, and other responses (Aguilera and Rabadan-Diehl 2000; Busch and Hayward 2009; Dierauf and Gulland 2001; Guyton and Hall 2000; NMFS 2006a; Omsjoe et al. 2009; Queisser and Schupp 2012; Romero 2004; Wagner et al. 2002), particularly over long periods of continued stress (Desantis et al. 2013; Sapolsky et al. 2000). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the hypothalamic-pituitary-adrenal axis may persist for weeks.

Cetaceans have been observed to react in a variety of ways to close vessel approaches. Reactions range from little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving, time spent submerged, foraging and respiratory patterns (Au and Green. 2000; Baker et al. 1983; Hall 1982; Jahoda et al. 2003; Koehler 2006; Scheidat et al. 2006). Individual factors related to a whale's physical or behavioral state can result in differences in the individual's response to vessels. These factors include the age or sex of the whale; the presence of offspring; whether or not habituation to vessels has occurred; individual differences in reactions to stressors; vessel speed, size, and distance from the whale; and the number of vessels operating in the proximity (Baker et al. 1988; Gauthier and Sears 1999; Hooker et al. 2001; Koehler 2006; Lusseau 2004; Richter et al. 2006; Weilgart 2007; Wursig et al. 1998b). Observations of large whales indicate that cow-calf pairs, smaller pods, and pods with calves appear to be particularly responsive to vessel approaches (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982). It should be noted that human observations of a whale's behavioral response may not reflect a whale's actual experience; thus, our use of behavioral observations as indicators of a whale's response to research may or may not be correct (Clapham and Mattila 1993).

Watkins et al. (1981) found that both fin whales and humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startled reaction, and moving away from the vessel with strong fluke motions. In another study, 71 percent of 42 whales that were closely approached (within 10 meters) showed no observable reaction; when reactions occurred, they included lifting of the head or flukes, arching the back, rolling to one side, rolling to one side and beating the flukes, or performing a head lunge (Baumgartner and Mate 2003). Studies of other baleen whales, specifically bowhead and gray whales, have documented similar patterns of short-term behavioral disturbance in response to a variety of actual and simulated vessel activity and sound (Malme et al. 1983; Richardson et al. 1985). Behavioral disturbance may negatively impact essential functions such as breeding, feeding and sheltering. Close approaches by inflatable vessels for biopsy sampling caused fin whales (n = 25) in the Ligurian Sea to stop feeding and swim away from the approaching vessel (Jahoda et al. 2003). A study on the effects of tag boat presence on sperm whale behavior found that sperm whales (n = 12) off the coast of Norway spent 34 percent less time at the surface and 60 percent more time in a non-foraging silent active state when in the presence of the boat than in the post-tagging baseline period, indicating costs in terms of lost feeding opportunities and recovery time at the surface (Isojunno and Miller 2015).

Changes in cetacean behavior can correspond to vessel speed, size and distance from the whale, as well as the number of vessels operating in the proximity (Baker et al. 1988). Beal and Monaghan (2004) concluded that the level of disturbance was a function of the distance of humans to the animals, the number of humans making the close approach, and the frequency of the approaches. In a study on the effects of close approaches by boat to Indo Pacific bottlenose dolphins, results showed that behavioral responses varied significantly depending on the distance between the animal and the approaching vessel: there was significantly less feeding and resting when boats approached dolphin groups to a distance of 50 meters than when they did to a distance of 150 meters, or with controlled approaches. The dispersal of dolphin groups was also significantly tighter (less dispersed), and direction of movement was less neutral, when boats approached to 50 meters than that with 150-meter-distance or controlled approaches (Steckenreuter et al. 2011).

As with vessel approach, cetacean responses to aircraft depend on the animals' behavioral state at the time of exposure (e.g., resting, socializing, foraging or traveling) as well as the altitude and lateral distance of the aircraft to the animals (Luksenburg and Parsons 2009). Thus, aircraft flying at low altitude, at close lateral distances and above shallow water elicit stronger responses than aircraft flying higher, at greater lateral distances and over deep water (Patenaude et al. 2002; Smultea et al. 2008). The sensitivity to disturbance by aircraft may also differ among species (Wursig et al. 1998a). Sperm whales (n = 11) responded to a fixed-wing aircraft circling at altitudes of 245-335 meters by ceasing forward movement and moving closer together in a parallel flank-to-flank formation, a behavioral response interpreted as an agitation, distress, and/or defense reaction to the circling aircraft (Smultea et al. 2008). Summarizing the available information, close approaches by aircraft or boat are likely to result in stress responses for some individuals and little or no responses from other individuals.

Pinniped responses to disturbance are variable depending on species, site (rookery vs. haul-out), season (breeding vs. nonbreeding), and the level of predation risk, if the site is abandoned (Allen et al. 1984; Calkins and Pitcher 1982; Engelhard et al. 2002; Maniscalco et al. 2007; Ono et al. 1987; Wirsing et al. 2008). In the water, pinnipeds are likely to respond to close approach by vessel with avoidance behaviors, such as diving. On land, pinnipeds are sensitive to human presence and may be influenced by chronic disturbance to rookery beaches (Wilson et al. 2012). This disturbance may impact survival due to the trampling of pups by fleeing adults, mother–pup separations, and the interruption of suckling bouts (Engelhard et al. 2002). Potential responses to aircraft overflights may range from no response to temporary entry into the water. Born et al. (1999) conducted a systematic study on the response of ringed seals to aircraft disturbance; 302 of 5,040 hauled-out ringed seals (6 percent) entered the water in response to a low-flying (150 meters altitude) twin-engine plane (Born et al. 1999). In Baffin Bay, Alaska, 44 bearded seals did not react to a twin-engine turboprop plane flying at 100 to 200 meters altitude (Finley and Renaud 1980). Burns and Frost (1979) report that bearded seals raise their heads but usually remain on ice unless a plane passes directly overhead. Kelly et al. (1986) report that all ringed seals (n = 13) subsequently returned to their lairs and hauled out, after entering the water in response to anthropogenic disturbances. In two separate studies, some Steller sea lions have demonstrated awareness to fixed wing aerial surveys at elevations between 195 to 250 meters, but no sea lions left the beach or stampeded (Snyder et al. 2001; Wilson et al. 2012). The presence and movements of vessels may disturb normal seal behaviors or cause seals to abandon their preferred habitats (Cameron et al. 2010; Kelly et al. 2010). On-ice ringed seals have been documented exhibiting short-term escape reactions (i.e., temporarily entered the water) when a ship came within 0.25 to 0.5 kilometers (Brueggeman et al. 1992).

Figure 82. One type of unmanned aerial system that has been used in the field for marine mammal research: the APH-22 Hexa-copter.

The field of UASs for marine mammal monitoring is still in its infancy; as such, published reports on behavioral responses to UASs among marine mammals were limited at the time of this opinion. Disturbance in marine mammals to UASs may result from sound or from visual cues (Smith et al. 2016). Reactions to UASs by pinnipeds may range from no response, to looking up at the UAS, to leaving the beach and entering the water. A study that employed a hexa-copter (Figure 82) to monitor Steller sea lions in the Aleutian islands reported that disturbance caused by the UAS was minimal, with only five of 1,589 non-pups (0.3 percent) that were flown over by the UAS slowly entering the water, and no 'stampede' reactions observed (Sweeney et al. 2015). Large whales were anecdotally reported to have shown no more avoidance behavior in response to a hexa-copter flown at 13 meters than what is commonly observed during photo-identification approaches (Acevedo-Whitehouse et al. 2010). Similarly, hexa-copters have been used for photogrammetry studies on killer whales, and no behavioral responses were observed from any of the study animals (Durban et al. 2015). A review of published literature on behavioral responses to UAS found no reports of cetacean behavioral responses (Smith et al. 2016).

Documentation, including the taking of photographs (e.g., photo identification), videos (including remote video), thermal imaging, and audio recordings, may occur both above and below the surface of the water during aerial and vessel surveys. We do not expect any response among marine mammals to documentation; thus documentation is not analyzed further in this opinion.

The MMHSRP will use boats, planes, and UASs specifically to approach marine mammals. During operations of these machines, staff will be vigilant in looking for marine mammals, sea turtles and fishes.

Potential response of sea turtles to vessels, vessel noise and visual stimuli (vessels and shadows) could disturb sea turtles, and potentially elicit a startle response, avoidance, or other behavioral reaction. Sea turtles are frequently exposed to research, ecotourism, commercial, government, and private vessel traffic. Some sea turtles may habituate to vessel noise and may be more likely to respond to the sight of a vessel rather than the sound of a vessel, although both may play a role in prompting reactions (Hazel et al. 2007).

According to Popper et al. (2014), there is no direct evidence of mortality or injury to fish from vessel noise. Further, temporary threshold shifts from continuous sound sources (e.g., vessel noise) have only been documented in fish species that have specializations for enhanced sensitivity to sound. None of the ESA-listed salmonids considered in this opinion are known to have these specializations. Data for species which do not have these specializations have shown no TTS in response to long term exposure to continuous noise sources (Popper et al. 2014). This includes a study of rainbow trout (*Oncorhynchus mykiss*) exposed to increased noise for nine months in an aquaculture facility. The study also did not document any negative effects on the health of the fish from this increased exposure to noise (Popper et al. 2014; Wysocki et al. 2007).

Popper et al. (2014) suggest that low frequency vessel noise (primarily from shipping traffic) may mask sounds of biological importance. As described previously in this opinion, none of the ESA-listed salmonids considered in this opinion have hearing specializations (which would indicate they may rely heavily on hearing for essential life functions), and they are able to rely on alternative mechanisms (e.g., sight, lateral line system) to detect prey, avoid predators, and orient in the water column (Popper et al. 2014). Further, hearing is not thought to play a role in salmon migration (e.g., (Putman et al. 2013)). Additionally, any potential masking would be temporary as both the fish and vessel would be transiting the action area (likely at different speeds and in different directions). For these reasons, we do not expect any short-term instances of masking to have any fitness consequences for any individual fish.

Vessel activity may result in changes in fish behavior (Popper et al. 2014). Because of the short-term and localized nature of MMHSRP activities, any behavioral responses to vessel noise are expected to be temporary (e.g., a startle response, brief avoidance behavior), and we do not expect these reactions to have any measurable effects on any individual's fitness. We expect individuals that exhibit a temporary behavioral response will return to baseline behavior immediately following exposure to the vessel noise. We do not expect these short term behavioral reactions to increase the likelihood of injury by annoying a fish to such an extent as to significantly disrupt normal behavioral patterns and therefore such reactions would not rise to the level of take. Therefore, the effect of vessel noise that may result in behavioral reactions is insignificant and is not likely to adversely affect the ESA-listed fish species considered in this opinion.

6.2.2 Potential Response to Active Acoustic Playbacks, Hazing and Attractants

As described above, the MMHSRP may haze ESA-listed marine mammals that are in the area of a potentially harmful situation (e.g., an oil spill or harmful algal bloom); or may attempt to attract marine mammals in order to encourage their movement from a potentially unsafe area into an area of relative safety. New methods of hazing and attractants may be evaluated during baseline health research. Methods include acoustic deterrent and harassment devices, visual deterrents, vessels, physical barriers, and capture and relocation. Responses to hazing and attractants among marine mammals appear to be context and species dependent. A male humpback whale in the Sacramento River in 1985 was reported to have moved toward the playback of sounds of foraging humpback whale vocalizations. Observations in Hawaii indicate that male humpback whales move toward playbacks of foraging humpback whale sounds, although females do not, possibly due to sexually active males seeking mates (Mobley Jr. et al. 1988). The lack of response of humpback whales to the sound of banging pipes, a method which has been shown to be effective in moving killer whales and dolphins (Gulland et al. 2008), may be due to physiological differences in hearing between mysticetes and odontocetes (Wartzok and Ketten 1999). Cetaceans and pinnipeds may experience temporary discomfort as a result of acoustic deterrents, but source levels are not expected to reach the levels necessary to cause physical injury, including temporary or permanent hearing loss. As hazing is often conducted by boat (either to deploy a hazing device, or to use the boat itself to haze animals from an area), we would expect those hazing attempts by boat to lead to the behavioral responses to "close approach" as described above (Section 6.2.1).

The MMHSRP may use active acoustic playbacks to expose cetaceans and pinnipeds to pre-recorded songs, social sounds, and feeding calls. We expect that any adverse response to active acoustic playbacks would be from the stress of close approach by vessel (described above, Section 6.2.1), and not from the procedure itself, as the sounds played back at target animals would not be transmitted at source levels, or at distances (minimum 100 meters), that could potentially be painful or overly disruptive to the animals. Previous tests indicate that sounds produced by typical playback equipment would be less powerful and attenuate more rapidly than other anthropogenic sources in the action area (i.e., cruise ships, fishing vessels) (NMFS 2014f).

Sea turtles and ESA-listed fishes are expected to be less affected by anthropogenic sounds than marine mammals. Because of this lower sensitivity, we find the risk to be insignificant and not likely to adversely affect ESA-listed sea turtles or fishes.

6.2.3 Potential Response to Capture, Restraint, and Handling

As discussed in the Description of the *Proposed Action*, the MMHSRP may capture marine mammals for health assessments, medical treatment, disentanglement/de-hooking, biomedical sampling, administration of medications, and attachment of tags and scientific instruments. Pinnipeds (other than Hawaiian monk seals) may be captured during enhancement or baseline health research activities; ESA-listed cetaceans and Hawaiian monk seals may be captured only during enhancement activities. Capture methods for cetaceans may include, but are not limited to: hand, nets, traps, behavioral conditioning, and anesthesia/chemical immobilization. For captures of pinnipeds, net types may include, but are not limited to: circle, hoop, dip, stretcher, throw nets, and chemical immobilization. At the time of the original application for permit No. 18786 there was no indication that any non-marine mammal species would be incidentally encircled, captured, or entangled in a net as a result of the MMHSRP's activities. However, given the previously mentioned incidental capture of ESA-listed turtles, we now consider the potential stressors to ESA-listed turtles and fishes as the result of being captured and/or entangled in a net. The potential stressors to these non-target species are similar to those experienced by the targeted marine mammal.

Capture and restraint procedures constitute one of the most stressful incidents in the life of an animal, and intense or prolonged stimulation can induce detrimental responses (Fowler 1986). The best available information leads us to believe that capture, restraint, and handling represent the greatest potential stressors proposed by the MMHSRP as part of the proposed action, both to marine mammals and non-target turtle and fish species. In addition to stress responses, capture, restraint, and handling may result in injury and unintentional mortality. Factors that may affect an animal's response to capture include the number of times the animal is captured, the duration of the restraint, the method(s) of restraint, as well as the species, age and general condition of the animal.

As described above, wild animals are believed to respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses, in which the human disturbance (e.g., capture and restraint) is perceived as a threat which leads to the "flight or fight" response, as well as interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). Stress responses could also lead to hyperthermia and myopathy (described below).

Continuous stimulation of the adrenal cortex, as from stress associated with chronic disturbance or repeated capture, can cause muscle weakness, weight loss, increased susceptibility to bacterial infections, and poor wound healing, and can lead to behavioral changes including increased aggressive and antisocial tendencies (Fowler 1986).

Capture myopathy is a non-infectious, metabolic muscle disease of wild mammals and birds associated with the stress of capture, restraint, and transportation (Herráez et al. 2013). Characterized by degeneration and necrosis of the brain, lung, liver, intestine, pancreas and lymph nodes, capture myopathy usually develops within seven to 14 days after capture and handling. It has been observed both in animals that exert themselves and those that remain relatively tranquil, and occurs with either physical or chemical restraint. Fear, anxiety, overexertion, repeated handling, and constant muscle tensions, such as those that may occur during a prolonged alarm reaction, are among the factors that lead to capture myopathy. A variety of factors can function in concert or individually. Muscle necrosis results from acidemia (low blood pH) from a buildup of lactic acid following profound muscle exertion; once necrosis has occurred, recovery from myopathy is unlikely.

Pinnipeds may respond to capture and restraint by vocalizing, biting, or trying to escape. Vocalizations are not likely to adversely affect pinnipeds. Attempts to escape could lead to injuries (such as contusions, lacerations, abrasions, hematomas, concussions, and fractures) or death. Stress responses could also lead to hyperthermia and myopathy, as described above. Death may also occur as a result of accidental drowning in nets used for capture. Capture attempts may disrupt non-target marine mammals, including conspecifics, potentially causing non-target marine mammals to flee into the water. Pups and young animals may be trampled or abandoned during stampedes; pups, juveniles or adults may be injured on rocks and cliff faces.

To determine the effects of capture and restraint on Hawaiian monk seals, Baker and Johanos (2002) compared the survival, migration, and condition of handled seals (n = 549) and non-handled “control” seals (n = 549) between 1983-1998. Responses recorded one year after the handling event included whether a seal was resighted, returned to the same subpopulation or migrated, and demonstrated a notable decline in health or condition (i.e., emaciation, shark-inflicted wounds, etc.). Among the 1,098 animals in the study, there were no significant differences in survival (i.e., resighting rates of 80-100 percent), observed migration, and body condition between handled seals and control animals, leading the authors to conclude that conservative selection procedures and careful handling techniques resulted in a lack of deleterious effects. Similarly, Henderson and Johanos (1988) determined that capture, brief restraint without sedation, and flipper tagging had no observable effect on subsequent behavior of weaned pups.

A review of all research procedures conducted on Hawaiian monk seals between 1982-1999 found that there were five recorded mortalities during 4,800 handling events (0.1 percent mortality rate) (Baker and Johanos 2002). One of these seals died as a result of male aggression, after release (i.e., restraint may have been a contributing factor but not the ultimate cause of death). Two seals died as a result of capture stress; the cause of death was undetermined for the other two seals. The results strongly suggest that if captured animals are released alive, they fare as well as non-handled seals (Baker and Johanos 2002). In recent years (1999-2013), two Hawaiian monk seals have died as a result of capture and/or restraint: an old, adult male died while under restraint and sedation as a result of a heart abnormality; another seal suffered a fatal head injury when it exhibited a defense behavior, rearing up defensively upon approach, and hit a nearby rock (NMFS 2014b). While we believe the latter case to be an unusual incident, it nonetheless reinforces that injury and death may occur as a result of animals' responses to the stress of capture and restraint.

Indicators of stress including elevated blood cortisol and aldosterone concentrations have been observed in cetaceans subjected to capture, restraint, and handling (Fair and Becker 2000; St Aubin and Geraci 1990). In cetaceans, shock associated with live-stranding and capture has been compared to capture myopathy observed in other mammals. Herráez et al. (2013) reviewed the necropsy reports of 51 cetaceans (odontocetes and mysticetes) that live-stranded on the coasts of the Canary Islands for symptoms of capture myopathy. All had experienced different types of rescue procedures involving capture, handling, and transportation to rehabilitation centers, where some animals were maintained and treated medically. While live-stranding in cetaceans represents an extreme and multifactorial condition, the results showed the presence of acute degenerative skeletal muscle, myocardial and renal lesions with myoglobinuria in 49 percent (25/51) of the live-stranded cetaceans following human capture/rescue interactions, indicating that cetaceans experience capture myopathy similar to that of terrestrial wildlife (Herráez et al. 2013). Thus we would expect that any cetaceans captured during enhancement activities may experience capture myopathy, which could compound any pre-existing health-related conditions that warranted the response by the MMHSRP.

Capture can cause stress responses in sea turtles (Gregory 1994; Gregory and Schmid 2001; Hoopes et al. 1998; Jessop et al. 2004; Jessop et al. 2003; Thomson and Heithaus 2014), sturgeon (Kahn and Mohead 2010; Lankford et al. 2005), and other fishes including smalltooth sawfish (Korte et al. 2005; Moberg 2000; Sapolsky et al. 2000). Although corticosterone does not appear to increase with entanglement time for green and Kemp's ridley sea turtles (Snoddy et al. 2009), we expect any incidental capture of a turtle of fish to be a stressful experience as indicated by severe metabolic and respiratory imbalances resulting from forced submergence (Gregory and Schmid 2001; Harms et al. 2003; Stabenau and Vietti 2003). We also expect behavioral responses (attempts to break loose of the netting via rapid swimming and biting) as well as physiological responses (release of stress hormones; Gregory et al. 1996; Gregory and Schmid 2001; Harms et al. 2003; Hoopes et al. 2000; Stabenau and Vietti 2003). We expect individuals captured to be rapidly removed from the net, although responses associated with subsequent stressors will continue. For example, handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Gregory and Schmid 2001; Hoopes et al. 2000). Encircling net captures also entails a risk of vessel-strike to sea turtles and fishes. However, as these animals would be evading capture, they will generally be moving away from the vessel. In addition, trained spotters will be on the lookout for any non-targeted species that may be encircled in the net, and activities will be stopped if such a non-target animal is present.

Additional risk to sea turtles in entanglement nets results from forced submersion. Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lungs (Lutcavage et al. 1997). Trawl studies have found that no mortality or serious injury occurred in tows of 50 minutes or less, but these increased rapidly to 70 percent after 90 minutes (Epperly et al. 2002; Henwood and Stuntz 1987). However, mortality has been observed in summer trawl tows as short as 15 minutes (Sasso and Epperly 2006). Metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. Serious injury and mortality is likely due to acid-base imbalances resulting from accumulation of carbon dioxide and lactate in the bloodstream (Lutcavage et al. 1997); this imbalance can become apparent in captured, submerged sea turtles after a few minutes (Stabenau et al. 1991). Sea turtles entangled in nets exhibiting lethargy can die even with professional supportive care, possibly due to severe exertion resulting in muscle damage (Phillips et al. 2015). To minimize the time any incidentally capture turtle is submerged, researchers will inspect the net prior to attending to the captured marine mammal and release any incidentally caught animal, as was done with the two previous incidental turtle captures in Brunswick, Georgia. We do not expect any sea turtle to require extensive recovery, but the terms and conditions set forth in the proposed permit amendment should mitigate sea turtles being released that have not recovered from forced submergence and/or the accumulation of other stressors that can cumulatively impair physiological function. In addition, veterinary assistance would be sought for these individuals.

Another potential source of accidental mortality during capture, restraint, and handling, for air breathers like pinnipeds, cetaceans or turtles, is drowning in a net. In 2013, a ringed seal drowned when a capture net was entangled in an ice floe. It took 20-30 minutes to disentangle the net from the ice, and while researchers did not see movement in the net during this time, it became apparent upon retrieval that an adult male ringed seal had drowned (NMFS 2014c). However, as the target animals of these captures are obligate air breathers (marine mammals), nets are specifically designed to prevent animals from drowning (light lead lines allow for entangled animals to reach the surface). Therefore, if a sea turtle or marine mammal becomes entangled in a net, death by drowning is unlikely to occur.

Smalltooth sawfish and sturgeon entangled in nets would likely experience stress in association with the event and some lacerations associated netting. However, they should be capable of continued respiration. If disentangled according to NOAA-approved protocols (NMFS 2009g), no further injury should occur. We expect incidental capture, handling, and restraint of sturgeon to cause short-term stress (Kahn and Mohead 2010). This can be exacerbated by less than ideal environmental conditions, such as relatively high water temperature (higher than 28° Celsius), high salinity, or low dissolved oxygen, potentially resulting in mortality or failure to breed (Hastings et al. 1987; Jenkins et al. 1993; Kynard et al. 2007; Moser and Ross 1995; Niklitschek

2001; Niklitschek and Secor 2009; Secor and Niklitschek 2002; Secor and Gunderson 1998; Secor and Niklitschek 2001). We do not expect the additional stress associated with brief capture, handling, and restraint to result in more than short-term stress if the researchers follow guidelines outlined in Kahn and Mohead (2010) and best practice guidelines established by the Smalltooth Sawfish Recovery Team (NMFS 2009g).

We also expect that activity budgets of captured marine mammals will be altered after release, with more time spent actively swimming for several hours to a day after release (Thomson and Heithaus 2014). After this period, we expect that individuals will engage in resting and feeding activities to a greater extent (Thomson and Heithaus 2014), but we do not expect this to alter an individual's fitness.

For incidentally captured and released sea turtles, sturgeon, and sawfish, the duration of encounter is expected to be minutes not hours and most would be released without handling. Because of this, we expect ESA-listed sea turtles, sturgeon, and sawfish to experience only minor stress and to resume normal behavior quickly with no long term adverse impacts to individuals encountered.

6.2.4 Potential Response to Transport

As discussed in the *Description of the Proposed Action*, the Permits Division proposes to authorize the MMHSRP to use vehicles, boats, or aircraft to transport marine mammals. We found limited published information on possible responses to marine mammal transport, thus we relied on the information on potential stressors provided by the MMHSRP in the Permit application. Depending on the condition of the animal being transported, the means of transport, and the amount of time in transport, several responses are possible: animals may develop hyperthermia or hypothermia; exposure to air may result in drying of body surfaces; the animal may be jostled while in transport, potentially resulting in muscle damage; animals may suffer temporary hearing damage as a result of exposure to high levels of sound; or, animals may inhale exhaust fumes. Improper transport of marine mammals may cause abrasions, pressure necrosis, thermoregulatory problems, and respiratory problems. Animals may experience muscular stiffness as a result of limited range of motion, either from being caged or strapped down on stretchers, foam pads, or air mattresses; any muscle stiffness is expected to be short-term (hours to days), unless permanent muscle damage occurs (Antrim and McBain 2001). Muscle damage in a bottlenose dolphin that became depressed and immobile following 22.5 hours of transport suggested that it may have experienced capture myopathy (described above, Section 6.2.3) related to the extended transport time (Colgrove 1978). In addition to these potential responses, it is expected that animals being transported would experience the stress of restraint and handling as described above (Section 6.2.3). Transport of marine mammals would only occur for animals for which their health is compromised such that not transporting them increases the possibility of death of the individual.

6.2.5 Potential Response to Holding

As discussed in the *Description of the Proposed Action*, the Permits Division proposes to authorize the MMHSRP to temporary hold animals in captivity for enhancement activities. Temporary holding of animals may occur when animals require rehabilitation prior to release in the wild, or when animals are deemed non-releasable but require temporary holding until they can be placed in a permanent captive facility.

As a result of temporary holding animals may experience changes in behavior, increased stress, injury, lower reproduction, and or even death, with the response depending greatly on the conditions in which the animal is held and the duration of the holding (NMFS 2009d; Rose et al. 2009). Captive marine mammals are often confined to relatively small enclosures and become increasingly bored, leading to stereotypic behavior which can have further health consequences (Rose et al. 2009). Being maintained in a relatively small enclosure may also be stressful, as animals may have limited ability to move and exercise (NMFS 2009d; Rose et al. 2009). Animals may suffer stress by being maintained in solitarily, or at the other extreme, with too many conspecifics. Captive animals may also injury themselves be attempting to escape captivity, interact with foreign objects, or as the result of stereotypic behavior (Rose et al. 2009). Animals may also be exposed to pathogens that they would not encounter in the wild (NMFS 2014f). Finally, while data comparing captive marine mammal reproduction and fitness to wild populations are limited, there is evidence of reduced reproduction and increased mortality in some species (Rose et al. 2009).

Importantly, most of these responses occur when animals are held in permanent captivity, as further discussed in Section 6.2.15. For the short duration animals would be held in captivity for enhancement activities, more severe responses such as injury, reduced reproduction, and death are not expected to occur. Nonetheless, to minimize adverse effects that may result from temporary holding, all facilities would follow the *Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release*, and *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012d), which further require facilities rehabilitating ESA-listed species to have quarantine protocols to minimize the spread of infectious diseases within the facility. Furthermore, temporary holding would always occur under the direct supervision of a qualified veterinarian, and only take place for enhancement purposes (e.g., for rehabilitation purposes or to rescue animals from imminent threats [e.g., nearby oil spill]). As such, any adverse effects from holding would be outweighed by the benefits of the temporary holding. Most, if not all, of these individuals would likely die otherwise.

In summary, while animals may experience changes in behavior, stress, injury, reduced reproduction, or even death as the result of temporary holding, animals would only be held when the benefits outweigh these possible adverse effects such that the net effect of temporarily holding would enhance the individual’s (and thus the species) chances for survival in the wild, or if deemed non-releasable, in captivity.

6.2.6 Potential Response to Release

In general, the release of an animal previously held for enhancement purposes likely increases the fitness and wellbeing of that animal, and contributes to the total wild population abundance. However, the release of animals is not without possible adverse effects. For example, the release of pinnipeds on rookeries or haul-out sites could disrupt other animals. When pinnipeds are startled and disperse from rookeries, pups may be trampled or abandoned. Juvenile and adult animals may be trampled during stampedes or injured on underwater rocks and cliff faces (NMFS 2014f). In addition, the release of animals carrying pathogens and non-native species into the wild may introduce for disease, viruses, or invasive species that could have adverse impacts on the rest of the wild population. However, *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012d) requires facilities rehabilitating ESA-listed species to have quarantine protocols to minimize the spread of infectious diseases within the facility, and *NMFS Standards for Release* (NMFS 2009e) requires that an extensive health assessment be completed prior to release, including screening for possible pathogens and non-native species. Thus, the release of animals carrying pathogens and non-native species is considered unlikely.

6.2.7 Potential Response to Attachment of Tags and Scientific Instruments

As discussed in the *Description of the Proposed Action* (Section 2.2.3.9), the Permits Division proposes to authorize the MMHSRP to tag ESA-listed cetaceans and pinnipeds to monitor animals' movements after release from a stranding site, rehabilitation, disentanglement, or after samples have been taken during research activities. Attachment methods for cetaceans include, but are not limited to: bolt, tethered-buoy, tethered, punch, harness, suction cup, implant, or ingestion. Pinniped attachment methods include, but are not limited to: glue, bolt, punch, harness, suction cup, surgical implant, or ingestion. Types of tags that may be used include, but are not limited to: roto-tags (cattle tags), button tags, VHF radio tags, satellite-linked tags, PIT tags, RFID tags, DTAGs, LIMPET tags, CDMA tags, pill (e.g., stomach temperature telemeters), TDRs, LHX tags, and video cameras such as Crittercams.

Effects of attached devices on animals may range from subtle, short-term behavioral responses to long-term changes that can affect survival and reproduction; attached devices may also cause effects not detectable in observed behaviors, such as increased energy expenditure by the tagged animal (White and Garrot 1990; Wilson and McMahon 2006). Internally placed devices may cause blockage, be rejected from the animal's body, or cause tissue reactions and infection (Eagle et al. 1984; Green et al. 2009; Guynn Jr et al. 1987; Hernandez-Divers et al. 2001; Lander et al. 2005). Thermoregulatory abilities may be affected; e.g. the attachment of markers to the plumage of mallard ducks (*Anas platyrhynchos*) reduced thermoregulatory abilities (Bakken et al. 1996). Markers may also interfere with the performance of natural behaviors; for example, radio-transmitters on mallard ducks interfered with time spent feeding and caused overall weight loss (Pietz et al. 1993). The attachment of scientific instruments may also increase energy expenditure and impede the animal's ability to perform natural behaviors such as locomotion, feeding or escaping from predators. For instance, penguins (*Pygoscelis* sp.) and green turtles

(*Chelonia mydas*) fitted with external data loggers and transmitters experienced drag, which decreased swimming speeds and increased energy expenditure (Bannasch et al. 1994; Watson and Granger 1998).

The behavioral responses whales exhibit during the tagging procedure are usually similar to those exhibited during a close approach by the tagging vessel when tags are not deployed, including head lifts, fluke lifts, exaggerated fluke beats on diving, quick dives, or increased swimming speeds. Less frequently, behavioral responses include fluke slaps, head lunges, fluke swishes, defecation, decreased surfacing rates, disaffiliation with a group of whales, evasive swimming behavior, or cessation of singing (in the case of humpback whales) (Mate et al. 2007). In cases where tagged whales have been followed immediately after tagging, the responses to tagging appeared to be short-term (Mate et al. 2007). Responses to human disturbances, such as tagging, may manifest as stress responses, interruptions of essential behavioral or physiological events, alteration of an animal’s time budget, or some combination of these responses. Wild harbor porpoises restrained and tagged did not show consistent elevations in cortisol nor did heart rate change in ways consistent with a stress reaction (Eskesen et al. 2009). We assume the actual tagging event could be stressful for a small portion of whales; however, the significance of this stress response and its consequences, if any, on the fitness of individual whales are not definitively known. The limited information available from Erickson (1978) indicates that for a more invasive radio package attachment on the dorsal fin, the blood parameters of killer whales showed no significant change. Given the evidence indicating that behavioral responses to the tagging procedure itself would be short-lived, we assume that tagging procedures could produce short-lived stress responses in some individuals.

The potential physiological effects of implantable tags on whales include wounds, bruising, swelling, and hydrodynamic drag. The available data on the effects of cetacean tagging is limited primarily to short-term effects, as few studies have attempted to follow up on tagged individuals weeks, months, or years after tagging; however, two recently published studies suggest that implantable tags can result in long-term effects in large whales. Gendron et al. (2014) monitored the wound site of a broken subdermal attachment from a satellite tag on an adult female blue whale over a period of 16 years (1995-2011). In 2005, ten years after tag deployment, the tag attachment remained embedded in the whale, with swelling less than 60 centimeters in diameter observed at the site of the attachment; in 2006, 11 years after tag deployment, the sub-dermal attachment had been expelled, leaving an open wound with blubber tissue apparently visible at the center of the swelling, which appeared to have decreased in size compared to two years before. The whale was last seen in 2011 with a scar (closed wound) present at the tag site. The whale’s calving history showed a total of three calves; two were observed prior to, and one after, the swelling period (1999-2007); though there was not definitive evidence of the tag attachment’s effect on reproduction, the authors suggested that it may have affected the female’s reproductive success during this period (Gendron et al. 2014). Among humpback whales in the Gulf of Maine that were satellite tagged with articulated (n = 19) or rigid (n = 16) anchoring systems, tag site reactions ranged from focal lesions to broad swelling, with broad swelling persisting over extended periods in some animals (at least 391 days in one case). In the 34 cases for which it could be assessed, at least 47.1 percent (n = 16) of tagged whales developed localized or regional swelling at the tag site. For individuals re-sighted in the year after tag deployment, 38.5 percent (n = 5) of swellings had resolved (Robbins et al. 2013).

Figure 83. Crossbow deployment of a satellite tag (visible in the dorsal fin) on an adult male killer whale at Marion Island, South Africa (Reisinger et al. 2014).

Physiological effects to cetaceans from implantable tags are likely dependent on several factors including tag size and design. Walker and Boveng (1995) concluded the effects of devices on animal behavior are expected to be greatest when the device-to-body size ratio is large. Gendron et al. (2014) reported that the tag attachment that remained embedded in a blue whale for at least 10 years originated from a surface-mounted satellite tag with two sub-dermal attachments, each consisting of cast bronze temple toggles mounted to stainless steel posts holding the tag to the whale's back. Subsequent veterinary advice (when the electronics packages became small enough) suggested implanting tags into the muscle layer so that attachments could deploy below the tough fascia at the blubber-muscle interface, in order to enhance long-term tag attachment and encourage encapsulation (Gendron et al. 2014). However, a necropsy on a North Atlantic right whale found that a pointed needle that was implanted through the blubber into the muscle had bent at 80° as a result of the shear forces between the blubber (which likely anchored the dart) and muscle (which being less dense, was "shredded" by the dart tip), resulting in extensive muscle tissue damage; this finding indicates that rigid, implanted devices that span the cetacean blubber-muscle interface, where the muscle moves relative to the blubber, could have secondary health impacts (Moore et al. 2013). Although the weight and size of an implantable device may be of less concern for larger animals such as cetaceans, there is still the potential for significant effects; for example long term secondary effects, which are very difficult to measure, may cause reduced biological performance, particularly during critical periods such as lactation (Walker and Boveng 1995; White and Garrot 1990). In addition, hydrodynamic drag as a result of tag attachment can result in increased swim costs, compromised swimming capacity and maneuverability, and extra load on an animal's tissue (Pavlov et al. 2007).

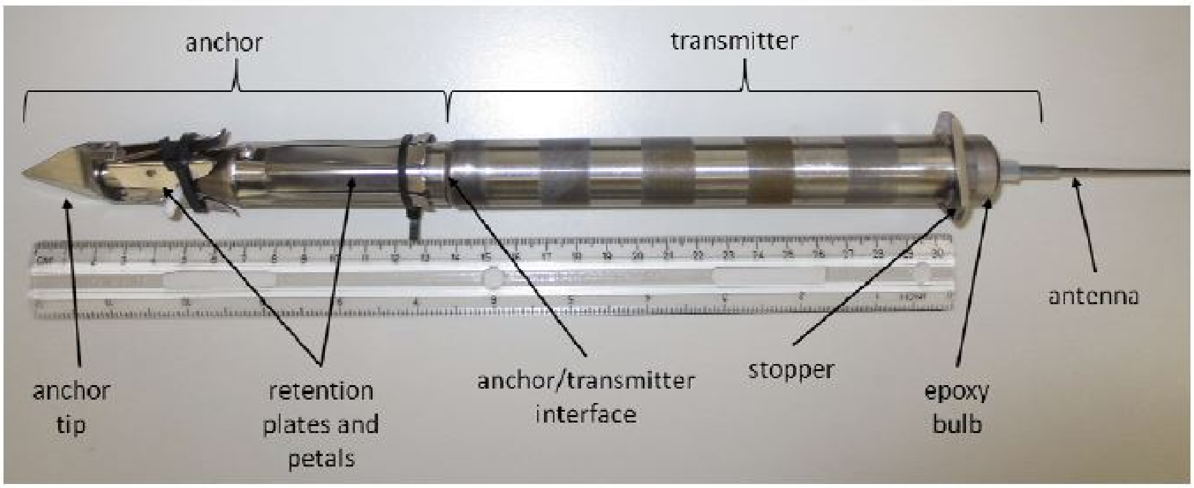

Figure 84. Example of an implantable satellite tag currently used in various large cetacean studies. Retention plates and petals are shown in pre-deployment position. Equally spaced etchings along the body of the tag are used to assess the rate at which it is ejected from the animal, using photo-identification data (Robbins et al. 2013).

In cases where tags with articulated anchors or with interfaces between anchoring systems and transmitters break after deployment, the transmitter component of the tag tends to be extruded, while the anchor (or some portion of it) remains inside the animal. This can result in substantial tissue response with associated swelling areas in some cases (Gendron et al. 2014). Tags that have no articulated parts or interfaces have proven to be more benign with the tag site showing complete healing and no evidence of swelling once the tag is fully rejected (A. Zerbini, pers. comm. to J. Carduner, NMFS, March 25, 2015). In their study on the effects of implantable tags on humpback whales in the Gulf of Maine, Robbins et al. (2016) examined the effects of implantable tags on vital rates of both males and females. For both sexes, there did not appear to be any effect on survival and many tagged females continued to successfully reproduce. However, tagging did appear to increase females' inter-birth intervals, with non-tagged females being nearly twice as likely to produce a calf compared to tagged females in the year following the initial tagging (or relevant year for non-tagged females). This suggest that implantable tagging may have an effect on pregnancy. Following this first year after tagging, tagged and non-tagged females appeared to be similarly likely to reproduce. Additional analyses investigating the effects of different tag models indicated that this impact on reproduction may have been due to a tag design flaw with the articulated anchors that lead to tag breakage and parts of the tag being left inside the whale after the tag detached. This flaw was recently addressed with a fully integrated implantable tag, and more recent data using these tags does not currently show the same negative effect on reproduction.

In examining the health effects and long-term impacts of implantable tags on large whales in the Pacific, Calambokidis (2015) used photographs and sightings records to evaluate tag-site wound healing and tagging effects on survival. Data came from a variety of long-term studies on blue and gray whales, which were tagged with implantable tags between 1993 and 2008 for blue whales, and in 2011 and 2013 for gray whales. While no effect on re-sighting rate was found for blue whales, tagged gray whales appeared to be less likely to be seen in subsequent years as compared to a control group. When sighting data were used in Cormack-Jolly-Seber capture recapture models to examine the effects of tagging on survival, there was no unequivocal evidence to support a tagging effect on survival, but several of the top models included a negative effect of tagging. Given this and the small sample size, caution should be used when interpreting these results, and effects of tagging on gray whale survival appear to be possible.

Importantly, many advances in tag technology have been made since the deployment of the tags discussed in the previous studies. These include smaller tag designs, stronger materials, fully-integrated designs, improved sterilization techniques, and better tag application methods. With these improvements, the chances of long-term adverse effects are greatly reduced (Mate et al. 2007; NMFS 2016b; Robbins et al. 2016; Szesciorka et al. 2016).

Based on the results reported by Moore et al. (2013), tags that do not cross the blubber-muscle interface may also be less likely to result in tissue damage. The LIMPET tag (Figure 85), a recently developed satellite tag, may be less likely to result in tissue damage compared to implantable tags that cross the blubber-muscle interface. The electronics in a LIMPET tag are external to the whale’s body and the tag package is attached via small percutaneous anchors; thus, for large cetaceans, the tag embeds only in the blubber layer. LIMPET tags have been successfully applied to over 20 species of cetaceans (Baird et al. 2012b; Ford et al. 2013; Moore et al. 2013; Reisinger et al. 2014; Schorr et al. 2009; Schorr et al. 2014; Straley et al. 2014). Published literature on physiological or behavioral responses to LIMPET tag attachment is limited; however, no significant difference in survival was detected among LIMPET tagged versus non-tagged false killer whales and short-finned pilot whales in Hawaiian waters (Baird et al. 2013). After deployment on a killer whale, dart penetration holes had completely healed over 262 days after tag deployment (217 days after the initially deployed tag fell out), with minor swelling at the site of each dart penetration point; 405 days after first tag deployment and 98 days after a second tag deployment, all wounds were re-pigmented and healed, with no swelling or scars visible at either tag site (Andrews et al. 2014). However, not all reports of LIMPET tags have been as positive, as exemplified by the recent death of a Southern Resident DPS killer whale.

In 2016, the death of a Southern resident killer whale, L95, was reported following attachment of a dart/barb tag under Permit No. 16163. An expert veterinary panel concluded that a fungal infection developed at the tag site, as determined by gross dissection, radiographs, magnetic resonance imaging and histopathology, though the killer whale presented in moderate to advanced decomposition at the time of necropsy (Haulena 2016; NMFS 2016f). This fungal infection contributed to illness in the whale and most likely contributed to its death. There were several factors in this case that may have predisposed this whale to a fungal infection at the tagging site including: incomplete disinfection of the tag after seawater contamination, retention of the tag petals which may have allowed for formation of a biofilm or direct pathogen implantation, placement of the tag lower on the body and near large bore vessels which increased the chance of fungal dissemination through the blood system, poor body condition, and possible immunosuppression.

The case of L95 is an important reminder that all invasive tags carry some risk of death, even if minimal. However, the circumstances that lead to L95's death are extremely unlikely to occur under Permit No. 18786-01 for several reasons. First, the MMHSRP would not attempt to tag any individual that appears to be in poor health. Second, MMHSRP would follow stringent field sterilization methods. In fact, MMHSRP personell are actively examining and developing updated sterilization methods for use by other researchers, and the MMHSRP was heavily involved in the case of L95's death. Third, the MMHSRP would use the latest tag technologies, such as the fully-integrated implantable tags to minimize chances of tag breakage. Given these measures, we find it highly unlikely that the use of invasive tags would result in the death of any individual whale.

Figure 85. North Atlantic right whale shortly after the attachment of an external tag tagging. Activities depicted authorized by Permit No. 14450-02 (Andrews 2015).

Physiological and stress responses of pinnipeds to tagging and attachment of scientific instruments is expected to vary depending on species and type of tag or device. Antarctic fur seals (*Arctocephalus gazella*) fitted with both time-depth recorders and radio-transmitters had increased durations of foraging trips and nursing visits compared with animals carrying only radio transmitters (Walker and Boveng 1995). A study using devices attached with epoxy glue that examined the effects of research handling (including blood sampling, flipper tagging and the placement of time-depth recorders, data loggers and video recorders) on the migratory behavior, survival and body condition of Hawaiian monk seals found no difference between animals that were tagged (n = 437) and/or had telemetry instruments attached to their pelage (n = 93) with control animals for both categories (n = 437 and n = 93, respectively) (Baker and Johanos 2002); there was no direct assessment of how the attachment of devices affected the seals’ foraging success.

A review of peer-reviewed articles published over a 31 year period (1980-2011) addressing the effects of marking and tagging (Walker et al. 2012) found that none of the reviewed studies that assessed visual tag (e.g., roto tag) attachment found that visual tags affect survival. However, visual tags can cause destruction of tissue at the site of tag attachment (Irvine et al. 1992) and have been known to cause subsequent tissue damage when torn out (Henderson and Johanos 1988). After the attachment of flipper tags in grey seals, Paterson et al. (2011) found small increases in surface temperature during the healing process, with some animals presenting with exudate, swelling and partially open wounds; 24 days after tagging, these signs were no longer present. One of the three studies that assessed behavioral responses to visual tag attachment reported a detectable effect: tagged Hawaiian monk seals hauled out further from the marking site than did untagged animals (Henderson and Johanos 1988). Another study showed that migration rates of Hawaiian monk seals were not influenced by flipper tagging (Baker and Johanos 2002).

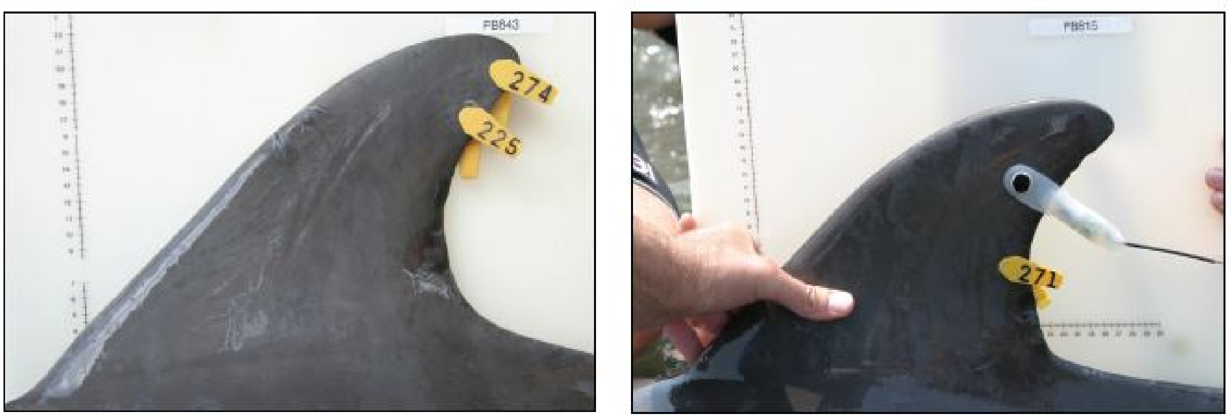

Figure 86. Roto tags (left); radio tag and roto tags (right) affixed to dorsal fins of bottlenose dolphins.

Internally placed devices (e.g., PIT tags, LHX tags) may cause blockage, be rejected from the animal’s body, or cause tissue reactions and infection (Eagle et al. 1984; Green et al. 2009; Guynn Jr et al. 1987; Hernandez-Divers et al. 2001; Lander et al. 2005). A review by Walker et al. (2012) reported on the outcomes of several published studies on internally placed devices in marine mammals. Three studies reviewed by Walker et al. (2012) investigated the effects of intraperitoneal implantation of LHX tags in sea lions (Horning et al. 2008; Mellish et al. 2007b; Walker et al. 2009). Horning et al. (2008) reported that California sea lions (*Zalophus californianus*) and Steller sea lions recovered well after implantation surgery, with minimal swelling around the incision site. Physiological effects of the surgical implantation of LHX tags included increased levels of acute-phase proteins. (i.e., indicators of infection, inflammation or tissue trauma) at two weeks post-surgery, with levels returning to baseline within six weeks (Mellish et al. 2007b). Dive behavior recorded post-surgery showed that dive depth, duration, frequency and dispersal distances were similar among LHX-implanted individuals and non-LHX-tagged individuals (Mellish et al. 2007b). Behavioral responses in Steller sea lions in the days after abdominal surgery to implant LHX tags included changes in back arching, standing, locomotion, time alert, lying time, and time spent with pressure on the belly, with behaviors still affected 12 days post-surgery, leading the authors to suggest more effective analgesic methods be explored for this procedure (Walker et al. 2009). PIT tags, which are placed subcutaneously, have been used on a wide variety of species, including cetaceans, seals, sea lions, and fur seals. When inserted into animals that have large body sizes relative to the size of the tag (e.g., cetaceans and pinnipeds), empirical studies have demonstrated that PIT tags have no adverse effect on growth, survival, reproductive success, or behavior (Brännäs et al. 1994; Clugston 1996; Elbin and Burger 1994; Hockersmith et al. 2003; Jemison et al. 1995; Keck 1994; Skalski et al. 1998). No tissue reactions to PIT tag placement were found in sea otters and southern elephant seals, and no differences in survival were documented between PIT-tagged and non-PIT-tagged individuals (Galimberti et al. 2000).

The MMHSRP proposes the attachment of tags to pinnipeds with epoxy glue. Though epoxy glue has the potential to cause thermal burns or react with the skin, such effects have not been documented (Walker et al. 2012). The attachment of instruments to juvenile grey seals did not alter the surface temperature of wet seals; however elevated temperatures were detected around the edges of the attachment site when the seal was dry (McCafferty et al. 2007). Such heat increases are small and localized (approximately three percent of body surface area) and do not have a significant influence on the total heat exchange (approximate 0.5 percent of basal metabolic rate) of seals (McCafferty et al. 2007).

The MMHSRP also proposes to mount video cameras (such as Crittercams) on some individuals. Littnan et al. (2004) assessed the effects of video cameras on the foraging behavior of immature Hawaiian monk seals. Video cameras, time-depth-recorders, and VHF radio transmitters were affixed to seals, and after three to ten days (mean duration 5.7 days) the video cameras were removed (TDR and VHF remained until 4-48 days later). Descent and ascent on dives was slower with the video cameras, possibly indicating energetic costs to individuals, but the results were not statistically significant, and the authors did not report a significant difference in foraging behavior of immature monk seals equipped with video cameras compared to those without; however, the sample size of the study was small (seven seals). Abernathy and Siniff (1998) found that monk seals fitted with TDRs dove to the same range of depths as seals equipped with cameras. Instrumentation, especially with larger equipment such as video cameras, may cause hydrodynamic drag, reducing foraging abilities and/or increasing the energy cost to animals.

6.2.8 Potential Response to Marking

As described above (Section 2.2.3.10) the MMHSRP proposes to mark marine mammals using methods including: bleach, crayon, zinc oxide, paint ball, notching, freeze branding and hot branding. Crayons, zinc oxide, and paint balls may be used on cetaceans and pinnipeds for temporary, short-term marking. Bleach or dye markings may be used on pinnipeds. Notching can be used to permanently mark cetaceans by cutting a piece from the trailing edge of the dorsal fin. Notching in pinnipeds removes a piece of skin from the hind flipper of phocids and the foreflipper of otariids.

Information on the effects of marking marine mammals is somewhat limited in that research has tended to focus on short-term behavioral responses; few studies have addressed the effects of marking on reproduction, growth, or survival. Walker et al. (2012) reviewed 39 peer-reviewed articles published from January 1980 to April 2011 addressing the effects of marking; a preponderance of studies focused on short-term effects such as injuries and behavioral changes (Walker et al. 2012). Of the studies reviewed by Walker et al. (2012), none of the studies designed to measure the effects of marking on survival demonstrated reduced life-expectancy as a result of marking. The majority of studies that addressed behavior and injury found effects, though the responses varied by marking device and species studied (Walker et al. 2012). It should be noted that the review included the use of marking devices such as paint or hot-iron brands, as well as radio- and satellite-telemetry devices and data loggers (the latter are discussed above in Section 6.2.7).

Temporary or short term marking procedures include paint, bleach, grease pen, crayon, zinc oxide or dye. Researchers have applied many thousands of bleach markings on monk seals and have observed no negative effects other than the occasional minor disturbance (NMFS 2013d). Most individuals are approached while sleeping and do not awaken during the process. Bleach marking, like branding, facilitates long-range identification, thereby reducing the necessary approach distance and consequently the chance of disturbance. Studies on the effects of paint marking are limited. In a comparison of painted and unpainted regions from northern fur seals marked with fluorescent paste, paint was not reported to cause histological abnormalities of tissue biopsies (Griben et al. 1984). We expect that paint applied remotely using a paint gun could potentially cause a stress response and/or a startle reaction. Other non-target animals may also be temporarily disturbed. Cetaceans and pinnipeds may also be marked with a grease pen, crayon, or zinc oxide; we believe these types of marks would not result in any adverse impacts. For any of these procedures (marking with paint, bleach, grease pen, crayon, zinc oxide or dye) that require capture as opposed to remote marking, we believe the capture and restraint necessary to perform the marking procedure would be the greatest potential stressor and would have the greatest potential for an adverse impact to the animal associated with the activity.

Notching of a fin or fluke is invasive as it does involve removal of tissue but it can generally be accomplished quickly. Because it entails the removal of tissue, there is the possibility that notching may result in infection. However, we could not find evidence of infections as a result of notching; any infections that may result are expected to be minor and to heal quickly, as notching would remove very small (less than 1 centimeter) pieces of flesh from the dorsal fin or fluke, and cetaceans are resilient to wounds of this scale, which they experience routinely throughout their lives.

Branding is useful because it can provide a mark that remains visible throughout the animal's life and is visible from long distances. Hot branding has been used extensively as a method to permanently mark pinnipeds, as well as livestock and large birds. Branding provides a permanent mark that remains visible throughout an animal's life and is not subject to the same problems as plastic or metal tags which eventually become worn and unreadable or fall off. The brand can also be easily read from a distance providing much higher resight rates than tags. The humaneness of hot branding as a marking method for marine mammals has been frequently debated (Jabour-Green and Bradshaw 2004; McMahon 2007).

Cold branding works by damaging the pigment-producing melanocytes but leaves the hair follicles intact allowing for regenerative growth of white hair (Daoust et al. 2006). There is limited information on the response of marine mammals to freeze branding. Machpherson and Penner (1967) reported that adult and juvenile seals tried to escape their restraints as soon as cold irons were applied to their skin, possibly indicating a response to pain. Both Lay et al. (1992) and Schwartzkopf-Genswein et al. (1997) reported that domestic cattle tried to break free from their restraints during freeze-branding and showed evidence of discomfort or avoidance responses for up to five days after they had been branded. Sherwin et al. (2002) reported that four species of bats experienced "discomfort" during freeze branding, but did not provide more information on the response of these small mammals to the branding procedure.

Hot branding (or "hot iron branding") involves the use of steel branding irons with numbers and letters (Figure 87), heated to "red-hot" (about 500° Fahrenheit) in a propane forge, and applied to the body of an animal for two to seven seconds to produce burns that penetrate the entire outer layer of the skin and into the inner skin layer (i.e., second degree burns). These burns are characterized by formation of blisters, swelling, and fluids seeping from the burned area (Figure 87).

Several studies have examined the physiological responses of pinnipeds to hot branding. In a captive study, Steller sea lions anaesthetized with Isoflurane exhibited a three-fold increase in breathing rate, from baseline (pre-branding) to branding, while heart rate increased over baseline by an average of 9.3 percent (Walker et al. 2011). In separate captive study, the physiological response of juvenile Steller sea lions to hot branding was monitored over a period of 2-8 weeks. Serial serum samples were analyzed for general inflammatory reaction (white blood cells, platelets), acute phase response (globulins, haptoglobins), and adrenocorticoid levels (cortisol). Overall, white blood cell counts, platelet levels, and haptoglobin and globulin values all increased within two weeks after branding (likely a result of minor tissue trauma), but had returned to capture levels within seven to eight weeks, while serum cortisol levels did not differ between pre- and post-brand samples. Results indicated that while hot branding may induce a short-term immune response, it did not appear to have any lasting physiological effects that might lead to impaired function or mortality (Mellish et al. 2007a)

Figure 87: Stages of hot brand healing in a juvenile Steller sea lion, shown as (A) day of brand, (B) one week post-brand, (C) three weeks post-brand, and (D) eight weeks post-brand (Mellish et al. 2007a).

Studies have also been undertaken to determine whether hot branding affects pinniped behavior. In a study of captive juvenile Steller sea lions (n = 11), the animals' behavior was monitored for three days prior to and three days following hot branding. Following branding, the sea lions increased wound-directed grooming and spent less time with pressure on their branded side, possibly due to increased sensitivity to pain, or hyperalgesia. Results showed that Steller sea lion behavior changes for up to 72 hours after hot-iron branding (Walker et al. 2010).

The behavior of Steller sea lion pups (n = 8) was monitored two days prior to and five days after hot branding in 2010 at Medny Island, Russia. A control group (n = 5) went through the same procedures as branded pups (handling, measuring, anesthetizing) but were bleach marked and not branded. Play behavior, grooming behavior, suckling and sleeping were monitored; of those, only duration of play behavior changed significantly among branded pups during the initial days after branding, but resumed to pre-branding level on the third day after branding. Overall, the branding procedure appeared to have only short-term effects on the behavior of Steller sea lion pups (Fomin et al. 2011).

Steller sea lion pups in the wild were visually monitored one week prior to and one week after hot branding to analyze changes in behavior. Overall, average activity profiles of pups were similar throughout the day and both before and after branding with most pups exhibiting resting behaviors, though differences in specific behaviors such as alertness and playing suggested an increase in stress may have occurred in branded pups versus non-branded pups during the week following branding (Di Poi et al. 2009).

The responses described in the studies above are consistent with previous studies on pain responses associated with hot branding. In a review of animal tagging and marking techniques, Walker et al. (2012) report that in studies of cattle, hot branding results in greater escape avoidance reactions, as well as a greater incidence of behavioral changes (tail-flicking, kicking and falling) and more prolonged physiological responses (elevated heart rate and plasma concentrations of cortisol and epinephrine), compared with freeze branding.

Several studies have examined whether hot branding is related to increased mortality rates in pinnipeds. In a study of 1,489 Steller sea lions pups hot branded from 1987-1989 at rookeries in Alaska and Russia, one-month survival was 99.8 percent; from 4-9 months later, no difference was found in mortality rates of branded and unbranded pups from sightings on the beach (Merrick et al. 1996).

The results of a study on hot branded California sea lions from 1980-1982 found that branding did not result in higher mortality rates versus non-branded pups, branded pups appeared to be as healthy as non-branded pups, and most branded pups (89 percent, 90 percent, and 93 percent, respectively, in each of the three years) were alive six months after branding. Mortality rates for years that pups were branded did not differ from years when no pups were branded, and the number of dead pups present on the rookery in non-branding and branding years indicated that survival was independent of branding. No mortalities could be attributed to branding (Aurioles and Sinsel 1988).

A mark-recapture study conducted for 12 weeks after hot branding from 2001-2002 at Lowrie Island, Alaska, found weekly survival of branded pups (n = 366) was nearly identical to estimates from a control group of undisturbed/unbranded pups born to 10-11 year old branded adult females in 2005 (0.987-0.988/wk.). Assuming survival differences between the first two weeks post-branding and later weeks was due entirely to the branding event (i.e., no additional natural mortality), potential mortality attributable to the branding event was 0.5 to 0.7 percent, or one pup for every 200 marked; however, it is extremely unlikely that no natural mortality occurred during that period. Although potential effects of maternal age, site, and year on pup survival could not be eliminated, available data indicated that the survival rate at 12 weeks post-branding (86.8 percent survival) was near the median estimate (85 percent) from other otariid studies of unbranded pups, indicating the mortality rate did not significantly increase as a result of branding. No mortalities could be attributed to branding. (Hastings et al. 2009).

In a longitudinal study on hot branding of New Zealand sea lions, the effects of branding on survival were examined by comparing survival of branded females (n = 135, age 4-24 years) with a cohort sample of tagged-only females (n = 131, age 6-16 years) over the course of 10 years. A subset of the branded females aged 6-16 years (n = 107) was also used for survival comparison, as their ages matched those of the tagged-only females. Survival estimates derived from branded versus tagged-only individuals were statistically similar after 10 years, leading the authors to conclude that hot branding does not have a negative impact on survival (Wilkinson et al. 2011).

In unpublished studies to assess the effects of branding on Steller sea lion growth, Alaska Department of Fish & Game and NMFS examined 371 juvenile Steller sea lions captured with hoop net or underwater noose techniques during 2000-2003; 27 of these had been branded as pups on natal rookeries. The pups did not differ in mass or length compared to non-branded sea lions of similar age up to two years of age, suggesting there was no effect of branding on subsequent growth. This conclusion was further supported by examination of the distribution of residuals from an analysis of covariance of mass by sex, branding status (yes/no), and region (natal region for branded pups, region of capture for non-branded pups) with age as a covariate. Though there were significant effects of sex, region and age and the overall model accounted for 71 percent of variance in mass, there was no significant effect of branding (NMFS 2009c).

Any marking technique that requires restraint of the animal is expected to result in the responses to capture, handling, and restraint described above (Section 6.2.3). However, it should be noted that long-term marking techniques such as branding are designed to be easily readable from long distances (e.g. from aerial surveys or UASs) which would reduce the necessity for future capture for identification, thereby reducing the likelihood of future stress to the animal from capture, restraint, and handling. Freeze branding is considered by some to be more acceptable for marking wildlife than hot branding because, if it is done correctly, there is a negligible risk of infection (Day et al. 1980). However, there is more preparation required for producing bald freeze brands than hot brands, and the freeze branding tool needs to remain in contact with the animal's skin for 25-60 seconds per character to produce a bald brand (Hobbs and Russell 1979) versus 2-4 seconds per character for a hot brand (Merrick et al. 1996). As such, freeze branding could take several minutes longer per animal than hot branding, and could therefore result in greater stress responses than may occur in hot branded animals as a result of increased handling time.

In summary, the marking of marine mammals is likely to result in a range of responses from no response (for minimally invasive techniques, such as bleaching) to stress responses and acute pain for several minutes to days (for branding). It is possible that in the case of an animal that was previously compromised by illness or injury, the physiological responses to hot or cold branding could compound a pre-existing condition. However, we expect the MMHSRP, and those authorized to perform marking activities under the permit, to avoid branding individual animals that are obviously unhealthy or otherwise compromised.

6.2.9 Potential Response to Disentanglement

The MMHSRP proposes to disentangle ESA-listed pinnipeds and cetaceans, including removal of gear, line, or debris, that has become wrapped around, hooked into, or otherwise associated with the outside of an animal's body, and the removal of ingested gear including hooks, line, or other marine debris. Though the goal of disentanglement is to reduce an animal's stress, pain, suffering, and likelihood of serious injury and mortality, adverse effects could occur during disentanglement activities. Takes of entangled animals would occur during close approaches by aircraft (to locate entangled animals or for photo-identification), by vessel (for documentation, general assessment, photo-identification, and disentanglement attempts), or by land or water (for entangled pinnipeds). Incidental takes from close approaches are likely if other animals are in the vicinity of the entangled animal. Potential effects are as described previously.

Responses among cetaceans and pinnipeds to disentanglement attempts depend on the species and the specific details of the entanglement. Stress responses may result from close approach, either by vessel or plane (or both). Floats, buoys, and control lines may be attached to large whales during attempts to physically restrain the animal, potentially resulting in increased stress or pain. An entangled animal may sustain what is assumed to be increased trauma (line wounds) as a result of increased drag force from disentanglement (kegging) efforts and possibly from carrying a tethered tag package, sometimes over several days' time. Based on annual reports submitted by the MMHSRP, disentanglement drag trauma may result in wounds increasing by several inches or may free the animal of the entangled gear. Physical restraint of pinnipeds may cause injuries or death. Chemical restraint of free-swimming animals may lower the respiratory rate, slow their breaching, and decrease their swimming strength, increasing the risk for drowning. Sedatives that may be delivered through a tethered dart syringe could startle the animal and cause it to react; if so, reactions would be similar to those expected from remote biopsy darts (described in Section 6.2.11). If darts are used to administer medication crossed the blubber-muscle interface they have a tether to allow for them to be retrieved and not remain embedded in the animal, epaxial muscle movement may result in more serious health impacts (Moore et al. 2013).

Figure 88. An attempt to disentangle a North Atlantic right whale.

Disentanglement attempts frequently involve the cutting of lines and other gear off the animal, potentially resulting in accidental injury (Figure 88). In the event that a line is embedded in an animal's tissue, when no other options to safely remove gear exist and only after consideration of the possible damage and animal and human safety, a responder may intentionally cut into the skin to free the line and reduce the entanglement. An attempt to disentangle a North Atlantic right whale resulted in lesions from both a spring-loaded knife (lesions were 4.5 centimeters wide, 15.5 centimeters long, and five centimeters deep) and a broadhead cutter (lesions from 0-7 millimeters into the blubber) that were deployed in attempts to cut entangling line off the whale (Moore et al. 2013).

6.2.10 Potential Response to Diagnostic Imaging

The MMHSRP proposes to perform diagnostic imaging on ESA-listed marine mammals. The greatest impacts of ultrasound sampling performed on free-swimming cetaceans would be the stress associated with close approach by vessel (described above, Section 6.2.1). The reaction of cetaceans to physical contact for ultrasound sampling has not been adequately studied; however the physical contact of the ultrasound device, while brief, may affect an animal. Given the documented responses among cetaceans to remote biopsy sampling (described above, Section 6.2.11), which is a more invasive procedure, we believe responses to diagnostic imaging would be minimal. Likewise, we believe the greatest potential risks associated with ultrasound performed on animals in-hand would result from the stressors related to capture, handling, and restraint (described above, Section 6.2.3). We expect any procedure that increases the duration of restraint to compound the stress of capture, however we do not expect diagnostic imaging to negatively affect an animal's health or cause additional stress in and of itself. In the case of pinnipeds, sedation and/or anesthesia may be necessary for the comfort of the animal and to limit movement for radiography; if so, we would expect the animal to respond as described in Section 6.2.12.

As with humans, radiation exposure in cetaceans and pinnipeds is believed to be dangerous only in high doses or repetitively. Radiographs are often used in small animal practices to diagnose and stage pregnancies. There is little risk to the fetus when radiographing pregnant animals. The accepted cumulative dose of ionizing radiation during pregnancy is five rad, and no single diagnostic study exceeds this maximum; for example, a fetus would receive a dose of 0.00007 rad from a two-view chest x-ray of a mother (Toppenberg et al. 1999). A recent review of bottlenose dolphins in Florida determined that 83 percent of pregnancies detected via diagnostic ultrasound during live capture-release health assessments were documented as resulting in live births, demonstrating that the ultrasound did not result in the loss of the fetus in significantly more cases than when ultrasound was not performed (Wells et al. 2014).

6.2.11 Potential Response to Sample Collection

Samples that may be collected by the MMHSRP from ESA-listed marine mammals include biopsy, blood, breath, urine, blowhole, fecal, milk, sperm, hair, nails, vibrissae, gas, and gastric sampling, sloughed skin, tooth extraction, and colonic temperatures.

Remote biopsy samples (taken with a crossbow or rifle) are typically one centimeters diameter by 1.5-2 centimeters deep. Most cetaceans exhibit mild behavioral responses to biopsy darting without any long term adverse effects (Barrett-Lennard et al. 1996; Best et al. 2005; Brown et al. 1991; Clapham and Mattila 1993; Gauthier and Sears 1999; Hooker et al. 2001; Jahoda et al. 2003). Gauthier and Sears (1999) reported that minke, fin, blue, and humpback whales showed no behavioral reaction to 45.2 percent of successful biopsy samples taken using punch-type tips fired from crossbows; whales that responded to biopsy sampling typically resumed their normal behavior immediately or within a few minutes (Gauthier and Sears 1999). When they occurred, behavioral responses included tail flicks and submergence. The authors concluded that biopsy sampling is an efficient method for obtaining high-quality whale skin and blubber samples with limited behavioral disturbance to balaenopterid whales.

Weinrich et al. (1991) studied the behavioral responses of humpback whales in the Gulf of Maine to biopsy sampling, classifying responses into the following categories: no reaction; low-level reaction (immediate dives but no other overtly forceful behavior); moderate reaction (trumpet blows, hard tail flicks, but no prolonged evidence of behavioral disturbance); and strong reaction (surges, tail slashes, numerous trumpet blows). Out of 71 biopsy attempts, seven percent resulted in no behavioral response, 26.8 percent resulted in low-level behavioral response, 60.6

percent involved a moderate reaction, and 5.6 percent involved a strong reaction. Clapham and Mattila (1993) also concluded that humpback whales exhibited low to moderate reactions to being struck by biopsy darts, with results showing that 66.6 percent of biopsied humpback whales showing no behavioral reaction or low-level reaction to the procedure. A separate study noted that studies on biopsy procedures showed no evidence of significant impact on cetaceans in either the short or long term (Clapham and Mattila 1993).

Based on the best available information, reactions among small cetaceans to biopsy sampling are expected to be similar to those of large whales (Krützen et al. 2002; Weller et al. 1997). Reactions among 49 Indo Pacific humpback dolphins (*Sousa chinensis*) to remote biopsy sampling by crossbow were mostly slight, with a few moderate reactions noted out of 49 total biopsy dart hits, but no extreme reactions (e.g., breaches or radical changes in the general behavior of the dolphins) were observed. Most dolphins flinched, and some also exhibited a tail-swish or fluke-slap. They generally sped up and swam away from the vessel, but it was possible to approach several sampled individuals closely again within three to five minutes of sampling. Dolphins reacted similarly to hits and misses, and their reaction was characterized as a startle response. All observable reactions were short-term, and there was virtually no evidence of long-term impacts on behavior, social organization, or distribution patterns. Wounds appeared to heal well and were healed over with tissue in less than 21 days (Jefferson and Hung 2008). Krützen et al. (2002) studied behavioral reactions among bottlenose dolphins to biopsy sampling using a modified 0.22 caliber rifle. No significant difference in reaction to the darting procedure was observed when an animal was hit or missed, and wounds were healed after approximately 23 days. A significant positive correlation was observed between the size of the sample obtained and the reaction to biopsy sampling, suggesting the size of biopsy darts should be adjusted relative to the size of the animal being sampled (Krützen et al. 2002). In studies that have reported stronger reactions among cetaceans to biopsy sampling (e.g., breaching), reactions were reported to be of short duration (less than three minutes) and animals were approached and photographed immediately following the procedure, suggesting any responses were very short term in nature (Parsons et al. 2003).

We were only able to find one example of reduced fitness in a cetacean, as a result of biopsy sampling. A common dolphin in the Mediterranean Sea died following penetration of a biopsy dart and subsequent handling (Bearzi 2000). The dolphin was hit in the dorsal muscle mass below the dorsal fin by a lightweight pneumatic dart fired from a distance of six meters by a variable-power carbon dioxide dart projector. The methods and equipment had been previously successfully used with minimal effect on common dolphins and other species under similar conditions; however, in the reported event, a dart stuck in the dorsal muscle mass instead of recoiling as expected. Less than two minutes after the hit, the dolphin began catatonic head-up sinking; it was recovered by a team member at depth. Basic medical care was given to ensure haemostasis, but the animal died 16 minutes later. Possible causes of death may have included either indirect vertebral trauma or stress (Bearzi 2000).

Potential infection at the point of penetration is possible, but has not been the subject of focused study, although anecdotal observations of the point of penetration or elsewhere among the many whales re-sighted in days following biopsy sampling has produced no evidence of infection (NMFS 1992). Of the large number of cetaceans that have been biopsy sampled in recent decades (probably in the tens of thousands), there has been one documented case of fitness reductions as a result of biopsy sampling; as such, we expect biopsy sampling to result in low level stress responses and temporary behavior changes in individuals that are biopsy sampled, but we do not expect any individuals to experience reductions in fitness.

The greatest potential risks associated with most types of sampling of animals in hand (e.g., blood, sperm, milk, and vibrissae sampling, tooth extraction) are expected to result from the stressors related to capture, handling, and restraint (described above, Section 6.2.3). We expect any procedure that increases the duration of restraint to compound the stress of capture, however we do not expect these procedures to result in fitness consequences in and of themselves. Any procedure that requires anesthesia, such as tooth extraction, would also include the additional risks that come with anesthetizing marine mammals (described below, Section 6.2.12) and the potential for infection following the procedure.

The potential risks associated with tooth extraction relate to the risks of capture, anesthesia, and the possibility of infection following extraction. The procedure may result in more than momentary pain, which could temporarily interfere with the animal's ability to forage. However, there are no data on the long-term effects of this procedure. Any interference with foraging is expected to be temporary and is not expected to cause the individual to become undernourished or emaciated. As with humans, the loss of a single tooth (#15 in the lower left jaw of cetaceans) does not prevent foraging or feeding in the long-term. In the dozens of cases where bottlenose dolphins have been re-examined years after extraction of a tooth, there has been no indication of long-term adverse impacts (NMFS 2014f). The collection of pinniped feces may disturb animals on haul-out sites or rookeries, potentially causing animals to rapidly depart the area, which could result in injury or death. The pulling of whiskers may cause pain due to the highly sensitive nature of the snout and because the hair bulb is surrounded by blood and neurons (NMFS 2014f). Clipping of hair, nails, and whiskers are not expected to cause pain; any effects of these procedures are expected to result from restraint and handling. Colonic temperature measurement procedures pose the risks of infection and perforation. Breath sampling performed on animals in hand (including those captured for other research, animals in rehabilitation, or during other rehabilitation activities) is not expected to have impacts beyond those that would be expected from capture and restraint (described above). Pneumotachography has been conducted on restrained animals with no observed behavioral impact (NMFS 2014f). The mild discomfort associated with the sampling described above would dissipate quickly and is not expected to reduce the fitness of any individual.

The insertion of a needle required for certain types of sampling (e.g., blood sampling) may cause discomfort, however it is not expected to cause injury as the needle entry point is very small. If multiple attempts to obtain a blood sample were necessary, this may compound the stress of capture and restraint, and may result in damage to the vein, clotting, and an abscess. Removal of a volume of blood that is too large relative to the animal's mass and ability to replace that amount may result in fatigue, anemia, weakened immunity, and problems with clotting (NMFS 2014f). In studies done on human hospital patients, phlebotomy is associated with a decrease in hemoglobin and hematocrit, and can contribute to anemia (Thavendiranathan et al. 2005). Such responses, however, are expected to be temporary and minor. Blood removal would cause a temporary increase in blood cell production, resulting in a small metabolic cost to the individual. Based on the best available information, we do not expect the collection of blood samples to reduce the fitness of any individual.

Responses to scat collection are expected to be the same as those that would be expected from close approach. Steller sea lions in British Columbia responded to the presence of researchers collecting scat by entering the water (fleeing the site) as researchers went ashore (Kucey 2005). Six of ten disturbed rookeries and haul-out sites reached full recovery in terms of the number of animals at the site (100 percent of the pre-disturbance mean), an average of approximately four days after the research disturbance; three of ten sites never recovered to pre-disturbance levels. However, it should be noted that branding of pups also occurred during the same visits by researchers, and the study was not able to verify whether the observed disturbance resulted merely from the presence of researchers collecting scat or from the branding procedures (or both) (Kucey 2005).

The greatest potential risks associated with most types of sampling of free-swimming cetaceans are expected to result from the stressors related to vessel close approach (described above, Section 6.2.1). The reaction of free-swimming cetaceans to physical contact for breath sampling has not been adequately studied; however, the collection of breath samples from free swimming anumals would only occur using a pole with a mesh or plate or via a UAS. Breath from animals that are captured and restrained would involve the quick physical contact of the vacuum cylinder or pneumotachograph (a device that records the rate of airflow to and from the lungs) is very brief, lasting only a few seconds. Based on behavioral responses to biopsy sampling among cetaceans (described above), which is more invasive than breath sampling, we believe breath sampling procedures performed from vessels is not likely to disrupt behavior, beyond that which would be expected from vessel close approach (described above). Depending on advances in technology, it is possible that breath sampling of free-swimming cetaceans may be possible via UAS during the duration of the permit. If this occurs, the procedure would be expected to be even less disruptive to cetaceans as close approach by boat would no longer be necessary. The collection of feces or sloughed skin from free-swimming animals would not be expected to cause any impact beyond that which would be expected from close approach.

6.2.12 Potential Response to Administration of Medications

As described above (Section 2.2.3.14), the MMHSRP proposes to administer medications to ESA-listed pinnipeds and cetaceans. The MMHSRP administer sedatives, anesthetics, and analgesics before performing biopsies, tooth extractions, and other procedures. Animals may also be sedated or chemically restrained during stranding response and disentanglement activities. Antibiotics, antifungals, and other medicines may be administered during response and rehabilitation. The MMHSRP may also administer vaccines, either prophylactically or in response to a detected pathogen. Potential responses to the administration of medications are expected to vary depending on species, condition of the animal, type of drug, dosage and method of administration. Potential adverse effects from the administration of medications include drug interactions, incorrect drug dosages, side effects, injuries, infections, and death.

Early reports describe the problems associated with anesthetic use in pinnipeds, including: narrow margins of safety, thermoregulatory disturbances, cardiovascular changes, and fatalities (Gage et al. 1993; Gales 1989). Until fairly recently, field-based chemical restraint and anesthesia of pinnipeds have been accomplished with intra-muscular agents, primarily combinations of a arylcyclohexylamine (particularly ketamine or tiletamine) and a sedative or anti-anxiety drug (diazepam, zolazepam, or xylazine) (Gales et al. 2005). Delivered in this manner, these drugs achieved variable results, exhibited adverse side-effects, and elevated rates of mortality (see reviews by (Gales 1989; Haulena and Heath 2001; Lynch et al. 1999)).

Delivery of anesthesia or sedation in marine mammals can be complicated by their particular anatomical and physiological specializations to the marine environment, compounded by the inherent challenges of working with wild animals. Anesthesia or sedation may activate the dive reflex, which would include breath holding, slowing of the heart rate, and the pooling of blood from peripheral vessels. The typical induction time for most chemical restraint agents is 10-20 minutes following intramuscular injection; as a result, darting can be dangerous because it can scare an animal into the water before the immobilization has taken affect, which can result in drowning; animals are at severe risk of drowning until completely awake (Heath et al. 1996). Miscalculation of an animal’s weight can also lead to an overdose, which can have lethal consequences (Fowler 1986). The safest injection site for projectile syringes (darts) are in the deep muscle areas of the hind limbs of terrestrial animals (Day et al. 1980); however, the blubber layer on pinnipeds can make delivery of an injectable drug into the muscle, where needed for proper absorption and distribution, very difficult. In addition, inadvertent injection of drugs into the blubber frequently results in aseptic necrosis, sometimes leading to large abscesses (Geraci and Sweeney 1986). Injections into the chest cavity or stomach region can result in puncture of the lungs or stomach, which may be lethal.

A study on the use of Telazol (a general anesthetic that provides immobility and muscle relaxation) on Steller sea lions reported that of 51 adult female sea lions immobilized with Telazol darts between 1992-1994, there were five deaths (9.8 percent) (Heath et al. 1996); two of the sea lions drowned after falling into small rainwater pools and aspirating water, two others died after experiencing a depressed respiratory rate, then bradycardia, hypoxia, apnea, and finally asystole (Heath et al. 1996), and one died during isoflurane anesthesia due to improper positioning of the isoflurane tank. In 1993, under Permit No. 771 issued to National Marine

Mammal Laboratory, a hauled out adult Steller sea lion darted with Telazol moved toward the water, rolled over into the surf and appeared unable to swim; despite an attempt to administer a respiratory stimulant and to calm the sea lion, she ultimately died. It was believed that the animal's immersion in sea water after darting may have triggered the dive response (breath holding, decreased heart rate, and reduced peripheral blood flow) and/or she may have aspirated sea water. In February 1993, under Permit No. 771 (64), a Steller sea lion pup died after it was accidentally darted with Telazol when it moved in front of the target adult animal (Merrick 1993). Another possible effect concerning the administration of Telazol is the effect on the fetus or pup, as it has been shown to cross the placental barrier (Telazol drug information sheet; CI 5129-1; Fort Dodge Animal Health, Fort Dodge, Iowa).

In order for many medications to be administered, including general anesthesia, pinnipeds must first be captured and restrained. Any procedure that requires restraint, including the administration of medications, is expected to result in additional stress related to the capture, restraint, and handling of the animal (see Section 6.2.3). This additional stress could alter an animal's reaction to medications in unpredictable ways, and could have lethal consequences. In a deworming study on Hawaiian monk seals, researchers reported that after multiple captures, individual seals became skittish and more evasive; the authors noted that repeated captures may alter seal behavior or increase their level of stress (Gobush et al. 2011). Petrauskas et al. (2008) reported that sedation does not elicit a significant stress response in California and Steller sea lions based on serum and fecal corticosteroid analysis; however, handling and restraint (without sedation) consistently resulted in a significant stress response, as indicated by elevated fecal corticosterone concentrations, serum cortisol levels, and glucocorticoid responses (Petrauskas et al. 2008). Similarly, Champagne et al. (2012) found that sedated northern elephant seals did not exhibit a cortisol response; whereas physically restrained seals (without sedation) exhibited a stress response, as indicated by increases in circulating cortisol, epinephrine, and glucose concentrations, as well as increased endogenous glucose production in weanlings (Champagne et al. 2012). Finally, Harcourt et al. (2010) found that administering a light dose of the sedative diazepam significantly ameliorated the cortisol response of handled Weddell seals without affecting testosterone levels; they concluded that mild sedation may reduce acute capture stress responses (Harcourt et al. 2010). From these studies, we conclude that sedation likely reduces the stress response of pinnipeds that must be handled for health assessment, but can result in fitness consequences and mortality if animals are not carefully monitored and in the absence of adequate safety protocols.

Hyperthermia can occur in animals under anesthesia because the blubber layer can make heat dissipation a problem, even at ambient temperatures that are comfortable for the researchers: otariids over 25 kg tend to become hyperthermic during anesthesia (Gage et al. 1993). Hypothermia can also occur in sedated animals, during anesthesia or post-recovery, as many drugs can affect thermoregulation. In hypothermia, the reduction in body temperature reduces tissue metabolism, while hyperthermia increases it. Both of these can have implications for the animal's reaction to any drugs administered, as well as any pathological conditions that may exist.

Medications that are injected may result in localized swelling and abscesses. Of forty-three wild Hawaiian monk seals injected with a deworming treatment, three seals developed minor swellings near the injection site that subsided on their own (all three seals were also noted to have previous wound histories unrelated to the study), one seal developed an abscess at the injection site and one seal displayed signs of respiratory distress (Gobush et al. 2011).

Large whales may be sedated to facilitate disentanglement by limiting evasive movements of the animal. Sedation of free-swimming cetaceans carries the risk that an excessively sedated animal could become excessively lethargic and drown (Moore et al. 2010). For this reason, very few attempts have been made at sedating cetaceans at sea. Following initial trials with beached whales, Moore et al. (2010) developed a sedation protocol for North Atlantic right whales. Two free swimming entangled whales were administered midazolam and butorphanol, first with a cantilevered pole syringe and later with darts, in increasing doses over multiple disentanglement attempts. After the third attempt to sedate one of the whales, a statistically significant increase in respiratory frequency was observed, with increased swimming speed and marked reduction of boat evasion that enabled decisive cuts to entangling gear. The whale was not re-sighted, thus the relative impact on the entangled whale's survival remains unknown. The results suggest that butorphanol and midazolam delivered ballistically, in appropriate dosages and combinations, may have merit in future free swimming entangled right whale cases until other entanglement solutions are developed (Moore et al. 2010).

Darts used to administer drugs to large whales may result in tissue damage if the needle crosses the blubber-muscle interface and remains in the animal. Results of a necropsy on a chronically entangled North Atlantic right whale that had been sedated and administered antibiotics found that the needle from one of four darts had remained embedded in the whale, with an 80º bend in the needle at the blubber-muscle interface. The bent needle was attributed to epaxial muscle movement relative to the overlying blubber, with resultant necrosis and cavitation of underlying muscle; though the whale's death was not associated with embedded needle, the authors concluded that rigid, implanted devices that span the cetacean blubber-muscle interface, where the muscle moves relative to the blubber, could have secondary health impacts (Moore et al. 2013).

The MMHSRP proposes to vaccinate ESA-listed cetaceans and pinnipeds (except Hawaiian monk seals), in captivity and in the wild. The use of vaccines would be limited to either recombinant or killed/inactivated vaccines; vaccination of ESA-listed marine mammals with live vaccines is not proposed. The body of published literature on vaccinations of marine mammals is very limited; thus we supplemented this information with literature on vaccinations of terrestrial mammals to analyze potential responses to vaccinations.

Numerous studies have reported instances of vaccine-induced disease in mammals, especially mustelids (weasel family) and procyonids (e.g., raccoons), sometimes resulting in death

(Carpenter et al. 1976 ; Durchfeld et al. 1990; Ek-Kommonen et al. 2003; McInnes et al. 1992; SutherlandSmith et al. 1997; Swenson et al. 2012). All studies that reported vaccine-induced disease and mortality that we were able to find were specific to live attenuated vaccines, which present the risk of the pathogen replicating in the host and either causing disease in the vaccinated animal, or being shed in secretions and becoming infective to other contacted animals. It is important to note that live vaccines are not proposed for use by the MMHSRP.

Vaccines are a mixture of compounds, and allergic sensitization can occur to any component, including vaccine antigens, adjuvants, excipients used in the manufacturing process (e.g., gelatin, neomycin) or a latex stopper on the vial (Erlewyn-Lajeunesse et al. 2007). Anaphylaxis, an acute hypersensitivity reaction with multi-organ system involvement that can rapidly progress to a severe life-threatening reaction, is considered a rare event following immunization (Erlewyn-Lajeunesse et al. 2007). Two cases of anaphylaxis occurred in belugas in captivity after booster vaccinations, with a killed vaccine, against the bacterium *Erysipelothrix* (Dierauf and Gulland 2001). Sweeney (1978) also reported anaphylactic reactions in animals receiving a second or later exposure to the vaccine. However, a different vaccine has been used for the last approximately 10 years to treat *Erysipelothrix* infection in captive marine mammals and we are not aware of any adverse responses to the newer vaccine; we believe the likelihood of anaphylaxis in marine mammals as a response to vaccination with killed and/or recombinant vaccines is exceedingly low (Dr. J. Lawrence Dunn, Mystic Aquarium, pers. comm. to J. Carduner, NMFS, May 8, 2015).

No adverse reactions have been reported to date following vaccination with a recombinant canarypox-vectored canine distemper vaccine in marine mammals (Steller sea lions, sea otters (Jessup et al. 2009), harbor seals (Quinley et al. 2013), and Hawaiian monk seals (NMFS 2016h). Captive harbor seals (n = 5) were vaccinated with PureVax, the recombinant canarypox-vectored canine distemper vaccine. The vaccine was evaluated for safety (by monitoring seals for local and systemic adverse effects and by testing for shedding of the canarypox vector) and efficacy (by testing for serum neutralizing antibodies). None of the seals showed signs of local or systemic adverse reactions to the vaccination. Three seals that were vaccinated once did not seroconvert, but the recombinant vaccine induced a persistent serum virus neutralizing titer in the two seals that were vaccinated twice (Quinley et al. 2013).

From 2002-2006, eight captive southern sea otters (*Enhydra lutris nereis*) at risk of exposure to potentially lethal morbilliviruses were vaccinated with a commercial recombinant poxvirus vectored canine distemper vaccine. Serum-neutralizing antibody responses were followed for several years. Results indicated that the commercial recombinant vaccine is safe, provokes a measurable serum-neutralizing antibody response, and that vaccination may provide some protection from infection for free-ranging sea otters (Jessup et al. 2009).

The only data on vaccination of pinnipeds against West Nile virus is from SeaWorld, San Antonio, where captive Hawaiian monk seals have been vaccinated with the inactivated West Nile virus vaccine “Innovator,” from Fort Dodge, following an outbreak of West Nile virus in the park and the loss of one monk seal to West Nile virus infection. The vaccinated seals sero-converted following vaccination with no adverse reactions reported (Braun and Yochem 2006).

Seals are likely to experience discomfort due to the injection, and they may experience a temporary immune response; tenderness at the injection site may occur. However, we believe more severe adverse effects are unlikely.

6.2.13 Potential Response to Auditory Brainstem Response/Auditory Evoked Potential

The MMHSRP proposed to evaluate the hearing abilities of individual animals or species using Auditory Brainstem Response (ABR) or Auditory Evoked Potential (AEP). These procedures may be conducted on stranded animals, animals in rehabilitation, or animals captured during studies. Procedures on odontocetes are generally non-invasive, but in some circumstances depending on the animal being tested, the procedure could be minimally invasive. An animal may be resting at the surface or may be physically restrained (held by researchers) during the procedure. The minimally invasive procedure entails a small needle that pierces the skin.

Any adverse response in cetaceans to ABR/AEP would be from the stress of people being close enough to perform the procedure, and not from the procedure itself; maximum sound levels presented would be lower than sound levels produced by animal whistles and echolocation clicks (frequencies used for testing range from 5-120 kHz with maximum sound pressure levels less than 160 decibels re μPa). Likewise, for pinnipeds, ABR/AEP procedures are not expected to result in stress or fitness consequences beyond the stress of capture, restraint, and handling required to perform the procedure. AEP testing has been conducted on several marine mammal species without any documented adverse effects (Castellote et al. 2014; Mooney et al. 2008; Mooney et al. 2012; Szymanski et al. 1999; Szymanski et al. 1998; Yuen et al. 2005).

Several stranded cetaceans that were tested with AEPs under the MMHRSP's previous permit; all tested animals showed no evidence of behavioral or stress responses. Of the tested animals that were subsequently released with tags, tag data showed that all of the released animals survived the stranding and AEP procedure. Short-term impacts, including inflammation and hyperemia, could result from the suction cups used to attach electrodes to the animal, and are expected to be minimal.

6.2.14 Potential Response to Euthanasia

The MMHSRP proposes to euthanize ESA-listed cetaceans and pinnipeds that are in irreversibly poor condition. The intended response of the animal from euthanasia is death as rapidly as possible with as little pain and suffering as possible. Euthanasia may be performed through the use of chemical agents, and sedation may precede the administration of euthanasia drugs. Smaller cetaceans may be euthanized by injecting barbiturates or other lethal agent into a vein of the flippers, dorsal fin, flukes, or caudal peduncle. It may also be injected directly into the heart or abdominal cavity using an in-dwelling catheter. A small cetacean may be sedated before injection occurred. Stranded marine mammals may also be euthanized by physical means, including ballistics (shooting), explosives (currently used in Australia – see (Coughran et al.

2012)), by exsanguination (Geraci and Lounsbury 2005), or other specialized euthanasia equipment such as sperm whale euthanasia devices, captive bolt, spinal lance, explosive penthrite grenades, etc. (IWC 2013). An example from the 2010 MMHSRP annual report illustrates some of the methods that may be used for euthanasia of large whales:

> In 2010, a juvenile humpback whale stranded on East Hampton Beach, Long Island, New York. The response took place from April 6-9, 2010. Several attempts were made to sedate the whale via remote darting in order to calm it before euthanasia. On April 7, 2010 the whale was given Midazolam at 0.2 milligrams/kilogram intramuscular/Butorphanol at 0.2 milligram/kilogram intramuscular. On April 8, the whale was given Butorphanol 6000 milligrams intramuscular. On April 9, 2010, the whale was euthanized using Beuthanasia-D 600 milliters IP and 320 milliters intravenous (retrobulbar plexus) after three pericranial 0.577 ballistic rounds.

Following the above use of euthanasia, the American Veterinary Medical Association guidelines for the euthanasia of animals were modified (AVMA 2013). The MMHSRP follows the 2013 American Veterinary Medical Association guidelines. The goal of euthanasia is to curtail suffering in an animal that is not expected to survive. In the worst case scenario, improper administration of chemical euthanasia agents or methods of delivery could prolong the pain and suffering of a moribund animal (NMFS 2014f). Other potential adverse responses to euthanasia include hyperexcitability or violent reactions in response to some chemical agents (NMFS 2014f). Intraperitoneal administration of a euthanasia solution may cause effects due to differential absorption, leading to the prolonged onset of action, and may cause irritation in the surrounding tissues (Greer et al. 2001).

Improper use of ballistics for euthanasia could fail to cause unconsciousness before death, resulting in increased pain and suffering. Likewise, when using explosives for euthanasia, the incorrect placement of explosive charges may fail to cause instantaneous unconsciousness and could cause tissue destruction and pain (Greer et al. 2001). During mass strandings, in which several animals are stranded on the beach together, ballistics used for euthanasia may result in stress in any surviving animals.

Exsanguination (the process of blood loss sufficient to cause death) requires expertise in anatomical knowledge of the head and cervical spine, arterial access, or the location and approaches to the heart. Improper attempts at exsanguination, insufficient supplies to perform the exsanguination procedure, or lack of effectiveness of analgesics administered prior to exsanguination could result in increased stress, prolonged pain and suffering (NMFS 2014f).

6.2.15 Potential Response to Permanent Captivity

As noted previously in Section 6.2.5, placing marine mammals in captivity may result in changes in behavior, increased stress, injury, lower reproduction, and or even death, However, animals would only be placed in captivity if they are deemed non-releasable either because they are unlikely to survive in the wild or pose a threat to the rest of the wild population (e.g., they carry a pathogen). In such circumstances, permanent captivity is considered to be the best option for the individual as any release would result in greater adverse impacts to the individual and or the species in the wild. Permanently captive animals are no longer considered part of the wild population and, as such, adverse impacts to these individuals have no effect on the wild population.

Nonetheless, they themselves may be subject to further enhancement and or baseline health research activities once they become permanently captive. Procedures conducted on permanently captive ESA-listed marine mammals would likely elicit the same responses to research procedures as those that we would expect from animals in the wild. In captivity, animals are provided husbandry and veterinary care on a daily basis, and in many cases, are trained to voluntarily participate (e.g., for weighing, measuring, ultrasound, blood sampling), which precludes the need for capture and sedation. The permit is conditioned to require that researchers halt activities if animals exhibit signs of excessive stress, pain, or suffering. The permit is also conditioned to require sedation or anesthesia if deemed necessary by the attending veterinarian to eliminate pain and discomfort. The attending veterinarian must be available for emergencies, illnesses, and for treating any health problems associated with the authorized procedures.

6.2.16 Potential Response to Import/Export of Marine Mammals and Marine Mammal Parts

We do not expect any response to the import/export of marine mammal parts and sample analysis. As such, these activities are not analyzed further in this opinion. Potential adverse effects of importing or exporting live marine mammals would be the result of capture, handling, restraint, and transport, previously discussed. Most impacts during import/export would be minor and temporary and would end once the animal reached its destination.

6.3 Mitigation to Minimize the Likelihood of Exposure

We believe the factors that are likely to minimize or mitigate the effects of the proposed action on ESA-listed marine mammals, turtles, and fishes include permit terms and conditions (as amended), research protocols, policy directives and best practices documents.

The permit includes terms and conditions that we believe will minimize the potential for adverse responses among ESA-listed species to the proposed action. Permit terms and conditions require that representatives of the MMHSRP who are authorized to perform baseline health research procedures are adequately trained. Terms and conditions also encourage coordination of research with external researchers ("piggy-backing"), which is expected to minimize the overall numbers of exposures to close approaches and research procedures among ESA-listed marine mammals, and the resulting responses among those animals. Terms and conditions also stipulate that detailed protocols for baseline health research projects must be submitted to the Permits Division for review in advance of the proposed activities, with approvals for specific research projects granted at the discretion of the Permits Division, providing additional oversight over baseline health research projects and ensuring take is not exceeded. Permit terms and conditions are non-discretionary.

Numerous research protocols describe specific procedures that are designed to minimize negative impacts of research on marine mammals. These include protocols on whether or not to attempt disentanglement of Steller sea lions, monk seal radiography safety requirements and protocol, protocol for gas sampling of marine mammals, right whale sedation protocol, and guidance for conducting biopsies on Cook Inlet beluga whales. In addition, policies and best practices documents exist that provide guidance on various procedures authorized by the permit. These include standards for cetacean and pinniped rehabilitation facilities, standards for handling release of both marine mammal and the non-marine mammal considered species, standards for rehabilitation of ESA-listed species (NMFS Policy 02-308-01), and the process for placement for non-releasable animals (NMFS Policy 02-308-02). In addition, the national template for the Stranding Agreement is a binding document between NMFS and the organizations or individuals authorized to respond to marine mammal strandings, and contains terms and conditions that ensure prevention of further harm to stranded animals. The document also makes clear that the Stranding Agreement does not authorize "intrusive research" on the part of the Agreement holder.

6.4 Exposure Analysis

In this section we attempt to quantify the likely exposures among ESA-listed species to the various stressors associated with the proposed action (described above; Section 6.1). The activities authorized by the Permits Division, for both enhancement and baseline health research, are summarized in Table 1 and Table 2, respectively. To estimate the likely exposure of ESA-listed species to the proposed activities over the duration of the permit, we analyzed previous data on MMHSRP activities that resulted in take; we then used those previous take numbers to estimate future exposures.

It should be noted that, for the purposes of this consultation, a single "take" may include numerous procedures conducted on an individual animal. For instance, efforts to disentangle large whales may entail multiple close approaches and attempts at cutting the entangling lines, as well as the attachment of floats or buoys and satellite tags, remote sedation and administration of antibiotics, as well as the attachment of implantable tags. All of these activities would be considered a single take, as they are all part of a single stress event for the individual animal. Thus, the number of takes reported by the MMHSRP over previous years of the Program would be expected to provide a good estimate of the number of individual animals that the Program interacted with, however the number of procedures performed on those animals may in fact be higher than reported take numbers.

6.4.1 Exposure of Marine Mammals to Enhancement Activities

During enhancement activities, the proposed permit would authorize the MMHSRP to expose injured, sick, entangled, or stranded marine mammals, or healthy animals that may be part of the same populations as injured, sick, entangled, or stranded marine mammals (e.g., in the case of a UME or oil spill) to the stressors associated with close approaches, aerial and vessel surveys, hazing and attractants, capture, restraint, handling, transport, holding, release, attachment of scientific instruments, marking, diagnostic imaging, sample collections, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, and disentanglement. The proposed permit would also authorize the MMHSRP to euthanize marine mammals in irreversibly poor condition (i.e., moribund as determined by a veterinarian).

Though it is not possible to precisely predict the marine mammal health emergencies that will occur over the duration of the permit that will warrant enhancement activities from the MMHSRP, we used primarily data on previous exposures of ESA-listed species to MMHSRP activities to inform our estimate of likely exposures over the duration of the permit. We identified the takes that occurred as a result of enhancement activities from July 2009 through June 2015 using the narrative versions of MMHSRP annual reports for those years, personal communication with the MMHSRP, and data on takes associated with MMHSRP activities that were provided with annual reports. These data are collected by the MMHSRP from the NMFS Regional Stranding Coordinators and co-investigators on the permit. The data include information on each interaction that occurred between the Program (or its authorized representatives, including co-investigators and Stranding Agreement holders) and ESA-listed marine mammals, including: the species, life stage, and sex of animal(s); the number of takes and number of takes per individual; the action associated with the take(s); and the location and date(s) on which takes occurred. These data are summarized in Table 62.

Prior to this opinion, enhancement activities were not clearly distinguished from baseline health research activities, and data provided by the MMHSRP in annual reports to the Permits Division for the years 2009 through 2015 did not differentiate between enhancement and baseline health research activities. Thus, before identifying previous takes that occurred as part of enhancement activities, we first had to analyze all previous takes, then categorize them as either enhancement or baseline health research takes, according to the definitions of those activities in this opinion. To do so, we used the descriptions of the activities that appeared in narrative versions of annual reports submitted by MMHSRP, in addition to annual take data submitted supplemental to those annual reports, and personal communications with the MMHSRP. We ultimately concluded that that the vast majority of MMHSRP interactions with ESA-listed marine mammals from January, 2009 through June, 2015 were enhancement activities (for information on takes that we determined were associated with baseline health research activities, see Section 6.4.2 below).

It should be noted that our ability to accurately identify previous take is limited by shortcomings in the available data. These data, collected by the MMHSRP from the NMFS Regional Stranding Coordinators and co-investigators on the permit in the form of annual reports, are then pooled into a single report that the MMHSRP submits to the Permits Division annually. Deficiencies in the annual reporting form completed by NMFS Regional Stranding Coordinators and co-investigators on the permit have resulted in data that is not entirely reliable. For instance, as described above, enhancement activities have not historically been reported separately from baseline health research activities. In addition, the form does not clarify what constitutes a "take," potentially resulting in misidentification by NMFS Regional Stranding Coordinators or co-investigators on the number of activities performed versus the number of marine mammals taken. Further limiting our ability to accurately estimate previous take, data in MMHSRP annual reports did not differentiate by DPS. Thus for species that are comprised of multiple DPSs, of which some are ESA-listed and others are not ESA-listed (e.g., ringed seal; false killer whale) we included all takes that were documented for the species. Therefore, take totals described in Table 62 may include takes of non-listed DPSs.

Based on our analysis of annual reports provided by the MMHSRP and personal communications with the MMHSRP, enhancement activities of the Program resulted in a total of approximately 794 takes of ESA-listed marine mammals from the period January 2009 through June 2015, for an annual average of 132.2 takes over that period (Table 62). Of the 794 total enhancement takes that occurred between January 2009 and June 2015, percentages of species taken were as follows: approximately 35 percent (n = 279) were humpback whales; approximately 38 percent (n = 231) were North Atlantic right whales; approximately 15 percent (n = 122) were Hawaiian monk seals; approximately four percent (n = 30) were Steller sea lions (DPS unknown); approximately 13 percent (n = 103) were Guadalupe fur seals; approximately one percent (n = 8) were sperm whales, approximately one percent (n = 8) were fin whales; approximately one percent (n = 7) were sei whales; approximately 0.2 percent (n = 4) were ringed seals (DPS unknown); approximately 0.2 percent (n = 1) were bowhead whales; and approximately 0.2 percent (n = 1) were false killer whale (DPS unknown). No takes for enhancement activities were reported for Cook Inlet beluga whales, Southern Resident killer whales, blue whales, North Pacific right whales, or bearded seals. Thus, based on historical take reported in MMHSRP annual reports (during the period January 2009 through June 2015), we would expect that enhancement activities of the MMHSRP would result in the annual take of ESA-listed marine mammals over the duration of the permit of approximately: 46 humpback whales; 38 North Atlantic right whales; 20 Hawaiian monk seals; five Steller sea lions; 17 Guadalupe fur seals; two sperm whales; one sei whale; one fin whale; and one ringed seal (see Table 62).

Since our initial exposure analysis using these data from previous MMHSRP enhancement activities, new information has become available on the likely exposure of vaquita to enhancement activities. Specifically, reinitiation of this consultation was required as it was determined that the MMHSRP is likely to import and subsequently export from Mexico in the event vaquita need veterinary care that can only be received in the U.S. or if a natural disaster such as a hurricane threatens vaquita at their facilities in Mexico. The number of vaquita that would be imported and exported is unknown at this time. Originally, CIRVA recommended at least three vaquita be captured in brought into captivity in Mexico, but with their continued decline, the most recent CIRVA report recommended the Mexican government capture as many vaquita as possible to be held in captivity in Mexico (CIRVA 2016; CIRVA 2017). While the capture team is highly unlikely to capture the entire population, it is possible. Thus, in addition to the exposure of ESA-listed marine mammals estimated above based on previous annual reports, we estimate that up to a maximum of 24 vaquita may be exposed to import and export, and associated enhancement activities (e.g., transport, restraint, handling, veterinary care, etc.) if the Mexcian government later exports the captured vaquita to the United States from Mexico to evacuate the captured vaquita from a natural disaster or other emergency. Holding of the captured vaquita in the United States would likely only be temporary, and the vaquita would be returned to Mexico.

It should be noted that, despite our estimate of future exposures to enhancement activities, due to the unpredictable nature of these activities, actual exposures among ESA-listed species to MMHSRP enhancement activities that will occur over the duration of the permit are largely unpredictable. The MMHSRP has the unique statutory responsibility to respond to marine mammal emergencies, and the nature of the strandings, entanglements, UMEs, oil spills, natural disasters, and disease outbreaks that will occur over the duration of the permit, as well as the species, sex, life stage and number of animals that will require emergency response, is impossible to predict. Thus while we use take numbers from the previous five years of the permit and those specified in recent reports for the capture of vaquita to estimate the number of takes that are *likely* to occur over the remainder of the permit, in this case we do not use that estimate to limit the number of authorized takes, because we do not want to constrain the efforts of the Program to respond to – and potentially save the lives of – ESA-listed marine mammals. This is described further in the *Risk Analysis* (Section 6.5 below).

Table 62: Takes of ESA-listed marine mammals associated with enhancement activities, from January 2009 through June 2014. Note that takes associated solely with analysis, import, export, archival, or transfer of biological samples are not included; interactions with animals that were dead upon initial contact with the animal are also not included.

Species	Jan. 2009 - Dec. 2009	Jan. 2010 - Dec. 2010	Jan. 2011 - Dec. 2011	Jan. 2012 - June 2013*	July 2013 -June 2014	July 2014- June 2015	Total takes Jan. 2009 - June 2015	Average annual takes, Jan. 2009 - June 2015*
Bowhead whale	0	0	0	0	1	0	1	0.16
False killer whale***	0	0	0	0	1	0	1	0.16
Fin whale	0	1	0	6	1	0	8	1.3
Guadalupe fur seal	5	0	0	8	11	79	103	24.0
Hawaiian monk seal	1	8	17	34	31	31	122	20.3
Humpback whale	7	52	24	103	71	22	279	44.4
North Atlantic Right Whale	17	5**	81	101	21	6	231	38.5
Ringed seal***	0	0	0	1	2	1	4	0.67
Sei whale	0	0	6	0	0	1	7	1.16
Sperm whale	0	5	1	1	1	0	8	1.33
Steller sea lion***	1	4	1	11	10	3	30	4.5
TOTAL	**31**	**75**	**130**	**265***	**150**	**143**	**794**	**132.3**

* In 2013, The MMHSRP changed its annual reporting cycle (from January – December to July – June) to coincide with the permit cycle. As a result, the MMHSRP annual report for 2012-2013 included 18 months of activity (January 2012 through June 2013). We have accounted for this in calculating the average annual takes over the period January 2009 through June 2015.

** The Florida Fish and Wildlife Commission reported "multiple" takes of a single North Atlantic right whale during a disentanglement attempt in December, 2010; we counted this as one take, thus this is probably an underestimate.

*** Annual reports did not consistently specify by DPS. For species that are comprised of both ESA-listed and non-listed DPSs, all reported takes have been included; thus total takes for those species may be overestimates.

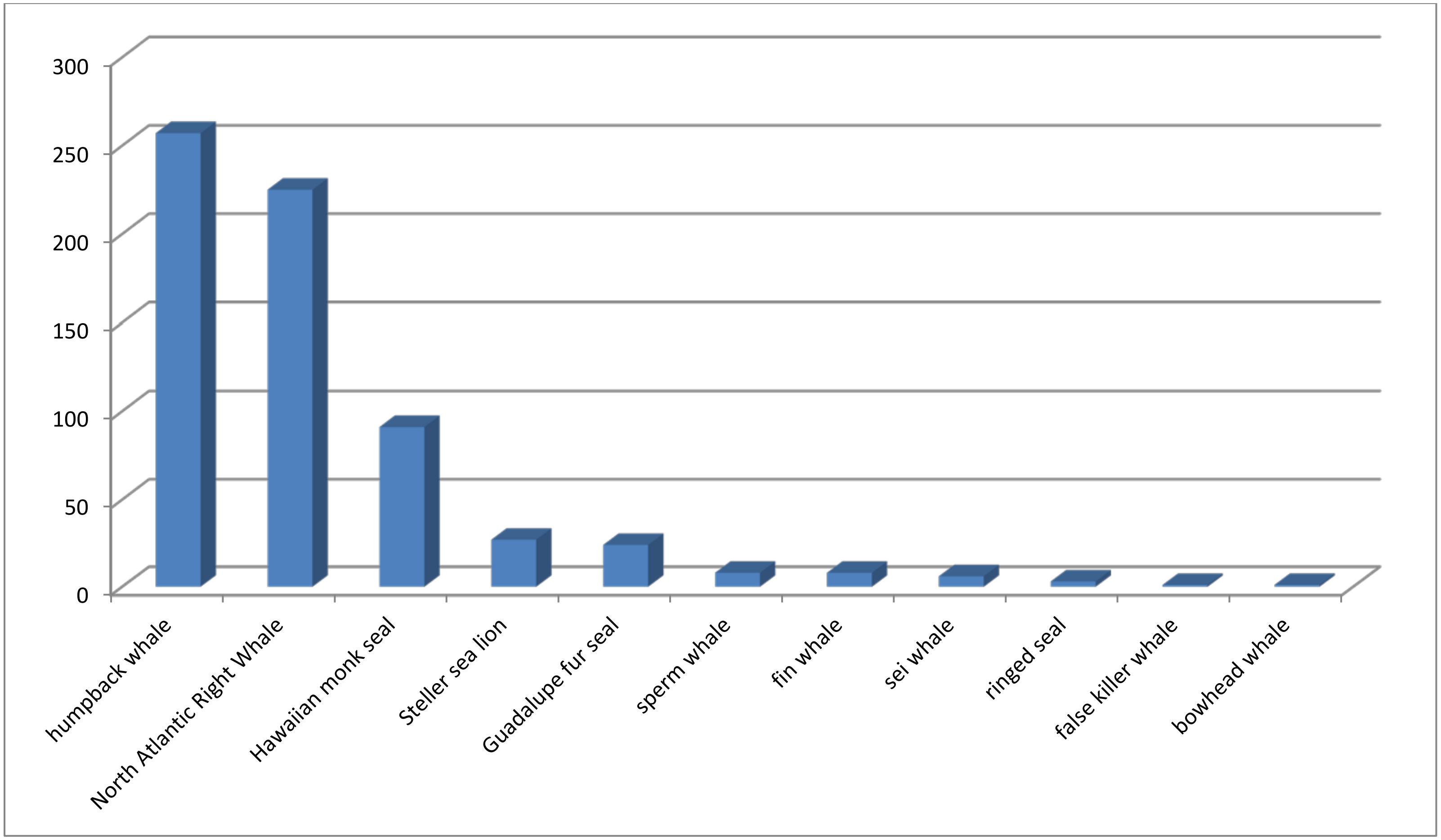

Figure 89: Takes of Endangered Species Act-listed marine mammal species associated with enhancement activities of the marine mammal health and stranding response program, January 2009 through June 2014.

6.4.2 Exposure of Marine Mammals from Baseline Health Research Activities

During baseline health research activities, the proposed permit would authorize the MMHSRP to expose "healthy" marine mammals (i.e., animals that are not stranded, entangled, injured, and do not appear in ill health) to the stressors associated with close approaches, aerial and vessel surveys, sample collection, acoustic playbacks, ABR/AEP testing, hazing and attractants, diagnostic imaging, tagging, marking, the administration of drugs, transport, capture, restraint, and handling. The proposed permit would also authorize the MMHSRP to euthanize marine mammals in irreversibly poor condition (i.e., moribund as determined by a veterinarian). A any procedures performed on sick animals would be part of enhancement and not baseline health research, euthanasia may occur in the event that research was performed on an animal that appeared healthy (baseline health research), but proved to be sick after examination.

As described above, we estimated the takes that were likely associated with baseline health research (as defined in this opinion) during the period June 2009 through June 2015, using descriptions of activities provided in annual reports submitted by the MMHSRP, in addition to annual take data submitted supplemental to those annual reports, and personal communications with the MMHSRP. We determined that for the period January 2009 through June 2015, a total of 38 individual animals from two ESA-listed species were taken, with a total of 162 takes reported (NMFS 2014a), as a result of baseline health research activities. These takes occurred during the research of two co-investigators, described below:

- From June 7, 2012, through August 6, 2012, Dr. Keith Mullin of the NMFS Southeast Fisheries Science Center (a MMHSRP co-investigator on the previous permit, No. 932-1905-01/MA-009526), collected biopsy samples and attached satellite tags to 37 sperm whales in the Gulf of Mexico as part of ongoing investigations into the effects of the Deepwater Horizon oil spill on marine animals. Dr. Mullin held an existing permit to conduct research on sperm whales (MMPA Permit No. 779-1633), but did not have authorization to attach satellite tags and lacked adequate take authorization for 37 biopsy samples under that existing permit. The MMHSRP determined that the potentially valuable information that could be gleaned from satellite tag data and from additional biopsy samples of sperm whales in the Gulf of Mexico warranted the additional take that Dr. Mullin was not authorized for under his own permit, and granted permission to Dr. Mullin for that take under the MMHSRP permit (No. 932-1905-01/MA-009526). This is an example of "piggy-backing" on other NMFS research permits. Dr. Mullin reported a total of 37 takes, as there was one "take event" that occurred for each of 37 individual sperm whales that was tagged and biopsied.
- From February, 2010, through August, 2011, Dr. Terrie Williams of the University of California at Santa Cruz (a MMHSRP co-investigator on the previous permit, No. 932-1905-01/MA-009526) performed ongoing research on a juvenile, male Hawaiian monk seal. Dr. Williams held an existing permit, but that permit did not authorize research on Hawaiian monk seals; the MMHSRP had research questions that it determined could be

addressed through research on the animal, and the MMHSRP was permitted for this type of research on Hawaiian monk seals, thus it authorized Dr. Williams to "piggy-back" the research on the MMHSRP's permit. Research included testing for: the basal metabolic rate in air and water; the resting metabolic rate in water; and the diving metabolic rate following a submerged pool swim. To limit potential adverse effects of testing, Dr. Williams' team never conducted more than one test in a single day, and limited metabolic tests to a maximum of two times per week to reduce potential stress on the seal. Dr. Williams reported that this research led to new understandings of: the basal metabolic rate of juvenile Hawaiian monk seals and the effects of molt on the basal metabolic rate (Williams et al. 2011); the thermal neutral zone of Hawaiian monk seals (presented at the Hawaiian Monk Seal Recovery Team meeting, February 2011, and at the Special Symposium on Endangered Pinnipeds at the Society of Marine Mammalogy Conference, November, 2011); and the energetic cost of stroking and diving in Hawaiian monk seals (used as a calibration for deployment of a newly developed accelerometer tag on wild monk seals in 2012). Dr. Williams reported 125 total takes, as there was one single animal but multiple "take events" over 125 days. The animal was in temporary rehabilitation and was later deemed non-releasable.

We used information on previous takes that occurred as part of baseline health research (as defined in this opinion) to estimate the number of takes that are expected to occur over the duration of the permit for baseline health research activities. As described above, a total of 38 individual animals were taken, with a total of 162 takes reported, as part of baseline health research over the 6.5 year period January 2009 through June 2015. Thus, over that period, an average of 25 takes occurred annually, with an average of six individual animals taken annually, as a result of baseline health research activities of the MMHSRP. Based on these figures, we would estimate that over the duration of the permit, the MMHSRP will take six individual animals annually, with 25 total takes occurring annually, as part of baseline health research activities.

It should be noted that our estimate of future takes associated with baseline health research is constrained by the very limited sample size that our estimate was based upon. Thus we use reported take numbers from previous permits to estimate the number of takes that are likely to occur annually over the duration of the permit (the mean) but we also consider variability between years within the reported dataset to determine the anticipated takes that may occur during an extreme year.

In addition, the opportunistic nature of baseline health research projects makes it difficult to predict the amount, and type, of take that will occur in the future. Samples may be collected for baseline health research whenever possible, and especially in conjunction with other federally authorized marine mammal projects (e.g., permitted research, bycatch, subsistence). Many of the baseline health samples collected for the MMHSRP are expected to originate from collaborations with other researchers to "piggy-back" takes. Estimating the number of annual takes that will be "piggy-backed" on these existing studies is especially difficult due to several factors, including: the inability to estimate the future funding available for other researchers' capture activities (i.e. availability of NOAA or other vessels for ice seal captures annually); changes in research partners that are permitted to take ESA-listed species depending upon the permit cycle; and changes in the tools available to collect certain remote samples (i.e. future use of UAS to collect large whale breath samples) from ESA-listed species. Because most specimens will be acquired opportunistically with other ongoing studies, the MMHSRP will have minimal control over the age, size, sex, or reproductive condition of any animals that are sampled.

Due to the unpredictable nature of the actual baseline health research takes that will occur over the duration of the permit, the takes listed in Table 2 are the maximum annual take numbers for ESA-listed species that the MMHSRP anticipates could occur for these species, based upon the funding, permitting, and advances in research tool development described above. These numbers are based on estimated numbers needed to provide statistically significant results, as well as likelihood of achieving the sampling based upon the current, existing, permitted researchers at the time of this opinion. Thus, while we estimated, based on previous takes, that an average of seven animals will be taken annually during "baseline health research," the MMHSRP has requested up to 40 takes annually of ESA-listed large whales and up to 60 takes annually of ESA-listed pinnipeds (not including Hawaiian monk seals). Though these figures are higher than the average annual take that has occurred historically under baseline health research, the example described above, in which 37 sperm whales were taken in one year (in that case, in a single research cruise), illustrates that due to interannual variability it is entirely possible that 40 takes of cetaceans could occur in one year, and none in another.

Further, if UAS are approved for remote breath sample collection within the duration, the MMHSRP could work with other permitted large whale researchers to utilize this new tool to collect breath samples from up to 40 large whales per year during other permitted research; based on the current pace of UAS technology development, and information available to this point on the responses of large whales to UAS, we believe this is a reasonable possibility and could be done within the authorized take analyzed this opinion. As another example, in summer 2015 the MMHSRP planned to "piggy-back" sample collection efforts with the National Marine Mammal Laboratory's scheduled ice seal research, which would have entailed samples from up to 70 ice seals (e.g., bearded seals, ringed seals); the trip was ultimately cancelled due to lack of funding. This example illustrates that the number of takes of pinnipeds for baseline health research could potentially approach 70 in a single research trip; therefore we believe that up to 60 takes of any ESA-listed pinniped species, as anticipated by the MMHSRP, could occur in a single year.

Thus, in any year when there was appropriate funding, availability of planned work by permitted researchers, and approval of the appropriate tools to collect baseline health samples, and taking into account the variability in take numbers between years within the reported dataset of previous baseline health research takes (e.g., the instance of 37 sperm whales taken in one year), we believe it is reasonably certain that baseline health research activities could result in up to 40 annual takes of ESA-listed cetaceans and up to 60 annual takes of ESA-listed pinnipeds. The MMHSRP and the Permits Division have carefully considered the likelihood of research occurring on all ESA-listed species and have requested authorization for take accordingly (i.e., the request for take authorization for five individual North Pacific right whales versus 40 individual humpback whales, annually).

6.4.3 Exposure of Non-target Species

As part of this consultation, we aimed to derive reasonable and defensible estimates for the number of individuals of the non-target ESA-listed species that will be subject to incidental take or effects as a result of nets deployments for capturing targeted marine mammals. Details regarding our estimation process are in the administrative record for this consultation and summarized below.

While specific incidental take numbers for non-target species have been requested by the Permits Division and the MMHSRP, we estimate take numbers using the best available data to insure that the requested take is sufficient and reasonable, and that the proposed action is not likely to exceed the authorized take. To our knowledge, the best available data comes from the MMHSRP's previous annual reports. This includes data on the number of net deployments for both baseline research and emergency response activities and previous incidents of incidental capture/entanglement of non-target, ESA-listed species for the full duration of the MMHSRP activities (2005-2015). While a single smalltooth sawfish was previously incidentally captured during turtle research permitted to another individual, the net sampling technique used there differs greatly from that proposed here by the MMHSRP and so this incident was not considered informative to this consultation.

6.4.3.1 *Incidental Capture Rates*

Historical data on net deployments from the MMHSRP were used to estimate future net deployments and likely incidental capture rates of ESA-listed animals. Data used were from 2005-2015 inclusive as the 2016 data was not available at the time of this analysis. From these data, 135 nets were deployed for baseline research activities, and 29 were deployed for emergency response, resulting in a total of 164 net deployments. These 164 deployments were further broken down in an overlap matrix according to their spatial overlap with non-target ESA-listed species' ranges, since not all net deployments were equally likely to impact the ESA-listed species (e.g. captures in Brunswick, Georgia do not overlap with the Gulf subspecies of Atlantic sturgeon). As previously noted, from 2005-2015 only two turtles (one loggerhead, one green) were incidentally encountered, both in 2015 during baseline research activities conducted in Brunswick, Georgia. One turtle was briefly encircled with the net and quickly released by lowering of the net float line. It was not handled. The other turtle was entangled by the net for a few minutes and immediately disentangled and released. There was no indication of harm or injury to the turtle. Thus, historical data from the MMHSRP indicate that turtles are captured on 1.23 percent of net deployments. However, given that we evaluate the effects to each ESA-listed species separately, we consider this a rate of 0.61 percent for loggerhead and 0.61 percent for green turtles respectively. Further, we broke down the historic data down according to the ESA-listed population or DPSs to which they most likely apply. We assume that the incidental capture rates for a given species do not differ based on population or DPS (e.g., the 0.61 percent for green turtles is assumed to apply to all green turtle DPSs). For ESA-listed species that have yet to be incidentally taken but whose ranges overlap with historic MMHSRP net deployments, the rate of incidental capture is currently zero percent. While these incidental capture rates (0.61 percent for loggerhead and green turtles, zero percent for all other considered species) represent the current incidental rates based on the best available data, they represent single point estimates with no measure of variation. As a result, we estimated the maximum expected future incidental take rates by conservatively assuming that one individual of each species will be captured on the next net deployment that overlaps with its range. Accordingly, maximum expected future incidental take rates were calculated according to the following formula:

$$ITR_{fmax} = \frac{1 + IT_h}{1 + ND_h}$$

Where ITR_{fmax} represents the maximum expected future incidental take rate, IT_h represents the number of historic incidental takes, and ND_h represents the number of historic net deployments that overlapped with the species range. Based on this calculation, all species specific estimates of the maximum expected future incidental take rates are conservative and slightly higher than that directly calculated from the historic dataset. The formula above was used the calculate ITR_{fmax} for all species except Olive ridley sea turtles and green sturgeon. For these species, no historic net deployments overlapped with their ranges so we have no way to estimate the ITR_{fmax} based on the historic data. As such, the ITR_{fmax} for olive ridley turtles and green sturgeon were conservatively assumed to be equal to the maximum ITR_{fmax} calculated for any other hardshell turtle and sturgeon species respectively. The final estimated ITR_{fmax} values for each species are as follows: green turtles (all DPSs) – 1.21 percent, hawksbill turtles – 0.61 percent, loggerhead sea turtles (all DPSs) – 1.21 percent, olive ridley turtles (all DPSs) – 1.21 percent, leatherback turtles - 0.61 percent, smalltooth sawfish – 1.92 percent, Atlantic sturgeon (all DPSs) – 1.75 percent, Gulf sturgeon – 2.13 percent, shortnose sturgeon – 2.13 percent, green sturgeon (Southern DPS) – 2.13 percent.

Future Net Deployments

Given the above ITR_{fmax} estimates, we estimated the likely number and location of future net deployments in order to estimate the number of individuals from each species likely to be incidentally taken. We use two data sources to derive the number of future net deployments, the number of requested net deployments as would be authorized by the permit (baseline research only), and an estimated number of future net deployments based on the historical data provided by the MMHSRP (baseline research and emergency response).

The number of future net deployments that are being requested and would be authorized under the permit can be seen in Table 63. From these data a total of 5,230 net deployments would be authorized. However, not all of these net deployments would overlap with the ranges of all the non-target species. Thus, the authorized net deployments were broken down by their predicted spatial location based on the ranges of the target marine mammal species, and an overlap matrix was created to determine the number of authorized net deployments that would overlap with the ranges of the various ESA-listed non-target species. It is important to note that it is only possible to conduct this overlap analysis for future baseline research activities as the nature of emergency response activities means that they may occur an unlimited number of times, on any marine mammal species, in any location with the action area. As such, the number of future authorized net deployments that overlap with each non-target species as listed in Table 64 represents a minimum value since an unlimited number of emergency response net deployments within each species range would also be authorized.

Given that historical data indicate the MMHSRP is not likely to reach its requested take limits, similar to the exposure analysis for marine mammals, we also predicted the number and location of likely future net deployments. Unlike with the requested future net deployments, we estimated the number of net deployments related to both baseline research activities and emergency response, given that historical data are available for both activities. The details regarding the derivation of these predictions can be found in the administrative record.

Incidental Take Estimates

To obtain final estimates of the annual expect future incidental take that would result from the MMHSRP's activities, we multiplied ITR_{fmax} by both the requested annual net deployments (for baseline research only) and the predicted annual net deployments (for both baseline and emergency response).

Table 64 summarizes these data, as well as other relevant annual data used in estimating these final annual incidental take numbers. Based on our analysis, we estimated the MMHSRP may take up to ten hardshell sea turtles, two leatherback turtles, three smalltooth sawfish, and three Atlantic sturgeon (all DPSs) annually. Our estimates of future incidental take for gulf and shortnose sturgeon align with the requested takes, and thus no change to these numbers was made. Further we estimated an annual incidental take of one green sturgeon (Southern DPS) as they overlap with possible future pinniped net captures on the West coast of the U.S.

Table 63. Number of net deployments to be authorized under Permit No. 18786-01.

Line No. from Take Tables (1 & 2)	Species and Listing Unit/ Stock	Take Action	No. Animals	No. Takes/ Animal	No. Possible Net Deployments
2	Dolphin, unidentified (Range-wide)	Capture/ Handle/ Release; Harass; Harass/ Sampling	200	5	1000
9	Pinniped, unidentified; Range-wide	Capture/ Handle/ Release; Harass; Harass/ Sampling	300	5	1500
25	Seal, ringed; Arctic	Capture/ Handle/ Release; Harass; Harass/ Sampling	60	5	300
26	Seal, bearded; Beringia DPS	Capture/ Handle/ Release; Harass; Harass/ Sampling	60	5	300
27	Seal, Guadalupe fur; Range-wide	Capture/ Handle/ Release; Harass; Harass/ Sampling	60	5	300
28	Sea lion, Steller; Western DPS	Capture/ Handle/ Release; Harass; Harass/ Sampling	60	5	300
29	Sea lion, Steller; Eastern DPS	Capture/ Handle/ Release; Harass; Harass/ Sampling	60	5	300
30	Seal, Northern fur; Eastern Pacific	Capture/ Handle/ Release; Harass; Harass/ Sampling	60	5	300
32	Dolphin, bottlenose; Western North Atlantic Coastal	Capture/ Handle/ Release; Harass; Harass/ Sampling	100	5	500
33	Whale, killer; non-ESA-listed	Capture/ Handle/ Release; Harass; Harass/ Sampling	10	3	30
34	Dolphin, spinner; Eastern Tropical Pacific	Capture/ Handle/ Release; Harass; Harass/ Sampling	40	5	200
35	Dolphin, pantropical spotted; North-eastern Offshore	Capture/ Handle/ Release; Harass; Harass/ Sampling	40	5	200

Table 64. Summary of data used to estimate annual incidental takes of non-target Endangered Species Act-listed species.

Listed Species	Baseline Research Net Deployments	Emergency Response Net Deployments	Incidental Take Rate	Baseline Research (Predicted)	Baseline Research (Requested)	Emergency Response (Predicted)	Incidental Take Rate	Incidental Take (Predicted)	Incidental Take (Requested)[6]	Estimated take
Green sea turtle (Central South Pacific)	0	0	--	1	1000	2	1.21%	0	12	
Green sea turtle (Central West Pacific)	0	0	--	1	1000	2	1.21%	0	12	
Green sea turtle (Central North Pacific)	0	0	--	1	2700	2	1.21%	0	33	
Green sea turtle (East Pacific)	0	0	--	1	3500	2	1.21%	0	42	
Green sea turtle (North Atlantic)	12	3	0.61%	78	3000	178	1.21%	3	36	
Hawksbill sea turtle	12	3	0.00%	78	3700	178	0.61%	2	22	10
Kemp's ridley sea turtle	12	3	0.00%	78	3000	178	0.61%	2	18	
Loggerhead sea turtle (North Pacific Ocean)	0	0	--	1	3500	2	1.21%	0	42	
Loggerhead sea turtle (Northwest Atlantic Ocean)	12	3	0.61%	78	3000	178	1.21%	3	36	
Loggerhead sea turtle (South Pacific Ocean)	0	0	--	1	1000	2	1.21%	0	12	
Olive ridley sea turtle (Mexico's Pacific coast breeding colonies)	0	0	--	1	3500	2	1.21%	0	42	
Olive ridley sea turtle (All other areas)	0	0	--	1	3500	2	1.21%	0	42	
Leatherback sea turtle	12	3	0.00%	78	4430	178	0.61%	2	27	2
Smalltooth sawfish	3	2	0.00%	16	1500	141	1.92%	3	29	3
Atlantic sturgeon (Gulf of Maine)	0	0	0.00%	1	3000	31	1.75%	1	53	
Atlantic sturgeon (New York Bight)	0	0	0.00%	1	3000	31	1.75%	1	53	3
Atlantic sturgeon (Chesapeake Bay)	0	0	--	1	3000	2	1.75%	0	53	

[6] *value represents a minimum since an unlimited number of net deployments for emergency response would be authorized in the permit.*

Listed Species	Baseline Research Net Deployments	Emergency Response Net Deployments	Incidental Take Rate	Baseline Research (Predicted)	Baseline Research (Requested)	Emergency Response (Predicted)	Incidental Take Rate	Incidental Take (Predicted)	Incidental Take (Requested)[6]	Estimated take
Atlantic sturgeon (Carolina)	0	0	--	1	3000	2	1.75%	0	53	
Atlantic sturgeon (South Atlantic)	4	1	0.00%	23	3000	37	1.75%	1	53	
Gulf sturgeon	4	0	0.00%	25	1000	31	2.00%	1	20	1
Shortnose sturgeon	4	1	0.00%	23	3000	37	2.13%	1	64	1
Green sturgeon (Southern)	0	0	--	1	3100	2	2.13%	0	66	1

6.5 Risk Analysis

In this section we assess the consequences of the responses to the individuals that have been exposed, the populations those individuals represent, and the species those populations comprise. Whereas the *Response Analysis* (Section 6.2) identified the potential responses of ESA-listed species to the proposed action, this section summarizes our analysis of the expected risk to individuals and populations, given the expected exposure to those stressors (as described in Section 6.4) and the expected responses to those stressors (as described in Section 6.2).

We measure risks to individuals of endangered or threatened species using changes in the individuals' "fitness" or the individual's growth, survival, annual reproductive success, and lifetime reproductive success. When we do not expect ESA-listed animals exposed to an action's effects to experience reductions in fitness, we would not expect the action to have adverse consequences on the viability of the populations those individuals represent or the species those populations comprise. As a result, if we conclude that ESA-listed animals are *not* likely to experience reductions in their fitness, we would conclude our assessment. If, however, we conclude that individual animals are likely to experience reductions in fitness, we would assess the consequences of those fitness reductions on the population(s) those individuals belong to.

The following discussion summarizes the probable risks the proposed action poses to threatened and endangered species that are likely to be exposed to the action. As discussed in the *Description of the Proposed Action* (Section 2) and the *Exposure Analysis* (Section 6.4), it is important to distinguish between the risks posed by enhancement activities and those posed by baseline health research activities of the MMHSRP.

6.5.1 Risk to Marine Mammals Associated with Enhancement Activities

As described in the *Exposure Analysis* (Section 6.4), based on takes that have occurred previously during enhancement activities and recent information on likely takes associated with the import/export of vaquita, we would estimate the annual take of ESA-listed marine mammals over the duration of the permit during enhancement activities to be as follows: 46 humpback whales; 38 North Atlantic right whales; 16 Hawaiian monk seals; five Steller sea lions; four Guadalupe fur seals; two sperm whales; one ringed seal; and up to 24 vaquita. We assume these cetaceans and pinnipeds may represent any age, gender, reproductive condition, or health condition. Despite the estimates above, enhancement activities are conducted in response to emergency scenarios, and as these emergency scenarios are unpredictable, actual exposures among ESA-listed species to MMHSRP enhancement activities that will occur over the duration of the permit are largely unpredictable (as described in Section 6.4).

Due to the unpredictable nature of emergency response, during enhancement activities the MMHSRP would be authorized to expose an unlimited number of ESA-listed marine mammals to close approaches, aerial and vessel surveys, hazing and attractants, capture, restraint, handling, transport, holding, release, attachment of scientific instruments, marking, diagnostic imaging, sample collections, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, disentanglement, and euthanasia.

The enhancement activities of the MMHSRP entail responses to health emergencies involving marine mammals world-wide, including responses to animals that are stranded, entangled in fishing gear or marine debris, are in ill health, or are otherwise in danger or distress. Based on the best available information, we assume that for the vast majority of animals involved in enhancement activities, those animals would either die or suffer fitness consequences that would reduce their longevity or reproductive success in the absence of the MMHSRP's response to their distress. That is, we assume that animals involved in these emergencies may experience short-term harm but long term gain as a result of the MMHSRP's intervention. They are less likely to die, or experience reductions in fitness, because of the MMHSRP's response to these emergencies than if the program did not respond. Exceptions to this assumption could potentially include accidental mortality or fitness consequences in an animal that was either not the target of a response (e.g., the death of a non-target animal as a result of a pinniped stampede), or was a member of a population that was responded to, but was healthy upon initial response (e.g., mortality of a previously healthy animal in a capture net during a UME response). Based on the best available information, including MMHSRP annual reports and communications with the MMHSRP, there have been no documented instances of death or fitness consequences among previously healthy ESA-listed animals as a result of MMHSRP enhancement activities historically (J. Taylor, MMHSRP, pers. comm. to J. Carduner, NMFS, May 12, 2015).

Based on the information above, we believe that over the duration of the permit, enhancement activities will lead to the improved condition of animals that are ill or in distress and will thus result in saved lives and increased fitness among ESA-listed marine mammal animals over the long-term, effectively adding animals to the populations of those species (versus the baseline in the absence of the MMHSRP's response, which would result in the removal of those animals from the populations). As such, we expect that MMHSRP enhancement activities will result in a net increase in the number of individual animals that compose populations of ESA-listed species.

6.5.2 Risk to Marine Mammals Associated with Baseline Health Research Activities

Unlike enhancement activities, which are carried out in direct response to emergencies that threaten the lives or fitness of ESA-listed animals, baseline health research activities are carried out proactively on "healthy" animals (that is, animals that appear healthy). Therefore, any fitness consequences or mortalities of ESA-listed animals that result from baseline health research would not necessarily have occurred in the absence of the MMHSRP's actions. It should be noted, however, that baseline health research is conducted with the goal of gathering information on marine mammal biology, health, and disease, ultimately increasing the research community's understanding of why marine mammals become ill or injured, strand, and potentially die. This research also leads to improvements in the MMHSRP's ability to respond to marine mammal emergencies and to address marine mammal health issues. While this does not minimize the short term effects of research procedures on individual animals, we believe that it does mitigate, to a certain extent, the long term effects of research activities on the populations of animals to which those individuals belong. We further expect that measures required by the Permit terms and conditions will greatly minimize the potential for stress, injuries, or mortalities associated with exposure to baseline health research activities.

As described in the *Exposure Analysis* (Section 6.4), the permit would authorize annual take, specifically for baseline health research activities of the MMHSRP, as follows: as many as 40 annual takes of beluga whales (Cook Inlet DPS), blue whales, humpback whales, fin whales, bowhead whales, North Atlantic right whales, sei whales, and sperm whales; as many as 20 takes of killer whales (Southern Resident DPS) and false killer whales (Main Hawaiian Islands insular DPS); as many as five takes of North Pacific right whales; and as many as 60 takes of Guadalupe fur seals, Steller sea lions (Western DPS), ringed seals (Arctic subspecies) and bearded seals (Beringia DPS). The permit would allow five takes per individual animal, annually, for all species except North Pacific right whale (three takes per individual, annually). Takes of Hawaiian monk seals in the wild for baseline health research is not proposed, however the permit would authorize 60 annual takes of captive Hawaiian monk seals, for baseline health research. In addition, the permit would authorize up to 5,000 annual takes in the form of behavioral harassment of ESA-listed large whales, and an unlimited number of annual takes in the form of behavioral harassment of ESA-listed small cetaceans and pinnipeds, during close approaches, aerial surveys and vessel surveys associated with baseline health research activities. The permit would authorize take in the form of mortality (unintentional or euthanasia), specifically during baseline health research activities, as follows: a maximum of five mortalities of bearded seals (Beringia DPS), five mortalities of ringed seals (Arctic subspecies), and five mortalities of Steller sea lions; one mortality of a Guadalupe fur seal; and one mortality of a Hawaiian monk seal (captive only), over the five year permit.

6.5.2.1 *Close Approach, Aerial Surveys and Vessel Surveys*

The permit would authorize up to 5,000 annual takes in the form of behavioral harassment of ESA-listed large whales, and an unlimited number of annual takes in the form of behavioral harassment of ESA-listed small cetaceans (Cook Inlet beluga whales, Southern resident killer whales, Main Hawaiian Islands insular false killer whales) and pinnipeds, during close approaches, aerial surveys and vessel surveys associated with baseline health research activities. A maximum of five annual takes per individual animal would be permitted during these activities for large whales and pinnipeds; unlimited takes per animal would be permitted for small cetaceans (as small cetaceans tend to approach boats and are characterized by large social groups, making consistent identification of individual animals difficult). An "approach" of a cetacean is defined in the Permit terms and conditions as a continuous sequence of maneuvers (episode), involving a vessel or researcher's body in the water, including drifting, directed toward a cetacean or group of cetaceans closer than 100 yards for large whales, or 50 yards for smaller cetaceans.

Based on the small sample size of previous baseline health research it is not possible to estimate the actual number of close approaches that may occur annually for any ESA-listed species. The number of takes permitted for other procedures also does not necessarily allow us to estimate takes for close approach. For instance, while the permit would authorize 40 annual takes for many procedures that require a close approach of a cetacean (e.g., tagging), numerous close approaches may be required to accomplish one procedure (attachment of a tag).

As described in the *Response Analysis* (Section 6.2.1), cetaceans are likely to display a range of responses to close approaches (including aerial and vessel surveys), ranging from no response to behavioral reactions including lunging, lifting of the head or fluke, altering swimming speed or orientation, diving, and increasing time spent submerged. Researchers have noted that different approach techniques have a major influence on a whale's response to vessels (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982). Responses are reported to range from minimal to non-existent when close vessel approaches are slow and careful, leading researchers to conclude that experienced, trained personnel approaching whales slowly would result in fewer individuals exhibiting responses that might indicate stress (Clapham and Mattila 1993; Weinrich et al. 1991).

We believe the potential for stress responses as a result of close approaches will be effectively minimized by the Permit terms and conditions, which include the following requirements:

- No individual animal may be taken more than three times in one day (with the exception of some small cetacean species which tend to approach boats and are difficult to identify to individuals).
- Researchers must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.
- Where females with calves are authorized to be taken, researchers:
    - Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions;
    - Must not position the research vessel between the mother and calf;
    - Must approach mothers and calves gradually to minimize or avoid any startle response;
    - Must not approach any mother or calf while the calf is actively nursing; and
    - Must, if possible, sample the calf first to minimize the mother's reaction when sampling mother/calf pairs.
- Any activity must be discontinued if an animal exhibits a strong adverse reaction to the activity or the vessel (e.g., breaching, tail lobbing, underwater exhalation, or disassociation from the group).
- Manned aerial surveys must be flown at an altitude of at least 750 feet for cetaceans.
- If an animal shows a response to the presence of aircraft, the aircraft must leave the vicinity and either resume searching or continue on the line-transect survey.

We further expect that researchers and responders authorized to drive vessels that closely approach whales as part of MMHSRP activities will be trained and experienced in driving boats near cetaceans. As a result, we believe that close approaches of cetaceans are likely to produce the same results as those reported by Clapham and Mattila (1993): short- to mid-term stress responses that are not expected to result in long-term behavioral changes that might result in fitness consequences for individual whales. Therefore we do not expect fitness reductions in any individual large or small cetacean as a result of close approaches, including aerial and vessel surveys.

As described in the Response Analysis (Section 6.2.1), pinnipeds are likely to display a range of short-term behavioral responses to close approaches, ranging from no response to diving (if approached in the water) or raising their heads or entering the water (if approached on land). As also described in the Response Analysis (Section 6.2.1), these short-term behavior alterations can potentially lead to fitness consequences in pinnipeds if they result in the interruption of suckling bouts, the abandonment of habitat, or the trampling of pups. However, we believe the potential for medium- or high-level stress responses which could result in fitness consequences as a result of close approaches will be minimized both by the experience level of researchers and by minimization measures required by Permit terms and conditions, which include the following:

- Researchers must exercise caution when approaching all pinnipeds, particularly mother/pup pairs
- Researchers must take reasonable steps to identify pregnant and lactating females to avoid disturbing them
- Efforts to approach … a particular pinniped must be immediately terminated if there is any evidence that the activities may be life-threatening to the animal
- Researchers must carry out activities quickly and efficiently and use biologists experienced in capture and sampling techniques to reduce disturbance of rookeries, haul-outs, and colonies

Close approaches during MMHSRP activities have not resulted in documented fitness consequences for ESA-listed pinnipeds in the past. We believe the permit conditions will ensure that responses of pinnipeds to close approaches be limited to short-term behavioral responses, which will not result in fitness consequences.

Based on the best available information, we believe that ESA-listed cetaceans and pinnipeds are likely to respond to close approach with temporary behavior changes that are not likely to result in fitness reductions, and that takes by close approach would therefore not affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.2 *Capture, Restraint, and Handling*

The permit would authorize 60 takes annually for all ESA-listed pinniped species, except Hawaiian monk seals, for baseline health research activities specific to capture, restraint, and handling; the capture, restraint, and handling of Hawaiian monk seals, and of ESA-listed cetaceans, for baseline health research is not proposed. Individuals may be captured a maximum of five times annually, to reduce the potential for stress in individual animals.

As described in the *Response Analysis* (Section 6.2.3), we believe that capture, restraint, and handling represent the greatest potential stressors among the activities proposed. Based on the best available information, we believe that the responses among ESA-listed pinnipeds to capture, restraint, and handling will include a range of stress responses, including vocalizing, biting, or trying to escape. Attempts to escape can potentially lead to injury or death. Stress responses could also lead to hyperthermia and myopathy, which can be fatal. Stress from capture, restraint, and handling may result in interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). Death may also occur as a result of accidental drowning in nets used for capture.

Several studies have shown that fitness consequences resulting from capture, restraint, and handling of pinnipeds are uncommon. A six year study on the effects of researcher presence, branding and handling of Steller sea lions on Alaska's Marmot and Ugamak Islands found that, despite the relatively high level of disturbance (most or all adults and juveniles displaced from the beach, many pups handled and separated from mothers), there were apparently only temporary behavioral changes and only one significant modification to on-land abundance. Over six years of monitoring, adult female and dependent pup abundance was not significantly affected, and there were no differences in the trends in pup production at disturbed versus undisturbed rookeries (Wilson et al. 2012). Baker and Johanos (2002) compared the survival and condition of handled Hawaiian monk seals (n = 549) and non-handled "control" seals (n = 549) of the same age, sex, and location, concluding there were no significant differences in survival (i.e., resighting rates of 80-100 percent) and body condition between handled seals and control animals, and no observable deleterious effects as a result of research handling. Similarly, Henderson and Johanos (1988) determined that capture, brief restraint without sedation, and flipper tagging had no observable effect on subsequent behavior of weaned Hawaiian monk seal pups.

While the best available information suggests that the majority of capture, restraint, and handling procedures do not lead to fitness consequences, these activities nonetheless carry the small risk of injury or death for captured and restrained animals. Between 1982-1999, there were five recorded mortalities among 4,800 events of handling Hawaiian monk seals (0.1 percent mortality rate) (Baker and Johanos 2002). Between 1999-2013, two Hawaiian monk seals died as a result of capture and/or restraint: one seal died while under restraint and sedation as a result of a heart abnormality; another seal suffered a fatal head injury when it hit a rock while rearing up defensively upon approach (NMFS 2014b). In 2013, a ringed seal drowned when a capture net was entangled in an ice floe and researchers did not realize the seal was in the net until it was hauled in 20-30 minutes after deployment (NMFS 2014c). During five years of Steller sea lion research, from 2010-2014, 14 mortalities were recorded during the capture and handling of 1,200 animals under Permit No. 358-1564. These examples highlight the risks that are inherent in activities that require the capture, handling, and restraint of wild pinnipeds.

We believe minimization measures required by the permit terms and conditions and the 2009 PEIS on the MMHSRP (NMFS 2009b) will minimize the likelihood of fitness consequences as a result of capture, handling, and restraint. These measures include the following:

- Researchers must carry out activities quickly and efficiently and use biologists experienced in capture and sampling techniques to reduce disturbance of rookeries, haul-outs, and colonies, and to minimize handling/restraint time.
- Researchers must capture and handle pinnipeds in groups small enough that individual animals can be adequately monitored.
- Efforts to approach and handle a particular pinniped must be immediately terminated if there is any evidence that the activities may be life-threatening to the animal.
- Researchers must immediately cease research-related procedures if a pinniped is showing signs of acute or protracted alarm reaction (e.g., overexertion, constant muscle tensions, abnormal respiration or heart rate) that may lead to serious injury, capture myopathy, other disease conditions, or death; and monitor or treat the animal as determined appropriate by the principal investigator, co-investigator, or attending veterinarian.
- Researchers must ensure that pinnipeds that have been captured or are recovering from immobilizing drugs have an opportunity to recover without undue risk of drowning or injury from other animals.
- Researchers must exercise caution when approaching all pinnipeds, particularly mother/pup pairs. Researchers must take reasonable steps to identify pregnant and lactating females to avoid disturbing them.
- In addition, for non-target protected species in the study area:
    - Researchers must make every effort to prevent interactions with non-target protected species.
    - For in-water captures, netting must not be initiated when non-target marine mammals or sea turtles are observed within the vicinity of the research.
    - Should a non-target protected species become captured in a net, researchers must free the animal as soon as possible without endangering target animals in the net.

In addition to the above terms and conditions, the MMHSRP stated in the permit application that a marine mammal veterinarian or other qualified personnel would monitor the physiologic state of each animal during the restraint process (e.g., by monitoring respiratory rate and character, heart rate, body temperature, and behavioral response to handling and sampling procedures). Animals that are physically restrained but continue to struggle or show signs of stress would either be sedated or be released immediately to minimize the risk that continued stress would lead to capture myopathy (NMFS 2014f).

We believe the minimization measures described above will greatly reduce the likelihood that fitness consequences or mortalities will occur as a result of capture, restraint, and handling.

However, as described above, while mortalities as a result of capture, restraint, and handling are uncommon, these activities inevitably carry some risk of injury and mortality, we believe it is reasonably certain that the MMHSRP will conduct more baseline research in the duration of the permit than has been conducted previously, thus more pinniped captures for baseline health research are expected to occur over the duration of the permit than has occurred historically. As such, the Permits Division proposes to authorize up to sixteen mortalities of ESA-listed pinnipeds over the duration of the permit, as follows:

- A maximum of one individual Guadalupe fur seal may be killed over the five year permit
- A maximum of five Steller sea lions (Western DPS), five ringed seals (Arctic subspecies), and five bearded seals (Beringia DPS) may be killed over the five year permit

These mortalities, if they occurred, would be unintentional. They may also result from euthanasia, in the rare event that an animal that appeared healthy upon capture is deemed moribund (baseline health research is not authorized on animals that are obviously unhealthy or otherwise compromised).

The total number of mortalities would not exceed one individual for Guadalupe fur seals, thus we consider the impact to the species from the loss of one individual over five years. The death of one individual animal would represent a loss of less than 0.02 percent of the estimated total Guadalupe fur seal population (N = 7,348; (Gallo-Reynoso 1994a)). The population of Guadalupe fur seals is increasing exponentially at an average annual growth rate of 13.7 percent (Gallo-Reynoso 1994a); at this rate of growth, the population should double every five years. The species is also expanding its breeding range (one of three recovery criteria), further suggesting the population is increasingly resilient. Based on the best available information on the status and trend of the Guadalupe fur seal population, we believe the mortality of one individual over five years, that may occur as a result of capture, handling, and restraint, would have a minimal impact on the Guadalupe fur seal population and is not likely to reduce the viability of the Guadalupe fur seal population or the species as a whole.

The total number of mortalities would not exceed five individuals for Western DPS Steller sea lions, thus we consider the impact to the species from the loss of five individuals over five years. The status review estimated the population of Western DPS Steller sea lions to be 79,300, including animals in both the U.S. and Russia (Allen and Angliss 2013d). Based on an estimated population of 79,300, the death of five individual animals would represent a loss of less than 0.007 percent of the estimated total population. Annual anthropogenic mortality of Western DPS Steller sea lions is estimated at approximately 230 individual animals (based on an estimated average of 30.4 annual fishery-related mortalities, 199 subsistence hunt-related mortalities, and 0.4 other mortalities) (Allen and Angliss 2013d); thus a loss of an average of one individual animal per year (maximum five mortalities over the five year permit) would represent an increase in annual anthropogenic mortality of less than 0.5 percent. Based on the best available information on the status of the Western DPS Steller sea lion population, as well as the species' resilience to anthropogenic mortality, we believe the mortalities of five individuals over five years that may occur as a result of capture, handling, and restraint would have a minimal impact on the Western DPS Steller sea lion population and is not likely to reduce the viability of the Western DPS Steller sea lion population or the species as a whole.

The total number of mortalities would not exceed five individuals for ringed seals (Arctic subspecies), thus we consider the impact to the subspecies from the loss of five individuals over five years. The 2013 status review estimated the population of the Arctic subspecies of ringed seals in Alaskan waters to be at least 300,000 individuals (this is considered a minimum population estimate and is likely an underestimate of the actual abundance) (Allen and Angliss 2013c); the population trend is unknown (Allen and Angliss 2013c). Using the population estimate of 300,000, the death of five individual animals would represent a loss of less than 0.002 percent of the estimated total population. Annual anthropogenic mortality of the Arctic subspecies of ringed seals is estimated at approximately 9,570 individual animals (based on an estimated 9,567 annual subsistence hunt-related mortalities and 3.52 average annual fisheries-related mortalities) (Allen and Angliss 2013c); thus a loss of an average of one individual animal per year (maximum five mortalities over the five year permit) would represent an increase in annual anthropogenic mortality of 0.001 percent. Based on the best available information on the status of the Arctic subspecies ringed seal population, as well as the species' resilience to anthropogenic mortality, we believe the mortalities of five individuals over five years that may occur as a result of capture, handling, and restraint would have a minimal impact on the Arctic subspecies ringed seal population and is not likely to reduce the viability of the Arctic subspecies ringed seal population or the species as a whole.

The total number of mortalities would not exceed five individuals for Beringia DPS bearded seals, thus we consider the impact to the species from the loss of five individuals over five years. The best estimate of the abundance of Beringia DPS bearded seals is 155,000 individuals (Cameron et al. 2010). Thus the death of five individual animals would represent a loss of less than 0.004 percent of the estimated total population, suggesting the unintentional mortalities that may result from the proposed action would have a minimal impact on the population. The best estimate of annual anthropogenic mortality of the DPS is approximately 6,790 animals (based on an estimated 1.8 annual fisheries-related mortalities and 6,788 subsistence hunt-related mortalities)(Allen and Angliss 2013b); thus a loss of an average of one individual animal per year (maximum five mortalities over the five year permit) would represent an increase in the annual anthropogenic mortality rate of 0.01 percent. Based on the best available information on the status of the Beringia DPS bearded seal population, as well as the species' resilience to anthropogenic mortality, we believe the additional mortalities of five individuals over five years that may occur as a result of capture, handling, and restraint would have a minimal impact on the Beringia DPS bearded seal population and is not likely to reduce the viability of the Beringia DPS bearded seal population or the species as a whole.

In summary, we believe capture, restraint, and handling of pinnipeds by the MMHSRP may result in stress responses, hyperthermia, myopathy, injury, and, in rare cases, mortality. Based on the best available information, we expect that in the vast majority of cases, behavioral and stress responses will represent the extent of responses; these responses may temporarily interfere with essential functions such as breeding, feeding, and sheltering, however any interference is expected to be temporary, thus we do not expect fitness consequences in the majority of animals that are captured, restrained, and handled. However, due to the risks inherent in capture, restraint, and handling of wild pinnipeds, mortality as a result of these procedures is a remote possibility; as such, the Permits Division proposes to authorize up to 16 mortalities over the five year permit, as described above. Thus capture, restraint, and handling may affect the numbers of Guadalupe fur seals, Western DPS Steller sea lions, Arctic subspecies ringed seals, or Beringia DPS bearded seals. We believe the potential mortalities of up to one Guadalupe fur seal, and of as many as five individual Steller sea lions (Western DPS), ringed seals (Arctic subspecies) or bearded seals (Beringia DPS), are not likely to reduce the viability of these respective populations, or the species as a whole.

6.5.2.3 *Transport*

The permit would authorize 60 takes annually for all ESA-listed pinniped species, except Hawaiian monk seals, for baseline health research activities specific to transport. Transport of cetaceans for baseline health research is not proposed.

As described in the *Response Analysis* (Section 6.2.4), transportation of marine mammals can result in stress, as well as numerous conditions that have the potential to result in fitness consequences: hyperthermia or hypothermia, the drying of body surfaces, abrasions, muscle damage, inhalation of fumes, pressure necrosis, muscular stiffness, and respiratory problems. However, we believe the transport of ESA-listed animals as part of baseline health research will occur only occasionally, and when it does occur, it would be to transport animals only small distances and only to improve their welfare (e.g., to move a pinniped from an area where they were captured to a safer location on the same beach for release). Further minimizing the potential risks of stress and physiological harm, any transportation of marine mammals must abide by the Animal and Plant Health Inspection Service's "Specifications for the Humane Handling, Care, Treatment, and Transportation of Marine Mammals" (9 CFR Ch. 1, 3.112).

Based on the best available information, we believe that ESA-listed cetaceans and pinnipeds are likely to respond to transport with temporary behavior changes that are not likely to result in fitness reductions, and that transport during baseline health research activities would therefore not affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.4 *Attachment of Tags and Scientific Instruments*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main Hawaiian Islands insular false killer whales (20 annual takes), Southern Resident killer whales

(20 takes) and North Pacific right whales (5 takes), for baseline health research activities specific to the attachment of tags and scientific instruments.

As described in the *Response Analysis* (Section 6.2.7) the attachment of tags and scientific instruments can potentially result in a range of responses, from no response to subtle, short-term behavioral responses to long-term changes that have the potential to affect survival and reproduction. Implantable tags (e.g. satellite tags) can cause wounds, bruising, swelling, and hydrodynamic drag, while internally placed devices (e.g., PIT tags, LHX tags) may cause blockage, be rejected from the animal's body, or cause tissue reactions and infection. Responses may be compounded by the stress of close vessel approach (for cetaceans) or capture, restraint, and handling (for pinnipeds) required to attach the tag or scientific instrument.

Flipper tagging and instrumentation of pinnipeds is not expected to affect behavior or result in injuries or fitness consequences. In a study assessing short-term effects of flipper tagging (and capture and restraint) of weaned Hawaiian monk seal pups, behavior and survival among tagged pups (n = 13) was compared to a control group of untagged pups (n = 13); results showed no difference between the two groups in short term survival as well as days seen ashore, numbers and lengths of trips from the island, and 14 other behavioral categories; no mortality was attributable to tagging (Henderson and Johanos 1988). Baker and Johanos (2002) compared flipper tagged Hawaiian monk seals (n = 437) with non-tagged seals (n = 437) and reported no significant differences in resighting rates, rates of returns to the same subpopulations, and health or condition (emaciation, shark inflicted wounds, etc.). In the same study, Hawaiian monk seals that had instruments attached to their dorsal pelage using epoxy glue (n = 93) were compared with seals that did not have instrumentation attached (n = 93); instruments included time-depth recorders, satellite-linked time-depth recorders, video recorders (Crittercam), and GPS data loggers. As with flipper tagging, results indicated no significant differences in resighting rates, rates of return to the same subpopulations, and the seals' health or condition (Baker and Johanos 2002). A review of peer-reviewed articles addressing the effects of marking and tagging between 1980-2011 (Walker et al. 2012) found that none of the reviewed studies assessing visual tag (e.g., roto tag) attachment found visual tags affect survival (Baker and Johanos 2002; Hastings et al. 2009; Henderson and Johanos 1988). While visual tags can cause tissue damage at the site of tag attachment (Irvine et al. 1992) and tissue damage may result if tags are torn out (Henderson and Johanos 1988), any injuries are expected to be minor and short-term, with full healing expected to occur within days of any injuries (Paterson et al. 2011). Though epoxy glue has the potential to cause thermal burns or react with the skin, such effects have not been documented in its use in tag or instrument attachment on pinnipeds (Walker et al. 2012).

The extensive re-sighting history of North Atlantic right whales suggests survival rates of tagged versus untagged individuals is not discernibly different (Mate et al. 2007). A review of peer-reviewed articles published over a 31 year period (1980-2011) addressing the effects of marking and tagging found that none of the reviewed studies that assessed visual tag (e.g., roto tag) attachment found that visual tags affect survival (Walker et al. 2012). Several studies have demonstrated that PIT tags have no adverse effect on growth, survival, or reproductive success, (Brännäs et al. 1994; Clugston 1996; Elbin and Burger 1994; Hockersmith et al. 2003; Jemison et al. 1995; Keck 1994; Skalski et al. 1998). Studies that have monitored satellite tagged whales over several years have reported swelling (sometimes lasting several years), but no fitness consequences or mortalities as a result of those tags has been documented (Gendron et al. 2014; Robbins et al. 2013). No significant difference in survival was detected among LIMPET tagged versus non-tagged false killer whales and short-finned pilot whales in Hawaiian waters (Baird et al. 2013).

We believe minimization measures required by the Permit terms and conditions and the 2009 PEIS on the MMHSRP (NMFS 2009b) will further minimize the potential for fitness consequences as a result of tagging and scientific instrument attachment. These measures include the following:

- Only highly experienced and well-trained personnel may perform intrusive procedures;
- In no instance will researchers attempt to tag a cetacean anywhere forward of the pectoral flipper
- No tagging can occur on large cetacean calves less than six months of age or females accompanying such calves; for small cetaceans, no tagging can occur for calves less than one year of age.
- Pinniped flipper tags would be placed appropriately, so animals would not walk on or be irritated by them.
- Attachment of scientific instruments to cetaceans would include the use of stoppers to reduce the force of impact and limit the depth of penetration of the tips of subdermal tags.
- Arrow tips would be disinfected between and prior to each use, to minimize the risk of infection and cross-contamination.
- Suction cup mounted tags would be placed behind a cetacean’s blowhole so that there is no risk of any migration of the suction cup resulting in obstruction of the blowhole.
- The tag and/or instrument size and weight would be kept to the minimum needed to collect the desired data to minimize the potential for increased energetic costs of or behavioral responses to larger tags.
- Tag attachment methods would be minimally invasive, to minimize potential pain or infection.
- Tag placement would be selected so that it will not interfere significantly with an animal’s ability to forage or conduct other vital functions.
- All tagged animals should receive follow-up monitoring, including visual observations where feasible, to evaluate any potential effects from tagging activities.

No fitness consequences have been previously documented as a result of MMHSRP tagging and attachment of scientific instruments, either during enhancement or research activities. The current trend in the development of tag technology leads us to believe that smaller, less invasive tags will continue to be developed and adopted for use over the duration of the permit (Dr. M.

Moore, Woods Hole Oceanographic Institution, pers. comm., to J. Carduner, NMFS, March 25, 2015); We anticipate that these improvements will further minimize the potential physiological effects of tagging over the duration of the permit.

Based on the best available information, we believe the attachment of tags and scientific instruments by the MMHSRP may result in short term stress responses, acute pain, and temporary low- to mid-level behavioral responses. Based on the best available information, we believe these responses are likely to be temporary and are not expected to result in fitness consequences (Baird et al. 2013; Baker and Johanos 2002; Eskesen et al. 2009; Mate et al. 2007; Walker et al. 2012). Minimization measures described above would further reduce the risk of fitness consequences occurring. Therefore we believe takes as a result of the attachment of tags and scientific instruments will not affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.5 *Marking*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main Hawaiian Islands insular false killer whales (20 annual takes), Southern Resident killer whales (20 takes) and North Pacific right whales (five takes), for baseline health research activities specific to marking.

As described in the *Response Analysis* (Section 6.2.8), marking procedures, including notching and branding, may result in a range of responses in both cetaceans and pinnipeds, from no response to acute pain for several hours to weeks (in the case of branding) and behavioral changes as a result of pain. In the case of pinnipeds, we believe that the capture and restraint necessary to perform a marking procedure would be the greatest potential stressor associated with marking. No capture of cetaceans is proposed for baseline health research. Freeze branding of cetaceans is not proposed for baseline health research, and thus would only occur under enhancement scenarios.

Several marking methods for pinnipeds, such as paint, bleach, grease pen, crayon, zinc oxide and dye, are not expected to result in responses beyond those that would be expected from capture, restraint, and handling. Researchers have applied thousands of bleach markings on monk seals and have observed no negative effects other than the occasional minor disturbance (NMFS 2013d). Most individuals are approached while sleeping and do not awaken during the process. More invasive marking techniques, such as notching and branding, may result in acute pain (lasting from hours to weeks). Some marking procedures (such as notching and branding) may also result in minor infections; however, based on the best available information, these infections are not expected to result in fitness consequences. Branding may induce short-term immune responses and may cause short-term behavior changes, but does not appear to result in any lasting physiological effects or increased mortality (Aurioles and Sinsel 1988; Di Poi et al. 2009; Hastings et al. 2009; Mellish et al. 2007a).

Hot branding is not proposed for baseline health research and thus would only occur during enhancement activities and only in situations where cold branding is deemed impractical. Therefore, we expect that if hot branding were performed, it would be used to facilitate the identification of individual animals in response to a situation where those animals were in some type of danger. For instance, branding allows for long-term tracking of pinnipeds entangled in marine debris or otherwise injured, facilitating efforts to determine effects of such events upon survival. In the case of an oil spill, branding can inform hazing efforts by providing information on individual animal movements relative to the spill location. As such, we believe that while hot branding may result in stress and acute pain, these responses will be temporary and will be offset by the long-term benefits of facilitating the identification of individual animals and the removal of those animals from harmful situations that could otherwise result in fitness consequences or death. Thus we believe hot branding will ultimately have a net positive effect on individuals, the populations to which those individuals belong, and the species comprised by those populations.

Permit terms and conditions will further minimize the potential for stress that may otherwise result from marking: to minimize potential effects on pups, branding cannot occur on pinnipeds below a certain size (minimum size for branding depends on species); efforts to handle a particular pinniped must be immediately terminated if there is any evidence that the activities may be life-threatening to the animal, and researchers must immediately cease research-related procedures if a pinniped is showing signs of acute or protracted alarm reaction (e.g., overexertion, constant muscle tensions, abnormal respiration or heart rate) that may lead to serious injury, capture myopathy, other disease conditions, or death. Likewise, if an animal exhibits a strong adverse reaction to the activity of a vessel (e.g., breaching, tail lobbing, underwater exhalation, or disassociation from the group), research activity must be discontinued. To the maximum extent practical, without causing further disturbance of pinnipeds, researchers must monitor study sites following any disturbance, including branding, to determine if any injury or mortality has occurred, or if any pups have been abandoned. Any observed serious injury to or death of a pinniped, or observed abandonment of a dependent pinniped pup, must be reported as indicated above.

Though marking may result in short term stress to the individual animal, all marking methods, including branding, reduce potential long-term adverse effects in marked animals as they aid in detection of an individual animal's identity from a greater distance than would be possible with tags alone, thereby reducing the necessary approach distance and consequently the chance of disturbance and the stress responses that result from disturbance.

Based on the best available information, we believe that ESA-listed cetaceans and pinnipeds are likely to respond to marking with temporary behavior changes as a result of pain from the procedure (in the case of branding), in addition to any behavior change that may result from the capture, restraint, and handling required to perform the procedure (in the case of pinnipeds only). In the most extreme cases, behavior changes may result in temporary alterations to essential functions such as breeding, feeding, sheltering; however the best available information suggests any changes to these functions will be short term (hours to days) and will not result in fitness consequences (Fomin et al. 2011). Therefore, we do not believe takes that occur as a result of marking will affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.6 *Diagnostic Imaging*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main Hawaiian Islands insular false killer whales (20 annual takes), Southern Resident killer whales (20 takes) and North Pacific right whales (5 takes), for baseline health research activities specific to diagnostic imaging.

As described in the *Response Analysis* (Section 6.2.10) we do not expect diagnostic imaging to result in any response beyond that which would be expected from either the close approach (in the case of cetaceans) or the capture, handling, and restraint (in the case of pinnipeds) required to perform the procedure. No fitness consequences have been reported in ESA-listed animals as a result of diagnostic imaging. We expect that minimization measures will further reduce the risks of fitness consequences as a result of diagnostic imaging: only qualified veterinarians or other personnel with sufficient experience in the technique will be allowed to perform the procedures; animals will be monitored for hyper- and hypothermia, and appropriate measures will be taken to mitigate either condition; cetaceans that react negatively to the dental radiographic plate will be discontinued if the plate is not tolerated after three attempts; and other radiographic procedures will be discontinued if animals exhibit excessive stress, pain, or suffering during the procedure (NMFS 2014f).

Based on the best available information, we do not believe diagnostic imaging will result in any behavior change among ESA-listed cetaceans and pinnipeds, and we do not believe diagnostic imaging will result in fitness reductions in any individual ESA-listed animal. Thus we do not believe diagnostic imaging will affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.7 *Sample Collection*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main Hawaiian Islands insular false killer whales (20 annual takes), Southern Resident killer whales (20 takes) and North Pacific right whales (5 takes), for baseline health research activities specific to sample collection.

As described in the *Response Analysis* (Section 6.2.11), potential responses among cetaceans and pinnipeds to sample collection are expected to range from no reaction to discomfort, stress, pain (in the case of tooth extraction), damage to a vein or an abscess (in the case of blood sampling), mounting of an immune response, and temporary behavior changes. We expect the greatest potential risks associated with most types of sampling of pinnipeds (e.g., blood, sperm, milk, vibrissae sampling, and tooth extraction) to result from the stressors related to capture, handling, and restraint (described above, Section 6.2.3). The sampling of cetaceans would be conducted by boat which would require close approach by vessel; we expect that the responses to sampling would be similar to those expected in response to close approach. Infection at the point of penetration is also possible.

Pinnipeds are likely to experience pain and may mount an immune response as a result of blood sampling, vibrissae sampling, tooth extraction, and biopsy sampling. The insertion of a needle to draw blood is likely to cause pain and discomfort; however, it is not expected to cause injury or infection, as the entry point is minuscule and new needles are used for each pinniped. The amount of blood collected (90-125 milliters) is minor in relation to the size of the animal. Blood removal may cause increased blood cell production, resulting in a metabolic cost. In studies done on human hospital patients, phlebotomy is associated with a decrease in hemoglobin and hematocrit, and can contribute to anemia (Thavendiranathan et al. 2005). Such responses, however, are expected to be temporary and minor. Blubber and muscle biopsies, like the blood draw, are invasive procedures. McCafferty et al. (2007) observed regions of elevated temperature at the sites of needle injection and biopsy, as a result of disruption of the fur layer, penetration of the blubber layer, or changes in peripheral circulation associated with an immune response. The hot spots around the injection and biopsy sites were not permanent and could not be detected at the following measurement period (McCafferty et al. 2007). Biopsy sampling has been performed on a number of different pinniped species with no serious injuries or fitness consequences reported (Baker and Johanos 2002; Henderson and Johanos 1988; Kanatous et al. 1999; Ponganis et al. 1993). To consider the fitness consequences of biopsy sampling, two studies were performed on Hawaiian monk seals. Baker and Johanos (2002) compared the survival, migration, and condition of 437 seals during the year after sampling to an equal number of matched controls; they found no differences in survival, migration, or condition between the sampled and control groups (Henderson and Johanos 1988). We are not aware of any injury or infection as a result of blood or biopsy collection, and we do not expect the reduction of fitness in any pinnipeds as a result of these procedures.

The removal of all whiskers (vibrissae) has been demonstrated to temporarily impair seals' ability to capture fish (Renouf 1979); however researchers would only remove one whisker per animal, reducing the potential for adverse effects to feeding. Pinnipeds shed their whiskers periodically; they also damage or lose whiskers during normal foraging activities (Hirons et al. 2001). These losses do not appear to affect their ability to forage, survive, or reproduce. Therefore, it is unlikely that the pulling of one whisker would affect a pinniped's ability to forage, survive, or reproduce.

Numerous studies have reported the outcomes of biopsy sampling on cetaceans, with the vast majority reporting mild behavioral reactions as the only response (Barrett-Lennard et al. 1996; Brown et al. 1994; Weinrich et al. 1991; Weinrich et al. 1992; Weller et al. 1997; Whitehead et al. 1990). We were able to find just one instance of fitness consequences or mortality as a result of biopsy sampling (Bearzi 2000). No long-term adverse responses or fitness consequences have resulted from biopsy sampling performed by the MMHSRP historically. Based on the best available information, we expect biopsy sampling of cetaceans to result in low-level behavioral responses; we do not expect biopsy sampling will result in injury or fitness consequences.

We believe the limited potential for fitness consequences as a result of biological sampling will be further minimized by Permit terms and conditions and mitigation measures described in the 2009 PEIS (NMFS 2009b). These terms and conditions and measures include the following:

- Only highly experienced and well-trained personnel may perform intrusive procedures (including but not limited to biopsy and blood sampling)
- A veterinarian or their designee must be present if animals will be sedated or anesthetized
- Biological samples must be collected from live animals in a humane manner (i.e., that which involves the least possible degree of pain and suffering)
- Sterile, disposable needles, biopsy punches, etc. must be used to the maximum extent possible (sterile or sterile disposable needles must always be used for blood sampling and injections of drugs or other approved substances)
- When disposables are not available, all instruments (e.g., biopsy tips) must be cleaned and disinfected using non-toxic and non-irritating disinfectants between and prior to each use
- Researchers may only biopsy sample small cetacean calves one year or older and females accompanied by these calves; and large cetacean calves six months of age or older, and females accompanied by these calves
- Before attempting to sample an individual, researchers must take reasonable measures (e.g., compare photo-identifications) to avoid repeated sampling of any individual
- The volume of blood taken from individual animals at one time would not exceed more than one percent of its body weight, depending on taxa (Dein et al. 2005)
- Qualified researchers should not need to exceed three attempts (needle insertions) per animal when collecting blood
- If an animal cannot be adequately immobilized for blood sampling, efforts to collect blood would be discontinued to avoid the possibility of serious injury or mortality from stress

In summary, based on the best available information, we believe that ESA-listed cetaceans and pinnipeds are likely to respond to sample collection and analysis with pain and temporary, low-level behavior changes, but that these activities will not result in fitness reductions; therefore we do not believe that takes as a result of sample collection and analysis will affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.8 *Administration of Medications: Antibiotics*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main Hawaiian Islands insular false killer whales (20 annual takes), Southern resident killer whales

(20 takes) and North Pacific right whales (five takes), for baseline health research activities specific to the administration of medications.

As described in the *Response Analysis*, the potential responses among cetaceans and pinnipeds to the administration of medications could range from no response to stress, pain, swelling, hyperthermia, infection, injury, and mortality. As with other procedures that require close approach or restraint, we believe the close vessel approach necessary to administer medications to cetaceans, and the capture, handling, and restraint required to administer medications to pinnipeds, will result in stress responses (as described above, Sections 6.2.1 and 6.2.3).

While temporary responses such as stress, swelling at the site of injections, and pain may be unavoidable, we believe minimization measures will ensure that ESA-listed cetaceans and pinnipeds do not suffer fitness consequences as a result of medication. The potential for infection will be effectively minimized through the use of disposable or sterilized tools and local antibiotics. The potential for injury will be minimized through the optimization of procedures, the training of staff, and sedation of the animal to minimize stress. Medications would be administered by trained personnel, typically by or under the direct supervision of a marine mammal veterinarian or veterinary technician. Animals would be closely monitored for negative reactions, and the attending veterinarian or other personnel would be able to intervene if needed.

Antibiotic administration may occur under baseline health research when an animal that was thought to be healthy was later found to be in ill health and required treatment; antibiotics are also applied to biopsy tips and implantable tags before deployment. An examination of MMHSRP annual reports indicates that the program is conservative in its use of antibiotics, administering them in potentially life-threatening cases (e.g., to prevent septicemia in whales whose condition is deteriorating). In such cases, we believe infectious disease is more likely to reduce the fitness of the individual than any potentially negative impacts of the medication such as localized tissue damage (as may occur from a bent needle; see (Moore et al. 2013)). Therefore, if used conservatively (on animals with deteriorating condition and to prevent infection during invasive research techniques), we believe the administration of antibiotics is likely to improve the fitness of an individual, relative to its current state.

Sedation of cetaceans is not proposed for baseline health research. The results of multiple studies have indicated that sedation likely reduces the stress response of pinnipeds that must be handled for health assessment (Champagne et al. 2012; Harcourt et al. 2010; Petrauskas et al. 2008). However, as described above (Section 6.2.12), sedation and anesthesia of pinnipeds is inherently complicated and has led to injuries and mortalities of animals in the past (Heath et al. 1996). To avoid similar problems in the future, the MMHSRP has developed a host of methods to improve the safety and efficacy of sedation. For some species, drug performance has been improved by delivery through an intravenous route (McMahon et al. 2000). For other pinnipeds, the most substantial improvements have been achieved by utilizing inhalation anesthesia delivered with field-modified equipment (Gales et al. 2005; Gales and Mattlin 1998).

To minimize adverse effects of sedation on pinnipeds, an experienced marine mammal veterinarian, veterinary technician or animal husbandry specialist would be present to carry out or would provide supervision of all activities involving the use of anesthesia and sedatives. In addition, the MMHSRP has established protocols, as described in the permit application (NMFS 2014f):

> Specifically for administering anesthesia and sedation medications, the weight of the animal is obtained prior to the dosing of medications when possible. In field situations when this is not possible, especially when darting pinnipeds with sedation drugs prior to capture, weight will be estimated from the length and body condition of the animal and the lowest effective dose will be used. To mitigate either hyperthermia or hypothermia during anesthesia and sedation, cold water or ice will be available to help lower the body temperature of the animal and warming blankets, heating pads and/or hot water bottles will be available to help warm or maintain body temperature. For cetaceans supportive foam pads, slings or other supportive body devices will be used for long anesthetic procedures to minimize cardiovascular and respiratory effects from gravity for species that normally live entirely in water. Dependent upon field conditions, patient monitoring while under sedation or anesthesia will consist of respiratory rate, depth and character including auscultation of lungs via a stethoscope; heart rate and character via stethoscope or manual palpation; monitoring depth of anesthesia via eye position, and palpebral, tongue, ear, jaw and/or flipper reflexes/tone; monitoring mucus membrane and tongue color to assess perfusion of peripheral vasculature; and monitoring body temperature via rectal or esophageal thermometer. Additionally, electronic monitoring of heart rate, body temperature, carbon dioxide levels, and blood oxygen saturation via pulse oximetry may be available dependent upon field conditions. Tracheal intubation will be used to maintain an airway and support normal respiration for animals that need respiratory support during long anesthetic procedures or during emergency responses including administration of supplemental oxygen and ventilation. Additionally, emergency drugs and care will be available to mitigate issues related to the dive reflex or stress response that can be associated with the use of sedation and anesthetic drugs in marine mammals. Specifically emergency drugs can be used to support respiration (Doxapram), heart rate (Atropine, Epinephrine), treat shock (Dexamethasone, Prednisolone), and treat pulmonary edema (Furosemide). Additionally, some anesthetics and sedation drugs have reversal agents that can be administered in emergency situations including Flumazenil to reverse Diazepam and Midazolam; Atipamezole to reverse Metedomidine type medications; Naloxone or Naltrexone to reverse opioids including Butorphanol.

Using these methods, there have been no accidental deaths or fitness consequences documented in association with the sedation of pinnipeds during MMHSRP activities historically, and we do not expect accidental deaths or injuries as a result of these activities in the future. Based on the best available information, we believe any stress responses or side effects in individual animals from medications will be temporary; we further expect that any temporary effects to individuals will be offset by the long term benefits associated with research into medical treatment of marine mammals, which we expect will result in improved fitness and potentially the extension of life of ESA-listed animals. Over the long term, we believe baseline health research on medical treatments of cetaceans and pinnipeds will result in a net gain in the number of individual animals that comprise ESA-listed populations, by improving the fitness of individual animals that would have otherwise succumbed to disease in the absence of medical intervention.

6.5.2.9 *Administration of Medications: Vaccinations*

We believe that risks associated with the use of either a killed/inactivated vaccine, or a recombinant vaccine, are minimal and that the use of killed and recombinant vaccines will not result in fitness consequences in any animals. This is largely supported by the studies done on other mammals for which the vaccines are specifically labeled. Rigorous safety and efficacy studies conducted on terrestrial mammals (e.g., ferrets, giant pandas, Siberian polecats, African wild dogs) vaccinated with PureVax, the recombinant canary-pox–vectored canine distemper virus vaccine licensed for use in ferrets, have concluded that the vaccine is safe and effective, and does not result in fitness consequences or mortality (Bronson et al. 2007; Connolly et al. 2013; Welter et al. 1999; Wimsatt et al. 2003). No adverse effects, fitness consequences or mortalities have occurred, and no virus shedding has been documented, among captive harbor seals (n = 5) and captive Hawaiian monk seals (n = 6) that have been vaccinated with PureVax (NMFS 2016h; Quinley et al. 2013). PureVax is commercially available in the U.S. and at the time of this opinion was the only currently recommended canine distemper virus vaccine by the American Association of Zoological Veterinarians (http://www.aazv.org) for use in wild carnivores. The Fort Dodge West Nile virus vaccine “Innovator,” an inactivated vaccine, has been routinely used for vaccinating captive pinnipeds, including Hawaiian monk seals, in managed care facilities with no adverse reactions observed (Braun and Yochem 2006).

General concerns about recombinant vaccines include the rare possibility of a local tissue reaction, such as minor heat, swelling, or inflammation; however, in the event that these reactions occurred, we would not expect that they would rise to level where treatment would be required (Dr. M. Barbieri, NMFS Pacific Island Fisheries Science Center, pers. comm., to J. Carduner, NMFS, May 1, 2015). In the case of recombinant vaccines, while there is technically a risk from the virus used as the recombinant host virus to become active, this risk is negated by using a virus that does not infect the host species. For example, recombinant vaccines for mammals usually use avian pox, ensuring that the bird virus cannot replicate in mammalian cells. The potential risk of virus shedding – whereby the virus is “shed” from body of an organism into the environment, where it may infect other bodies – is greatly mitigated in the case of recombinant vaccines where the whole virus is not present (Dr. P. Yochem, Hubbs-SeaWorld Research Institute, pers. comm. to J. Carduner, NMFS, May 13, 2015).

The alternative to vaccinating wild marine mammals against disease is to allow pathogens that affect wild marine mammal populations to run their course without intervention. We believe the potential risks to the survival of ESA-listed marine mammal species associated with nonintervention are far greater than the potential risks associated with vaccinating wild ESA-listed marine mammals with either killed or recombinant vaccines. Infectious diseases, especially those that are newly introduced to naïve populations of animals, can have substantial effects on marine mammal populations by directly causing mass mortality or other more debilitating diseases, and by inhibiting growth and development, resulting in adverse effects on lifetime reproductive success (Conrad et al. 2005; Costas and Lopez-Rodas 1998; Harwood and Hall 1990; Honnold et al. 2005; Miller et al. 2002; Osterhaus et al. 1997; Raga et al. 1997; Stoddard et al. 2005). Moreover, infectious diseases may have important influences on genetic structure and evolution of some species, particularly those with small populations (Lehman et al. 2004; Weber et al. 2000). For those species characterized by very low abundances and/or isolated discrete population segments with low genetic diversity, a newly introduced pathogen may result in a disease outbreak with significant population impacts. Severe epidemics may reduce host population density to such an extent that stochastic events or previously unimportant ecological factors may further reduce the host population size (Harwood and Hall 1990). For example, the canine distemper virus vaccine dramatically reduced black-footed ferret (*Mustela nigripes*) populations in Wyoming, bringing them to extinction in the wild (Thorne and Williams 1988); avian malaria reduced native Hawaiian honeycreeper (*Hemignathus parvus*) populations to such small numbers that many were finally eliminated by predation or habitat loss (Warner 1968).

Since 1987, viruses belonging to the *Morbillivirus* genus of the Paramyxoviridae family, including canine distemper virus, phocine distemper virus, and cetacean morbillivirus have emerged as significant causes of disease and mortality among marine mammals (Saliki et al. 2002). Phocine distemper virus epidemics resulted in the deaths of more than 23,000 harbor seals (*Phoca vitulina*) in 1988 and an additional 30,000 animals in 2002 (Härkönen et al. 2006). In 1997 more than half of the total population of about 300 Mediterranean monk seals (*Monachus monachus*) inhabiting the western Saharan coast of Africa died as a result of morbillivirus infection; analysis of the virus found that it most closely resembled previously identified cetacean morbilliviruses, indicating that interspecies transmission from cetaceans to pinnipeds had occurred (Osterhaus et al. 1997; Van de Bildt et al. 1999). In the early 1990s more than 1,000 striped dolphins (*Stenella coeruleoalba*) died in the Mediterranean Sea as a result of infection by cetacean morbillivirus (Aguilar and Raga 1993). A cetacean morbillivirus outbreak along the U.S. Atlantic coast in 1987-1988 was responsible for a 50 percent loss of the coastal migratory stock of bottlenose dolphins (*Tursiops truncatus*) (Scott et al. 1988). Blood samples obtained from free-ranging and stranded animals between 1986-1995 found serologic evidence of morbillivirus infection in eleven of fifteen species of odontocete cetaceans from the western Atlantic (Duignan et al. 1995). While there is greater documentation of morbillivirus in small odontocetes than in mysticetes, morbillivirus is known to infect baleen whales; necropsies of two fin whales that stranded on the Belgian and French coastlines in the late 1990s found that both whales were infected with morbillivirus (Losson et al. 2000). While mysticetes generally form smaller social groups than odontocetes, groups on feedings grounds may reach 100 or more animals (Gambell 1985), facilitating the spread of infections as in other cetacean species

(Duignan et al. 1995). Although infectious disease does not currently appear to be significantly affecting the survival of any pinniped or cetacean species, there is the potential for some infectious diseases to have devastating effects on endangered and threatened species, especially those with particularly small populations.

We were concerned that the logistical challenges associated with vaccinating some species of marine mammals may limit the effectiveness of vaccination implementation. For instance, whereas Hawaiian monk seals are easily approached and captured and their population is small in number and well monitored, making the population as a whole conducive to vaccination, the logistics associated with locating, identifying, and medicating whales and dolphins would make the vaccination of wild cetaceans significantly more challenging. However, we did not find evidence that vaccination (with a recombinant or killed vaccine) of even a small sub-set of individuals within a population would present risks to those individuals or the broader population. To the contrary, Vial et al. (2006) report that for the purposes of conserving rare species that are threatened by outbreaks of infectious disease, population persistence may be assured by a vaccination strategy designed to suppress only the largest outbreaks of disease that could reduce the population to below a minimum viable population size. These strategies targeting only a viable minimal ‘core’ of the population are also likely to be logistically less demanding. Mathematical models have shown that, by protecting a demographically viable ‘core’ of individuals, even low-vaccination coverage can be effective in reducing the threat of extinction (Haydon et al. 2006; Vial et al. 2006), and can be considered where resources or logistical constraints limit access to a larger proportion of the population (Cleaveland 2009).

We were also concerned that vaccination of ESA-listed marine mammals could theoretically reduce the long-term survival of a species by increasing the survival probability for individuals that would have otherwise died if “natural” processes were left to play out in the absence of human intervention, thereby altering the natural selection process. Thus by increasing short-term survival rates among individuals with weaker immune systems, those individuals would be more likely to survive and reproduce, ultimately weakening the gene pool of the species. Indeed, parasites and pathogens are important parts of natural systems and play an essential role in the regulation of populations (Cleaveland 2009). However, we believe the increasing trend in disease outbreaks amongst pinnipeds and cetaceans over the past 25 years (Ward and Lafferty 2004) is at least partially (if not primarily) attributable to anthropogenic factors; as such, we do not believe recent marine mammal mass mortality events related to disease outbreaks are necessarily a product of the natural selection process, since anthropogenic factors have increased rates of disease beyond what would be considered “natural.” The rapid expansion of domestic animal populations is entirely attributable to humans, and most wildlife emerging disease threats are associated with human activity (Daszak et al. 2000); outbreaks of canine distemper virus that have led to high death rates among pinnipeds including Baikal seals (*Phoca siberica*) and crabeater seals (*Lobodon carcinophagus*) have been attributed to contact with domesticated dogs (Kennedy et al. 2000). In addition, the high concentration of immunotoxic chemicals in some marine mammals may facilitate disease emergence and lead to the creation of susceptible "reservoirs" for new pathogens in contaminated marine mammal populations (Ross 2002). As marine mammals typically occupy high trophic levels, they can be highly contaminated with these chemicals; persistent organic pollutants, including polychlorinated-biphenyls (PCBs), dibenzo-p-dioxins (PCDDs), dibenzofurans (PCDFs) and related compounds, are demonstrated immunotoxicants in marine mammals. Among striped dolphins in the Mediterranean Sea, PCB levels were found to be significantly higher in animals affected by the 1990 morbillivirus epizootic than in the "healthy" populations sampled before or after the event (Aguilar and Borrell 1994). There is evidence that previous mass mortalities of northwest Atlantic bottlenose dolphins and Hawaiian monk seals may have resulted from an interaction between morbillivirus infection and other external stressors such as toxic algal blooms and environmental contaminants (Ross 2002). Finally, the impacts of climate change could magnify the effects of disease on marine mammal populations if stressed hosts are already susceptible to infection. Thus, we do not believe that vaccination of wild ESA-listed marine mammals will jeopardize the species to which those individuals belong as a result of long-term weakening of the gene pool; rather, we believe the vaccination of those individuals is warranted to counteract the potentially catastrophic effects of diseases that, in many cases, would not have affected those species were it not for humans.

As described above in the *Proposed Action* (Section 2.2.3.14), for new vaccines (those not already approved for use on a particular species) the MMHSRP proposes a safety and efficacy testing regime on captive animals (either the target species, or, if unavailable, a surrogate species) prior to the use of the new vaccine on animals in the wild. We believe the required safety and efficacy testing will minimize the potential for adverse responses to vaccines among ESA-listed cetaceans and pinnipeds.

As with any administration of drugs, there are risks involving dosage, delivery, and side effects. The Permits Division and MMHSRP would minimize these risks and any discomfort to individuals by using standardized procedures and dosages, allowing only qualified personnel to administer the drugs, and minimizing interactions whenever feasible.

In summary, based on the best available information, we do not believe that ESA-listed cetaceans and pinnipeds are likely to respond to the administration of medications with behavior changes other than those that may result from any capture, restraint, and handling that may be required to administer a drug. The administration of drugs by the MMHSRP has not resulted in any documented loss of fitness in any individual in the past, and we do not believe the administration of medications will result in fitness reductions in the duration of the permit; therefore we do not believe that takes as a result of the administration of medications will negatively affect the numbers, reproduction, or distribution of any ESA-listed species (in some instances, we expect the administration of drugs, including vaccines, to increase the likelihood of survival and reproduction of ESA-listed animals through the treatment of infectious diseases).

6.5.2.10 *Hazing, Attractants, Active Acoustic Playbacks*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main

Hawaiian Islands insular false killer whales (20 annual takes), Southern Resident killer whales (20 takes) and North Pacific right whales (5 takes), for baseline health research activities specific to active acoustic playbacks and hazing/attractants.

As described in the *Response Analysis* (Section 6.2.2), cetaceans and pinnipeds are likely to display a range of responses to hazing, attractants, and acoustic playbacks, from no response to moving toward or away from the boat or source of sound (which would be the preferred outcome in the case of attractants or hazing techniques, respectively). Responses are expected to be similar to those that would result from close approach (described in Section 6.2.1). Cetaceans and pinnipeds may experience temporary discomfort as a result of these procedures, but this discomfort is not expected to rise beyond the level of behavioral harassment.

Based on the best available information, hazing, attractants, and active acoustic playbacks do not appear to cause any long-term adverse effects, such as loss of hearing. We believe ESA-listed cetaceans and pinnipeds are likely to respond to hazing, attractants, and active acoustic playbacks with very short term behavior change. We believe that the most severe behavioral reactions could result in temporary interference with essential functions such as breeding, feeding, or sheltering, however any interference would be very short term and we do not believe that it would result in fitness reductions in any individual.

We expect minimization measures will further reduce the potential for adverse behavioral responses and will prevent the possibility of injury: if a change in animal behavior is observed (other than the desired result of moving away from, or toward, the hazing or attractant, respectively), the acoustic source would be shut down; airguns would not be used near mysticetes due to their sensitivity to lower frequencies (and airguns are not proposed for baseline health research); mid-frequency sonar would be discontinued if animals were too close to the sound source (NMFS 2014f). Permit terms and conditions require that acoustic playback studies must be limited to 20 minutes in duration, not exceed 155 dB re 1 µPa at one meter, and must not be broadcast to animals closer than 100 meters. It should also be noted that as baseline research would be used to test the effectiveness of hazing and attractants in limiting animals' exposure to harmful situations (e.g., oil spills), we would expect behavioral harassment during research on hazing and attractants to result in long term benefits for ESA-listed species.

Based on the best available information, we believe any behavior changes as a result of hazing, attractants, and active acoustic playbacks will be temporary and will not result in fitness reductions; as such, we do not believe that takes as a result of these procedures will affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.11 *Auditory Brainstem Response/Auditory Evoked Potential*

The permit would authorize 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except Main Hawaiian Islands insular false killer whales (20 annual takes), Southern resident killer whales

(20 takes) and North Pacific right whales (five takes), for baseline health research activities specific to ABR/AEP hearing tests.

We believe any adverse response to hearing tests would result from the stress of capture, restraint, and handling required to perform the procedure (in the case of pinnipeds), and not from the procedure itself. Maximum sound levels presented to animals during hearing tests would be lower than sound levels produced by animal whistles and echolocation clicks.

As described in the *Response Analysis* (Section 6.2.13), AEP testing has been conducted on several marine mammal species with no documented adverse effects (Castellote et al. 2014; Mooney et al. 2008; Mooney et al. 2012; Szymanski et al. 1999; Szymanski et al. 1998; Yuen et al. 2005). The procedure would be suspended if the animal displayed negative reactions or if there was reason for concern regarding the animal's health. In AEP tests conducted in 2013 under the MMHSRP's previous permit, cetaceans were continuously provided with supportive care (thermoregulation, foam padding and quiet conditions); according to the MMHSRP, these measures appeared to be effective in minimizing stress (NMFS 2014f), and similar measures would be employed in the future when possible. Permit conditions, including those below, would further minimize any potentially negative effects of hearing test procedures performed as part of baseline health research:

- No auditory testing is authorized on pregnant female animals, on mother/calf pairs, or on lone calves less than six months old (an exception may only be authorized by the principal investigator).
- Auditory testing must be conducted in a humane manner (i.e., that which involves the least possible degree of pain and suffering) and in a manner that minimizes restraint time and handling stress.
- If an animal is suffering, showing adverse reactions, or is at risk of injury during the auditory measurements or handling, researchers must immediately discontinue the activities.
- Auditory testing must not delay or interfere with treatment, transport, or release of stranded animals (in the case of enhancement activities).

Based on the best available information, we believe ESA-listed cetaceans and pinnipeds will not respond to hearing tests, beyond any behavioral response that may occur as a result of capture, restraint, and handling necessary to perform the procedure, and that minimization measures required by Permit terms and conditions will further prevent any stress responses that may result from capture and handling to perform the procedure. Thus we believe hearing tests will not result in fitness reductions and, as such, we do not believe that baseline health research takes as a result of ABR/AEP will affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.12 *Disentanglement*

Disentanglement activities are categorized as enhancement activities of the MMHSRP, thus an unlimited number of animals from any ESA-listed species may be disentangled by the MMHSRP or those authorized by the MMHSRP to respond to marine mammal entanglements over the duration of the permit. As disentanglements are emergency responses, the number of future disentanglements that will occur, and the species that will be affected, over the duration of the permit is difficult to predict. However, as described in the *Exposure Analysis* (Section 6.4.1), based on previous MMHSRP annual reports, we estimate that approximately 67 percent of disentanglements will be performed on humpback whales, approximately 25 percent on North Atlantic right whales, approximately three percent on Steller sea lions, approximately two percent on Hawaiian monk seals and approximately two percent on Sei whales. We assume animals that are disentangled could be any age, sex, and reproductive status.

As described in the *Response Analysis* (Section 6.2.9) entanglement response can result in stress, as well as lesions from cutting of ropes or lines, an increase in trauma resulting in wounds, and various other types of injuries. However, based on the best available information, we believe that the overall effects of disentanglement will be beneficial to the individual affected, the population to which that individual belongs, and to the species as a whole. In most cases, if an animal cannot free itself from the entangling material it will die without intervention, and death can occur after weeks or months of pain and suffering for the individual (Moore and Van der Hoop 2012). Entanglement response actions also provide crucial information on the causes of marine mammal entanglements, whether fisheries or other marine debris, which facilitates both the development of gear that is less likely to result in entanglement, and management actions to prevent or minimize future entanglements.

Between 2000 and 2013, there were 25 cases involving North Atlantic right whales that were positively impacted by response teams from members of the Atlantic Large Whale Disentanglement Network. These include cases where some or all of the entangling gear was removed and the animal was documented to have survived the entanglement. Of the 25 cases, at least 11 animals were subsequently observed to give birth to calves. Thus, of those 25 cases, at least 11 are likely to have increased the number of animals in the population versus if the entanglement responses had not occurred. An analysis of the documented history of de-hookings and disentanglements of Hawaiian monk seals from 1980-2012 demonstrated that between 17-24 percent of the population of Hawaiian monk seals in 2012 was either an animal that had experienced an intervention or was the descendant of an intervention animal (Johanos et al. 2014).

Based on annual reports submitted by the MMHSRP and the permit application, entanglement responders employ measures to minimize stress responses and the potential for injury among entangled animals: entanglements are carefully assessed prior to disentanglement attempts; for large whale disentanglements, responders approach animals gradually, with minimal sound to reduce any reaction and minimize the time in close proximity to the animal; responders approach at slow speeds, avoiding sudden changes in speed or pitch, and avoiding use of reverse gear; additional caution is taken when approaching mothers and calves; The Criteria for the Large Whale Disentanglement Network ensure that only responders with extensive experience operating vessels near large whales are involved in vessel approaches and all individuals authorized to respond to large whale entanglements are adequately experienced and trained in entanglement response. Cutting of ropes only occurs when the entanglement is deemed potentially life threatening, thus without the intervention the animal would have died and been removed from the population.

Non-target animals may be harassed during disentanglement attempts on entangled animals. For instance, on June 29, 2014, the Alaska Department of Fish and Game reported three takes by incidental harassment of a Steller sea lion that was in the vicinity of another Steller sea lion that was disentangled. Based on the best available information, we believe non-target animals that are incidentally harassed may respond behaviorally, but that any behavioral response will be short term and will not affect the animal's fitness. Harassment of non-target pinnipeds poses the additional risk that behaviorally disturbed animals may leave a haul-out or rookery, which could lead to a stampede resulting in the mortality of pups. We believe protocols that have been developed for entanglement response to Steller sea lions will minimize effects to non-target animals from disentanglement attempts and will effectively reduce the risk of stampedes. For instance, protocols for approaching occupied rookeries and haul-outs include the following:

- Disentanglement will not be attempted in locations within breeding rookeries that are likely to disturb mother/pup pairs.
- Initial survey of the scene and identification of target entangled individual will be made by skiff, first passing carefully far offshore to judge wariness of the hauled out sea lions, later passing closer if needed to better judge the scene.
- Approach to the haul-out will be made by skiff from the most practical concealed direction.
- A small darting team will be landed at this location and stalk carefully, wearing camouflaging clothes and using natural cover, to within 5-20 meters of the subject animal.
- Prior to darting or restraint of target animal, personnel will cease efforts if significant injury to target or non-target animals appears imminent.

No animals have been reported injured or killed during previous MMHSRP disentanglement activities. Based on the best available information, we believe disentanglement activities over the duration of the permit will not result in fitness reductions, therefore we do not believe that disentanglement will negatively affect the numbers, reproduction, or distribution of any ESA-listed species; on the contrary, we believe disentanglement activities will result in improved fitness and increased survivorship among animals that may otherwise have died.

6.5.2.13 *Euthanasia*

As described above, the mortality of up to one Guadalupe fur seal and up to five Steller sea lions (Western DPS), five ringed seals (Arctic subspecies), and five bearded seals (Beringia DPS) may occur over the five year permit. These mortalities may occur as a result of euthanasia, if a research animal that was thought to be healthy was found to be moribund. Euthanasia during baseline health research would only occur in the rare event that an animal that appeared healthy upon capture for research is found to be moribund and it is determined that euthanasia is the preferred course of action to reduce suffering on the part of the animal (note that an unlimited number of animals from any ESA-listed species may be euthanized by the MMHSRP over the duration of the permit during enhancement activities).

Euthanasia is chosen as a last resort when all other options for successful intervention would not be successful, and is considered the best option to minimize suffering on the part of animals that are not expected to survive. For instance, slow cardiovascular collapse from gravitational effects outside of neutral buoyancy, often combined with severely debilitating conditions, lead to undue suffering in stranded cetaceans that are not accustomed to feeling the full weight of their bodies; these factors motivate humane efforts to end the animal's suffering (Harms et al. 2014). Based on MMHSRP annual reports and personal communications with the MMHSRP, we believe the MMHSRP is extremely conservative in their approach to ensuring that euthanasia does not cause increased pain or suffering among moribund animals, and that euthanasia is employed in situations where an immediate and pain-free death is preferable to letting the animal die on its own. Euthanasia procedures would follow approved guidelines, such as those listed in the 2013 Report of the American Veterinary Medical Association on Euthanasia (AVMA 2013), the *CRC Handbook of Marine Mammal Medicine* (Greer et al. 2001), and/or the American Association of Zoo Veterinarians guidelines (Baer 2006).

Based on the best available information, we believe that ESA-listed cetaceans and pinnipeds are not likely to respond to euthanasia with behavior changes, aside from any behavior changes that may result from the stress of restraint and handling required to perform the procedure. As euthanized animals would be expected to die in the absence of the MMHSRP’s response, we do not believe euthanasia will result in fitness reductions beyond what the animal is already experiencing, therefore we do not believe that euthanasia will affect the numbers, reproduction, or distribution of any ESA-listed species.

6.5.2.14 *Research on Captive Animals*

All of the research activities described above may be performed on all species of ESA-listed cetaceans and pinnipeds that are held in permanent captivity. While we expect that the stressors, responses, and mitigation measures described above would apply to captive animals in similar ways as what we expect for wild animals, the stress of capture is not a factor for procedures conducted on captive animals, and it is less likely that sedation would be needed to perform several research procedures on captive animals, further reducing the potential risks of fitness consequences. In addition, permanently captive animals would never be released to the wild and are therefore no longer considered part of the wild population (i.e., any reduction to the population would have occurred when the animal was permanently removed from the wild). Thus, maintaining marine mammals in permanent captivity and conducting research on those animals in captivity will not affect the reproduction, numbers, or distribution of any ESA-listed species.

6.5.3 Risk for non-target species

Risk to sea turtles, sturgeon, and sawfish from the proposed action come from vessel traffic and potential vessel strike and encounters or capture when nets are used to capture marine mammals.

Vessel traffic may disturb ESA-listed animals and result in their movement away from the vessel for a short time. Because the MMHSRP activities are to contribute to the health and wellbeing of marine mammals, the individuals carrying out the activities are expected to be vigilant and proceed careful when ESA-listed non-target species may be in the area.

Capture can cause stress responses in sea turtles (Gregory 1994; Gregory and Schmid 2001; Hoopes et al. 1998; Jessop et al. 2004; Jessop et al. 2003; Thomson and Heithaus 2014), sturgeon (Kahn and Mohead 2010; Lankford et al. 2005), and other fishes including smalltooth sawfish (Korte et al. 2005; Moberg 2000; Sapolsky et al. 2000).

Because sea turtle, sturgeon, and sawfish entangled or netted would be immediately removed from the nets, without human handling if possible, we expect them to experience a low level of stress that would be very short term with resumption of normal behaviors to occur within minutes of release.

Additional risk to sea turtles in entanglement nets results from forced submersion. Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lungs (Lutcavage et al. 1997). Trawl studies have found that no mortality or serious injury occurred in tows of 50 minutes or less, but these increased rapidly to 70 percent after 90 minutes (Epperly et al. 2002; Henwood and Stuntz 1987). However, mortality has been observed in summer trawl tows as short as 15 minutes (Sasso and Epperly 2006). Metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. Serious injury and mortality when it occurs is likely due to acid-base imbalances resulting from accumulation of carbon dioxide and lactate in the bloodstream (Lutcavage et al. 1997); this imbalance can become apparent in captured, submerged sea turtles after a few minutes (Stabenau et al. 1991). Sea turtles entangled in nets exhibiting lethargy can die even with professional supportive care, possibly due to severe exertion resulting in muscle damage (Phillips et al. 2015).

We do not expect any sea turtle to require extensive recovery, but proposed permit terms and conditions (holding comatose or behaviorally abnormal sea turtles and monitoring sea turtles after release) should mitigate sea turtles being released that have not recovered from forced submergence and/or the accumulation of other stressors that can cumulatively impair physiological function. In addition, veterinary assistance would be sought for these individuals.

Based on our exposure analysis we expect that up to 10 hardshell sea turtles may be incidentally encountered in nets during MMHSRP activities. Because the MMHSRP activities are largely done as warranted, predicting the exact number and species of sea turtles that might be taken is difficult. That said, based on the expected responses of encountered sea turtles of startle reactions, changes in respiration, alteration of swim speed, alteration of swim direction, and possibly avoidance of the activity area while the activity is ongoing, any disruptions are expected to be temporary in nature, with the animal resuming normal behaviors shortly after the exposure. Given our expectation that the response for any turtle would be minor, the risk to any sea turtle species or DPS, even if 10 individuals from a single species or DPS, were taken is minimal.

We anticipate that up to two leatherback turtles, three sawfish, three Atlantic sturgeon (any DPS), one Gulf sturgeon, one shortnose sturgeon, and one green sturgeon may be encountered during MMHSRP activities. Like hardshell turtles, these ESA-listed species would be removed from nets quickly, likely without handling. We expect animals would experience a low level short term stress and resume normal behavior quickly after release. We do not expect injuries or death to any ESA-listed sea turtles or fishes.

To result in significant fitness consequences we would have to assume that an individual turtle could not compensate for lost feeding opportunities by either immediately feeding at another location, by feeding shortly after release, or by feeding at a later time. There is no indication this is the case. Similarly, we expect temporary disruptions of swim speed or direction to be inconsequential because they can resume these behaviors almost immediately following release. Further, these sorts of behavioral disruptions may be similar to natural disruptions such those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses of up to 10 sea turtles from any ESA-listed DPS or species, to encountering or being captured in a net are unlikely to lead to fitness consequences and long-term implications for the population.

Smalltooth sawfish entangled in nets would likely experience stress in association with the event and some lacerations associated netting. However, they should be capable of continued respiration. If disentangled according to NOAA-approved protocols (NMFS 2009g), no further injury should occur. Bycatch in the past does not appear to be fatal due to distress and we do not expect distress that would impede fitness for any interactions with trawls under the proposed permits.

We expect capture and handling of Atlantic, shortnose, gulf and green sturgeon would cause short-term stress (Kahn and Mohead 2010). This can be exacerbated by less than ideal environmental conditions, such as relatively high water temperature (higher than 28° Celsius), high salinity, or low dissolved oxygen, potentially resulting in mortality or failure to breed (Hastings et al. 1987; Jenkins et al. 1993; Kynard et al. 2007; Moser and Ross 1995; Niklitschek 2001; Niklitschek and Secor 2009; Niklitscheka and Secor 2009; Secor and Niklitschek 2002; Secor and Gunderson 1998; Secor and Niklitschek 2001). We do not expect the additional stress associated with brief capture, handling, and release to result in more than short-term stress if the MMHSRP follow guidelines outlined in Kahn and Mohead (2010) and best practice guidelines established by the Smalltooth Sawfish Recovery Team (NMFS 2009g).

6.6 Cumulative Effects

"Cumulative effects" are those effects of future state or private activities, not involving Federal activities, that are reasonably certain to occur within the action area of the Federal action subject to consultation (50 CFR 402.02). Future Federal actions that are unrelated to the proposed action are not considered in this section because they require separate consultation pursuant to section 7 of the ESA.

Based on the best available scientific and commercial information, we expect the future state, tribal, local, or private actions that are reasonably certain to occur in the action area to be similar to those described in the *Environmental Baseline* (Section 5). The possible effects of these actions include: hooking, entanglement, ingestion of debris, and drowning as a result of commercial and recreational fisheries; ship strikes, disturbance, and possible habitat displacement as a result of vessel traffic and whale watching; disturbance, masked communication, and possible habitat displacement from ocean sound; mortality as a result of subsistence hunting (in the case of pinnipeds), and habitat degradation and possible fitness consequences due to pollution, discharged contaminants, and coastal development. An increase in these activities could result in an increased effect on ESA-listed species. However, the magnitude and significance of any anticipated effects are not predictable at this time.

6.7 Integration and Synthesis of Effects

The *Integration and Synthesis* section is the final step in our assessment of the risk posed to species and critical habitat as a result of implementing the proposed action. In this section, we add the *Effects of the Action* (Section 6) to the *Environmental Baseline* (Section 5) to formulate the agency's biological opinion as to whether the proposed action is likely to: (1) reduce appreciably the likelihood of both the survival and recovery of an ESA-listed species, or a species proposed for listing under the ESA, in the wild by reducing its numbers, reproduction, or distribution; or (2) reduce the value of designated or proposed critical habitat for the conservation of the species. These assessments are made in full consideration of the status of the species and designated critical habitat. The purpose of this analysis is to determine whether the proposed action, in the context established by the *Status of the Species* (Section 4) *Environmental Baseline* (Section 5), and *Cumulative Effects* (Section 6.6), would jeopardize the continued existence of ESA-listed species, or destroy or adversely modify designated critical habitat.

In the context of the ESA, the phrase "jeopardize the continued existence of" means "to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and the recovery of a ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 CFR 402.02). Thus, in making this conclusion for each species or DPS, we first looked at whether there will be a reduction in reproduction, numbers, or distribution (See the *Risk Analysis*; Section 6.5). If there is a reduction in one or more of these elements for any species or DPS, we explore in this section whether it will cause an appreciable reduction in the likelihood of both the survival and the recovery of the species or DPS.

In the *ESA Section 7 Handbook* (USFWS and NMFS 1998), for the purposes of determining jeopardy, “survival” is defined as: “The species’ persistence as ESA-listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery.” The term “recovery” is defined in the section 7 handbook as: “Improvement in the status of ESA-listed species to the point at which listing is no longer appropriate under the criteria set out in Section 4(a)(1) of the Act.”

The following discussion summarizes our opinion on whether the proposed action will cause an appreciable reduction in the likelihood of both the survival and the recovery of ESA-listed species (critical habitat is not addressed below, as we determined that critical habitat is not likely to be adversely affected by the proposed action). As discussed in the *Description of the Proposed Action* (Section 2.2), and the *Exposure Analysis* (Section 6.4), we need to distinguish between the enhancement activities and the baseline health research activities of the MMHSRP for cetacean species. For non-target ESA-listed species we consider all potential stressors.

6.7.1 Marine Mammals and Enhancement Activities

As described in the *Exposure Analysis* (Section 6.4), we would estimate the annual take of ESA-listed marine mammals over the duration of the permit during enhancement activities, based on historical takes that have occurred during enhancement activities and the best available information on vaquita import/export activities, as follows: 45 humpback whales; 38 North Atlantic right whales; 16 Hawaiian monk seals; five Steller sea lions; four Guadalupe fur seals; two sperm whales; one sei whale; one fin whale; one ringed seal; and up to 24 vaquita. We assume these cetaceans and pinnipeds may represent any age, gender, reproductive condition, or health condition. However, as enhancement activities are conducted in response to emergencies, and these emergency scenarios are unpredictable, actual exposures among ESA-listed species to MMHSRP enhancement activities that will occur over the duration of the permit are largely unpredictable.

Due to the unpredictable nature of emergency response, during enhancement activities the MMHSRP would be authorized to expose an unlimited number of ESA-listed marine mammals to close approaches, aerial and vessel surveys, hazing and attractants, capture, restraint, handling, transport, holding, release, attachment of scientific instruments, marking, diagnostic imaging, sample collections, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, and disentanglement within the action area. The proposed permit would also authorize the MMHSRP to euthanize an unlimited number of ESA-listed marine mammals.

As described in the *Risk Analysis* (Section 6.5), enhancement activities of the MMHSRP entail responses to health emergencies involving marine mammals, including responses to animals that are stranded, entangled in fishing gear or marine debris, are in ill health, or are otherwise in danger or distress. We assume based on the best available information that for the vast majority of animals involved in enhancement activities, in the absence of the MMHSRP's response to their distress, those animals would either die or suffer fitness consequences that would reduce their longevity or reproductive success. As such, we believe that over the duration of the permit, regardless of the number of procedures conducted during MMHSRP enhancement activities, those activities will lead to the improved condition of animals that are ill or in distress (with the obvious exception of euthanasia), and will thus result in saved lives and increased fitness among ESA-listed marine mammals over the long-term. Thus, we conclude that MMHSRP enhancement activities will result in a net increase in the number of individual animals that comprise populations of ESA-listed marine mammal species; we therefore find that enhancement activities are not likely to reduce appreciably the likelihood of both the survival and recovery of beluga whales (Cook Inlet DPS), blue whales, bowhead whales, Bryde's whales (Gulf of Mexico subspecies), Chinese river dolphins, false killer whales (Main Hawaiian Islands Insular DPS), fin whales, humpback whales (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), gray whales (Western North Pacific DPS), killer whales (Southern Resident DPS), Maui's dolphins, South Island Hector's dolphins, North Atlantic right whales, North Pacific right whales, sei whales, southern right whales, sperm whales, Indus river dolphin, vaquita, bearded seals (Beringia and Okhotsk DPSs), Guadalupe fur seals, Hawaiian monk seals, Mediterranean monk seals, ringed seals (Arctic, Baltic, Lagoda, Okhotsk, and Saimaa subspecies), spotted seals (Southern DPS), and Steller sea lions (Western DPS).

6.7.2 Marine Mammals and Baseline Health Research Activities

Unlike enhancement activities, the procedures that constitute baseline health research may be performed on animals that are healthy; thus any fitness consequences or mortalities that result from those activities would have the potential to impact the reproduction, numbers, or distribution of ESA-listed species in the wild. Therefore, in assessing the potential impacts of baseline health research activities on the reproduction, numbers, or distribution of ESA-listed species, we analyzed the various procedures proposed as part of those activities, and the likely risks those activities pose to ESA-listed marine mammals given the likely exposure of those animals to the various procedures.

The first step in that analysis was to determine the take that was reasonably certain to occur. As described in the *Exposure Analysis* (Section 6.4.2), we believe previous take data are not a reliable estimator of takes that will occur during baseline health research over the duration of the permit. Instead, we believe the takes for baseline health research as described in Table 2 are reasonably certain to occur over the duration of the permit. Therefore we based our assessment of the expected impacts to ESA-listed marine mammals from baseline health research activities on those take numbers.

In the *Response Analysis* (Section 6.2), we analyzed the likely responses among ESA-listed cetacean and pinniped species to the various procedures proposed as part of baseline health research; we then analyzed the risk to those species (Section 6.5, in consideration of their likely exposure level (Section 6.4) and the measures to minimize the likelihood of exposure (Section 6.3). Based on the best available information, we determined that several proposed procedures are not expected to result in fitness consequences or mortality: close approach, aerial and vessel surveys, active acoustic playbacks, hazing and attractants, transport, attachment of tags and scientific instruments, marking, diagnostic imaging, sample collection and analysis, administration of medications, and hearing tests. The best available information suggests the range of responses among cetaceans and pinnipeds to these procedures may include: temporary discomfort, stress, behavioral harassment, acute pain, and minor injury. Some of these responses are expected to lead to short-term behavioral disruptions, some of which may temporarily interfere with essential functions such as breeding, feeding and sheltering. However, we concluded that none of these responses are expected to result in fitness consequences or mortality. Therefore, we determined that these activities would not affect the numbers, reproduction, or distribution of any ESA-listed species.

Of the procedures proposed during baseline health research activities, we determined that capture, restraint, and handling are the only set of procedures that may result in fitness consequences or mortalities in ESA-listed pinnipeds (capture, restraint, and handling are not proposed for cetaceans). The likelihood of death is small; however, given the inherent risks associated with these procedures, the Permits Division proposes to authorize takes for mortality during baseline health research as follows: a maximum of one Guadalupe fur seal, and a maximum of five Steller sea lions (Western DPS), five bearded seals (Beringia DPS), and five ringed seals (Arctic subspecies) may die as a result of baseline health research activities over the duration of the permit. As such, we analyzed the impact of these mortalities on the numbers, reproduction, and distribution of the four species listed above.

The death of one Guadalupe fur seal would represent a loss of less than 0.02 percent of the estimated total population (N = 7,348; (Gallo et al. 1993)). The best available information suggests the population of Guadalupe fur seals is increasing exponentially at a rate of 13.7 percent (Gallo-Reynoso 1994a), a rate that would result in the population doubling every five years. The species is also expanding its breeding range, one of three recovery criteria (Allen and Angliss 2013b), further suggesting the population is increasingly resilient. These factors lead us to believe the loss of one individual over five years as a result of baseline health research would not reduce the viability of the Guadalupe fur seal population or the species as a whole. Taking into account the *Status of the Species* (Section 4.2.20), the *Environmental Baseline* (Section 5.3) and the *Cumulative Effects* (Section 6.6), we believe the mortality of one individual over five years that may occur as a result of the proposed action would not reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution.

The death of five Western DPS Steller sea lions over five years would represent a loss of less than 0.007 percent of the estimated total population (N = 79,300; (Allen and Angliss 2013d)). Despite continued decreases in abundance documented in certain geographic areas, increases in other areas of the species' range have resulted in an increasing trend in the overall population since 2000 (Fritz et al. 2014; Fritz et al. 2015). Based on the best estimate of annual anthropogenic mortality (n = 230) (Allen and Angliss 2013a), the loss of an average of one individual animal per year (maximum five mortalities over the five year permit) would represent an increase in annual anthropogenic mortality of less than 0.5 percent. These factors lead us to believe the loss of five individuals over five years as a result of baseline health research would not reduce the viability of the Western DPS Steller sea lion population or the species as a whole. Taking into account the *Status of the Species* (Section 4.2.25), the *Environmental Baseline* (Section 5.3) and the *Cumulative Effects* (Section 6.6), we believe the mortality of five individuals over five years that may occur as a result of the proposed action would not reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution.

The death of five ringed seals (Arctic subspecies) would represent a loss of less than 0.002 percent of the total population (N = 300,000 (Allen and Angliss 2013a). Based on the best estimate of annual anthropogenic mortality (n = 9,570; (Allen and Angliss 2013a)), the average annual death of one individual animal (maximum five mortalities over the five year permit) would represent an increase in annual anthropogenic mortality of just 0.001 percent. Additionally, the species was listed as threatened under the ESA because it is at risk of becoming endangered in the future due to the loss of ice habitat resulting from climate change; current rates of anthropogenic mortality were not deemed a threat to the species (77 FR 76705). These factors lead us to believe the loss of five individuals over five years as a result of baseline health research would not reduce the viability of the Arctic subspecies ringed seal population or the species as a whole. Taking into account the *Status of the Species* (Section 4.2.22.6), the *Environmental Baseline* (Section 5.3) and the *Cumulative Effects* (Section 6.6), we believe the mortality of five individuals over five years that may occur as a result of the proposed action would not reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution should the ESA-listed status be reinstated.

The death of five Beringia DPS bearded seals would represent a loss of less than 0.004 percent of the estimated total population (N = 155,000; (Cameron et al. 2010)). Based on the best estimate of annual anthropogenic mortality (n = 6,790; (Allen and Angliss 2013a)) the loss of an average of one individual animal per year (maximum five mortalities over the five year permit) would represent an increase in annual anthropogenic mortality of just 0.01 percent. Additionally, the species was listed as threatened under the ESA because it is at risk of becoming endangered in the future due to the loss of ice habitat resulting from climate change; current rates of anthropogenic mortality were not deemed a threat to the species (Cameron et al. 2010). These factors lead us to believe the loss of five individuals over five years as a result of baseline health research would not reduce the viability of the Beringia DPS bearded seal population or the species as a whole. Taking into account the *Status of the Species* (Section 4.2.19), the *Environmental Baseline* (Section 5.3) and the *Cumulative Effects* (Section 6.6), we believe the mortality of five individuals over five years that may occur as a result of the proposed action would not reduce appreciably the likelihood of both the survival and recovery of the species in the wild by reducing its numbers, reproduction, or distribution should the ESA-listed status be reinstated.

In addition to the mortalities analyzed above, the permit would authorize up to one captive Hawaiian monk seal mortality over the duration of the permit. Since a captive animal would have already been permanently removed from the wild population, the death of that animal would have no impact on the survival and recovery of the species in the wild.

The permit would also authorize euthanasia of marine mammals during research. Because we expect that euthanasia would be performed only on moribund animals which exhibit irreversibly poor condition (i.e., effective fitness approaches zero), euthanasia would therefore not result in fitness consequences or mortality beyond that which would have occurred in the absence of the research procedures. Thus the loss of those individuals is not likely to reduce the survival and recovery of any ESA-listed marine mammal species in the wild.

As we determined that the activities during baseline health research that had the potential to result in fitness consequences or mortality for ESA-listed pinnipeds were limited to capture, restraint, and handling, we expect that baseline health research will not result in fitness consequences or mortality for those species for which these activities are not proposed during baseline health research. Thus, taking into account the *Status of the Species* (Section 4.2), the *Environmental Baseline* (Section 5.3) and the *Cumulative Effects* (Section 6.6), we believe that baseline health research activities are not likely to reduce appreciably the likelihood of both the survival and recovery of the following species in the wild, by reducing their reproduction, numbers, or distribution: beluga whales (Cook Inlet DPS), blue whales, bowhead whales, Bryde’s whales (Gulf of Mexico subspecies), Chinese river dolphins, false killer whales (Main Hawaiian Islands Insular DPS), fin whales, humpback whales (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), gray whales (Western North Pacific DPS), killer whales (Southern Resident DPS), Maui’s dolphins, South Island Hector’s dolphins, North Atlantic right whales, North Pacific right whales, sei whales, southern right whales, sperm whales, Indus river dolphin, vaquita, bearded seals (Beringia and Okhotsk DPSs), Guadalupe fur seals, Hawaiian monk seals, Mediterranean monk seals, ringed seals (Arctic, Baltic, Lagoda, Okhotsk, and Saimaa subspecies), spotted seals (Southern DPS), and Steller sea lions (Western DPS).

6.7.3 Sea Turtles, Sturgeon, and Sawfish and Enhancement and Baseline Health Research Activities

As described in the *Exposure Analysis* (Section 6.4), several ESA-listed sea turtle, sturgeon, and saw fish species may be exposed to incidental capture and entanglement as the result of cetacean net captures. Using data from previous reports from the MMHSRP, we estimated that up to 50 hardshell turtles (green sea turtles from the Central South Pacific DPS, Central West Pacific DPS, Central North Pacific DPS, East Pacific DPS or North Atlantic DPS, hawksbill sea turtles, Kemp's ridley sea turtles, loggerhead sea turtles from the North Pacific Ocean DPS, Northwest Atlantic Ocean DPS, or the South Pacific Ocean DPS, and olive ridley sea turtles from the Mexico's Pacific coast breeding colonies or all other areas), 10 leatherback turtles, 15 smalltooth sawfish (U.S. DPS), 15 Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina or South Atlantic DPS), five gulf sturgeon, five shortnose sturgeon, and five green sturgeon (Southern DPS) may be exposed to cetacean net captures and potentially be incidental captured or become entangled during both enhancement and baseline health research activities. No mortalities are expected or would be authorized for these species.

Based on the information available, endangered and threatened sea turtles, may have a brief startle response to vessel operations during cetacean net captures, but are most likely to ignore vessels entirely and continue behaving as if the vessels and any risks associated with those vessels did not exist. Sturgeon and sawfish are likely to avoid vessels in close proximity to them by swimming away from the vessel. Because sea turtles, sturgeon and sawfish would be release from nets well prior to the onset of severe metabolic and respiratory changes, encounters or captures of a sea turtle, sturgeon, or sawfish during MMHSRP activities would only result in low level stress for the animal. This stress in expected to be short-term and the animal would resume normal behaviors quickly such that the disruption would not significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering.

Based on the evidence available, the issuance of Permit 18786-01 and the implementation of the MMHSRP could result in minor disturbance and stress of ESA-listed sea turtles, sturgeon and sawfish if encountered. Thus, taking into account the *Status of the Species* (Section 4.2), the *Environmental Baseline* (Section 5.4) and the *Cumulative Effects* (Section 6.6), we believe that enhancement and baseline health research activities are not likely to reduce appreciably the likelihood of both the survival and recovery of the following species in the wild, by reducing their reproduction, numbers, or distribution: green turtles (Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, and North Atlantic DPSs), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean DPSs), olive ridley turtles (from the Mexico's Pacific coast breeding colonies or all other areas), Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina or South Atlantic DPS), green sturgeon (Southern DPS), gulf sturgeon, shortnose sturgeon, and smalltooth sawfish (U.S. DPS).

7 CONCLUSION

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, any effects of interrelated and interdependent actions, and cumulative effects, it is NMFS' biological opinion that the proposed action (the issuance of the permit by the Permits Division to the MMHSRP and the implementation of the MMHSRP for both enhancement and baseline health research activities) is not likely to jeopardize the continued existence of the targeted ESA species - beluga whales (Cook Inlet DPS), blue whales, bowhead whales, Chinese river dolphins, false killer whales (Main Hawaiian Islands Insular DPS), fin whales, humpback whales (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), gray whales (Western North Pacific DPS), killer whales (Southern Resident DPS), North Atlantic right whales, North Pacific right whales, sei whales, southern right whales, sperm whales, Indus river dolphin, vaquita, bearded seals (Beringia and Okhotsk DPSs), Guadalupe fur seals, Hawaiian monk seals, Mediterranean monk seals, ringed seals (Baltic, Lagoda, Okhotsk, and Saimaa subspecies), spotted seals (Southern DPS), and Steller sea lions (Western DPS).

Further the proposed action is not likely to jeopardize the continued existence of the non-targeted ESA species that may be incidentally taken – green turtles (Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, and North Atlantic DPSs), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean DPSs), olive ridley turtles (from the Mexico's Pacific coast breeding colonies or all other areas), Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina or South Atlantic DPS), green sturgeon (Southern DPS), gulf sturgeon, shortnose sturgeon, and smalltooth sawfish (U.S. DPS).

It is NMFS' conference opinion that the proposed action is not likely to jeopardize the continued existence of the follow species proposed for listing under the ESA: Bryde's whales (Gulf of Mexico subspecies), Maui's dolphins, South Island Hector's dolphins, and ringed seal (Arctic DPS, currently vacated pending appeal, so considered proposed for this opinion).

8 INCIDENTAL TAKE STATEMENT

Section 9 of the ESA and Federal regulations pursuant to section 4(d) of the ESA prohibit the take of endangered and threatened species, respectively, without special exemption. Take is defined as to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct. Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Under the terms of section 7(b)(4) and section 7(o)(2), taking that is incidental to and not intended as part of the agency action is not considered to be prohibited taking provided that such taking is in compliance with the terms and conditions of this incidental take statement.

8.1 Amount or Extent of Take

Section 7 regulations require NMFS to specify the impact of any incidental take of endangered or threatened species; that is, the amount or extent, of such incidental taking on the species (50 CFR § 402.14(i)(1)(i)). The amount of take represents the number of individuals that are expected to be taken by actions while the extent of take or "the extent of land or marine area that may be affected by an action" may be used if we cannot assign numerical limits for animals that could be incidentally taken during the course of an action (51 FR 19953).

We expect that up to ten hardshell sea turtles will be taken during MMHSRP activities each year. In total these takes may be of any hardshell species or DPS including: green sea turtle from the Central South Pacific DPS, Central West Pacific DPS, Central North Pacific DPS, East Pacific DPS or North Atlantic DPS, hawksbill sea turtle, Kemp's ridley sea turtle, loggerhead sea turtle from the North Pacific Ocean DPS, Northwest Atlantic Ocean DPS, or the South Pacific Ocean DPS, olive ridley sea turtle from the Mexico's Pacific coast breeding colonies or all other areas. Over the five years of the permitted activities, a total of 50 hardshell sea turtles of the species listed above may be taken in the form of harassment from net entanglement or capture. No mortalities of hardshell sea turtles is anticipated or exempted from the prohibition on incidental take provided by this incidental take statement.

We expect that up to two leatherback turtles will be taken during MMHSRP activities each year, for a total of up to ten leatherback turtles over five years. Take would be in the form of harassment by net entanglement or capture. No mortalities of leatherback turtles is anticipated or exempted from the prohibition on incidental take provided by this incidental take statement.

We expect that up to three smalltooth sawfish will be taken during MMHSRP activities each year, for a total of up to 15 smalltooth sawfish over five years. Take would be in the form of harassment by net entanglement or capture. No mortalities of smalltooth sawfish is anticipated or exempted from the prohibition on incidental take provided by this incidental take statement.

We expect that up to three Atlantic sturgeon will be taken during MMHSRP activities each year, for a total of up to 15 Atlantic sturgeon over five years. In total these takes may be of any Atlantic sturgeon DPS including Atlantic sturgeon from the Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, Carolina DPS or South Atlantic DPS. Take would be in the form of harassment by net entanglement or capture. No mortalities of Atlantic sturgeon is anticipated or exempted from the prohibition on incidental take provided by this incidental take statement.

We expect that one each of Gulf sturgeon, shortnose sturgeon, and green sturgeon from the Southern DPS will be taken during MMHSRP activities each year, for a total of up to five Gulf sturgeon, five shortnose sturgeon, and five green sturgeon over five years. Take would be in the form of harassment by net entanglement or capture. No mortalities of Gulf sturgeon, shortnose sturgeon or green sturgeon is anticipated or exempted from the prohibition on incidental take provided by this incidental take statement.

8.2 Effects of the Take

In this opinion, NMFS determined that the amount or extent of anticipated take, coupled with other effects of the proposed action, is not likely to result in jeopardy to the species.

8.3 Reasonable and Prudent Measures

The measures described below are nondiscretionary, and must be undertaken by the Permits Division and the MMHSRP so that they become binding conditions for the exemption in section 7(o)(2) to apply. Section 7(b)(4) of the ESA requires that when a proposed agency action is found to be consistent with section 7(a)(2) of the ESA and the proposed action may incidentally take individuals of ESA-listed species, NMFS will issue a statement that specifies the impact of any incidental taking of endangered or threatened species. To minimize such impacts, reasonable and prudent measures, and term and conditions to implement the measures, must be provided. Only incidental take resulting from the agency actions and any specified reasonable and prudent measures and terms and conditions identified in the incidental take statement are exempt from the taking prohibition of section 9(a), pursuant to section 7(o) of the ESA.

"Reasonable and prudent measures" are nondiscretionary measures to minimize the amount or extent of incidental take (50 CFR 402.02). NMFS believes the reasonable and prudent measures described below are necessary and appropriate to minimize the impacts of incidental take on threatened and endangered species:

1. The Permits Division must ensure that all MMHSRP personnel implement the mitigation measures incorporated as part of Permit No. 18786-01.
2. The Permits Division and the MMHSRP must exercise care when operating in areas and when handling all ESA-listed species to minimize the possibility of injury.
3. The Permits Division and the MMHSRP must monitor and report on all incidental takes of ESA-listed species.

8.4 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA, the Permits Division and the MMHSRP must comply with the following terms and conditions, which implement the reasonable and prudent measures described above and outlines the mitigation, monitoring and reporting measures required by the section 7 regulations (50 CFR 402.14(i)). These terms and conditions are non-discretionary. If the Permits Division and the MMHSRP fail to ensure compliance with these terms and conditions and their implementing reasonable and prudent measures, the protective coverage of section 7(o)(2) may lapse.

The following terms and conditions implement reasonable and prudent measure 1:

1) The Permits Division must ensure that the principle investigator of the MMHSRP ensures that all personnel working under Permit No. 18786-01 have a copy of the permit when conducting emergency response enhancement activities or baseline health research.
2) The Permits Division must ensure that the principle investigator of the MMHSRP ensures that all personnel working under Permit No. 18786-01 are knowledgeable about the terms and conditions in the permit.

3) The Permits Division must ensure that the principle investigator of the MMHSRP ensures that all personnel working under Permit No. 18786-01 and this incidental take statement are knowledgeable of the potential non-target ESA-listed species in the location that an emergency response enhancement activity or baseline health research activity is being conducted.
4) Netting activities must be closely attended and continuously monitored during deployment when netting in areas where non-target ESA-listed animals are likely to be encountered.

The following terms and conditions implement reasonable and prudent measure 2:

1) When conducting MMHSRP activities, a close watch must be made for ESA-listed species that may be present in order to avoid interaction or injury.
2) When vessels are used to conduct MMHSRP activities, they must be operated in a safe manner at slow speeds to avoid interaction or injury of non-target ESA-listed species.
3) All non-target ESA-listed species encountered shall be released as close as possible to the location where they were encountered outside of the MMHSRP activity area to reduce the potential of re-encountering the animal.
4) When released from a vessel or in the vicinity of vessels, ESA-listed species shall be released over the side of the vessel, away from the propeller, and only after ensuring that the vessel's propeller is in the neutral, or disengaged and in areas where they are unlikely to be re-encountered, captured, or injured by vessels.
5) All released ESA-listed species must be observed by MMHSRP personnel, and personnel must document the animal's apparent ability to swim, dive, and behave in a normal manner.
6) Upon incidentally capturing a sea turtle, the MMHSRP, principal investigator, and anyone acting on the MMHSRP's behalf must use care when handling a live turtle to minimize any possible injury; and appropriate resuscitation techniques must be used on any comatose turtle prior to returning it to the water. All sea turtles must be handled according to procedures specified in 50 CFR 223.206(d)(1)(i).
7) Prior to release, sturgeon or sawfish should be held vertically and immersed in water. They should be moved front to back to aid stimulation with freshwater passage over the gills. The fish should be released only when showing signs of vigor and ability to swim away under its own power. A spotter should watch the fish as it is released making sure it stays submerged and does not need additional recovery.
8) Research Vessel Lighting: From May 1 through October 31, sea turtle nesting and emergence season, all lighting aboard research vessel operating within three nautical miles of sea turtle nesting beaches shall be limited to the minimal lighting necessary to comply with U.S. Coast Guard and/or Occupational Safety and Health Administration requirements. All non-essential lighting on the research vessel shall be minimized through reduction, shielding, lowering, and appropriate placement of lights to minimize illumination of the water to reduce potential disorientation effects on female sea turtles approaching the nesting beaches and sea turtle hatchlings making their way seaward from their natal beaches.

The following terms and conditions implement reasonable and prudent measure 3:

1) In all MMHSRP activities, a close watch must be made for ESA-listed species that may be present in order to avoid interaction or injury.
2) Interactions with ESA-listed species authorized in the incidental take statement should be documented, including any pertinent detail (species, type of interaction, location, date, size, water and air temperature, any obvious patterns and photos if possible).
3) The Permits Division and the MMHSRP must immediately stop a particular activity, and the Permits Division must contact the Chief, NMFS ESA Interagency Cooperation Division at 301-427-8405 if authorized take is exceeded in any of the following ways:
   a) More ESA-listed animals other than marine mammals are taken than are anticipated in the incidental take statement and exempted from the take prohibitions,
   b) ESA-listed animals other than marine mammals are taken in a manner not authorized by this permit, or
   c) ESA-listed species other than those exempted from the take prohibitions by this incidental take statement are taken.
4) The Permits Division and the MMHSRP shall report the annual number of incidental takes of each ESA-listed each species that occurs under this incidental take statement. The annual report from the MMHSRP is due by September 30 for each year the permit is valid. The annual report from the Permits Division summarizing how the MMHSRP complied with the incidental take statement and Permit No. 18786-01 is due by October 31 for each year the permit is valid. Reports must be submitted to the Chief, ESA Interagency Coordination Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Silver Spring, MD 20910.

9 CONSERVATION RECOMMENDATIONS

Section 7(a)(1) of the ESA directs Federal agencies to utilize their authorities to further the purposes of the Act by carrying out conservation programs for the benefit of endangered and threatened species. Conservation recommendations are discretionary agency activities to minimize or avoid adverse effects of a proposed action on ESA-listed species or critical habitat, to help implement recovery plans, or to develop information (50 CFR 402.02).

1. **Adaptive Management**

   The Permits and Conservation Division should compile data from MMHSRP annual reports on marine mammal responses to research procedures and on developments in research techniques or technologies that minimize impacts of research on marine mammals. This information should be used to inform the development of future guidance documents and best management practices related to marine mammal research, and should be used to inform the authorization process for future research permits.

2. **Information Sharing**

The Permits and Conservation Division should share the information gleaned from MMHSRP annual reports on marine mammal responses to research and new developments in research techniques, as described in number 1 above, with the Marine Mammal Commission, NMFS Regional Offices, the Endangered Species Act Interagency Cooperation Division, and the broader marine mammal research community, in order to minimize impacts of future scientific research on marine mammals.

3. **Coordination of Research**

The Permits and Conservation Division should track the locations and times of ongoing permitted marine mammal research projects and should encourage coordination between the MMHSRP and other researchers permitted to conduct research on the same species, in the same locations, or at the same times of year, by sharing research vessels and the data they collect in order to minimize disturbance of animals. In addition, the Permits and Conservation Division should continue to coordinate with NMFS Regional Offices, regional species coordinators, existing permit holders conducting research within the Regions, and future applicants, to ensure results of all research activities and other studies on ESA-listed marine mammals are coordinated among the various investigators.

In order for NMFS' Office of Protected Resources Endangered Species Act Interagency Cooperation Division to be kept informed of actions minimizing or avoiding adverse effects on, or benefiting, ESA-listed species or their designated critical habitat, the Permits Division and the MMHSRP should notify the Endangered Species Act Interagency Cooperation Division of any conservation recommendations they implement in their final action.

10 REINITIATION NOTICE

This concludes formal consultation on the proposed actions. As described in 50 CFR §402.16, reinitiation of formal consultation is required where discretionary Federal agency involvement or control over the action has been retained (or is authorized by law) and if: (1) the amount or extent of incidental take is exceeded; (2) new information reveals effects of the agency action that may affect ESA-listed species or critical habitat in a manner or to an extent not considered in this opinion; (3) the agency action is subsequently modified in a manner that causes an effect to ESA-listed species or designated critical habitat not considered in this opinion; or (4) a new species is listed or critical habitat designated that may be affected by the action. In instances where the amount of take is exceeded or an animal is taken lethally or in any other way not anticipated in the incidental take statement, any operations causing such take must cease, pending discussion with the Interagency Cooperation Division and, if warranted, reinitiation.

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