National Marine Fisheries Service Endangered Species Act

Section 7 Biological and Conference Opinion

Action Agencies: 1) National Marine Fisheries Service, Office of Protected Resources, Permits and Conservation Division, and

2) National Marine Fisheries Service, Marine Mammal Health and Stranding Response Program

Activities Considered: 1) Issuance of permit No. 18786–01 to the Marine Mammal Health and Stranding Response Program pursuant to sections 109(h), 112(c), 104(c) and Title IV of the Marine Mammal Protection Act and section 10(a)(1)(A) of the Endangered Species Act, and

2) Implementation of the Marine Mammal Health and Stranding Response Program

Consultation Conducted By: Endangered Species Act Interagency Cooperation Division, Office of Protected Resources, National Marine Fisheries Service

Approved:

Donna S. Wieting
Director, Office of Protected Resources

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1 INTRODUCTION

The Endangered Species Act (ESA) of 1973, as amended (16 USC 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), the United States Fish and Wildlife Service (USFWS), or both depending upon the endangered species, threatened species, or designated critical habitat that may be affected by the action. If a Federal agency's action may affect a listed species or designated critical habitat, the agency must consult with the NMFS, USFWS, or both (50 CFR §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 the NMFS, the USFWS, or both concur with that determination, consultation concludes informally (50 CFR §402.14(b)).

The Federal action agency shall confer with the NMFS, the USFWS, or both, on any action which is likely to jeopardize the continued existence of any proposed species or result in the destruction or adverse modification of proposed critical habitat (50 CFR §402.10). If requested by the Federal agency and deemed appropriate, the conference may be conducted in accordance with the procedures for formal consultation in §402.14.

Section 7(b)(3) of the ESA requires that at the conclusion of consultation, or conference if combined with a formal consultation, the NMFS, the USFWS, or both provide an opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modifytheir designated critical habitat. If either Service determines that the action is likely to jeopardize listed species or destroy or adversely modify critical habitat, that Service 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 the Services to provide an incidental take statement that specifies the impact of any incidental taking and includes reasonable and prudent measures (RPMs) to minimize such impacts and terms and conditions to implement the RPMs.

The action agency for this consultation is the NMFS Office of Protected Resources (NMFS OPR) 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 pursuant to section 10(a)(1)(A) of the ESA and the NMFS OPR Marine Mammal Health and Stranding Response Program (hereafter referred to as "the MMHSRP" or "the Program") pursuant to sections 104c, 109(h), 112(c) and Title IV of the Marine Mammal Protection Act (MMPA).

Consultation in accordance with section 7(a)(2) of the statute (16 USC 1536 (a)(2)), associated implementing regulations (50 CFR. §402), and agency policy and guidance (USFWS and NMFS 1998a) was conducted by the NMFS OPR's ESA Interagency Cooperation Division (hereafter referred to as "we"). This biological opinion (opinion) and incidental take statement were prepared by the NMFS OPR's ESA Interagency Cooperation Division in accordance with section 7(b) of the ESA and implementing regulations at 50 CFR §402.

This document represents the NMFS' opinion on the effects of these actions on endangered and threatened species and designated critical habitat for those species. A complete record of this consultation is on file at the 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 2009d).

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 2014e). 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 2015b).

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. The first event occurred on September 24, 2015, when a juvenile green sea turtle (*Chelonia mydas*) was discovered by the net recovery crew. The turtle's head and front flippers were minimally caught within the mesh of the net, and the turtle was brought onboard the "catcher" vessel to be disentangled and examined by a veterinarian. The turtle was not constricted or fully wrapped in the net, and no injuries were seen. The turtle used all four flippers at full range of motion, and otherwise seemed in good health with a robust body condition. The animal was onboard the vessel for approximately 5-8 minutes and then released from the bow of the "catcher," in the opposite direction of the net as the net pick up was being completed. The second incident occurred the following day, September 25, 2015, when a juvenile loggerhead sea turtle (*Caretta caretta*) was encircled in the net with a dolphin. Before the sea turtle could become entangled in the mesh, the net compass was opened up and the turtle swam out of the net without further incident.

Immediately after each of these events, Dr. Teri Rowles, the principle investigator on permit No. 18786 notified the Permits Division, in compliance with the conditions of the permit. While neither turtle was injured during the encounter, it was determined by the Permits Division on September 25, 2015 that operations should cease, and Dr. Rowles complied by terminating the study early and ceasing all net captures for baseline research activities. However, net captures for emergency response related activities continued.

As a result of these events, on May 23, 2016, the Permits Division and MMHSRP sent us a draft memo requesting to re-initiate consultation in order to evaluate impacts to the non-mammal listed species – sea turtles, fish, and Johnson's sea grass, and their designated critical habitat – resulting from enhancement activities and baseline health research of marine mammals carried out pursuant to Permit No. 18786 and to section 109(h) of the MMPA, and to add incidental take of non-target animals to the incidental take statement of the June 2015 biological opinion.

On May 24, 2016, we met with the Permits Division and MMHSRP to offer technical assistance (pre-consultation) on reinitiation. On May 27, 2016, we sent the Permits Division and MMHSRP comments on the draft memo and requested additional information on the incidental capture events and previous net capture deployments. On June 7, 2016, the MMHSRP and Permits Division provided an updated draft of the memo that also considered effects on Johnson's seagrass. On June 8, 2016, we met with the Permits Division and MMHSRP to provide technical assistance on the ESA-listed species to be considered, mitigation measures, and the MMHSRP's take of non-ESA listed stranded marine mammals pursuant to section 109(h) of the MMPA, which does not fall under Permit No. 1878. On June 10, 2016, we and the Permits Division provided the MMHSRP with comments on the second draft memo. On June 15, 2016, we received an updated draft of the memo and returned the memo to the Permits Division and the MMHSRP with minor comments on the same day. On June 16, 2016, the Permits Division and the MMHSRP sent us the final, official memo and initiation package requesting formal consultation under section 7 of the ESA. After reviewing the memo and initiation package for completeness, we provided minor comments and asked for additional information regarding historic net deployments, and initiated formal consultation on June 21, 2016.

1.2 Consultation History

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

- On June 22, 2016, we asked the Permits Division for addition information regarding the previous consultation for permit No. 932-1489, which was received the same day.
- On June 24, 2016, we asked the MMHSRP for clarification regarding takes of unidentified dolphins (both ESA-listed and non-listed).

- On June 24, 2016, we received a reply to our comments on the initiation package, including the additional data requested on June 21, 2016.
- On June 30, 2016, we asked the Permits Division for any additional detail that may exist on the incidental capture of non-target ESA-listed species during other permitted research net deployments. On July 1, 2016 we received information from the Permits Division on the incidental capture of a smalltooth sawfish during permitted turtle net captures. Additional information regarding the incidental capture of turtles during cetacean net captures from a researcher outside of the MMHSRP was expected to be delivered by July 7, 2016.
- On July 5, 2016, we received a response to our June 24 request for clarification regarding unidentified dolphin takes. On this day, we also provided the Permits Division and the MMHSRP with a summary document, detailing our exposure analysis estimating the likely number of incidental captures of non-target, ESA-listed turtles and fishes, including our addition of green sturgeon - Southern distinct population segment (DPS), which was not initially included in the species list provided in the initiation package.

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. *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.

This consultation was triggered by the incidental take of two ESA-listed turtles. As a consequence of these events, both the Permits Division and the MMHSRP requested re-initiation of consultation. The Permits Division proposes to amend and replace permit No. 18786 (Original Permit) with permit No. 18786-01 (Amended Permit) to include a new appendix for mitigation measures to minimize the impact of incidental take on several ESA-listed sea turtle and fish species. Other than the mitigation measures, the Amended Permit is identical to the Original Permit, and the only change to the MMHSRP will be the implementation of the mitigation measures. However, our consultation evaluates all impacts to listed species and designated critical habitat resulting from the issuance of the Amended Permit and the implementation of the MMHSRP pursuant to the Amended Permit. Thus, the proposed action for this biological opinion encompasses both the issuance of permit No. 18786 as amended (hereafter permit No. 18786–01) and the implementation of the MMHSRP.

2.1 Issuance of Permit No. 18786-01

The Permits Division within the NMFS OPR previously issued the original permit to the MMHSRP for scientific research and enhancement activities. The objectives of the amended permit (No. 18786-01) remain as they were in the original permit (NMFS 2015b):

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 the original and amended permits 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 original permit authorized takes of all marine mammal species under the NMFS's jurisdiction, while the amended permit would provide measures to minimize the impact of take of several non-mammalian ESA-listed marine species range-wide (green turtles, *Chelonia mydas*; hawksbill turtles, *Eretmochelys imbricate*; Kemp's ridley turtles, *Lepidochelys kempii*; leatherback turtles, *Dermochelys coriacea*; loggerhead turtles, *Caretta caretta*; olive ridley 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 that were authorized under the original permit (which are being reconsidered here) are shown in Table 1 and Table 2. The incidental take statement of this opinion provides the anticipated amount and extent of incidental take of non-mammalian ESA-listed species and provides an exemption to the prohibition of the take for those species pursuant to section 7(o)(2) of the ESA. Table 3 indicates the amount of anticipated take identified in the incidental take statement.

The amended permit would cover the 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

[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.*

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 5-year duration of the original permit. In issuance of the amended permit, the Permits Division would specify terms and conditions designed to help mitigate the impact of the MMHSRP on marine mammals and other ESA-listed species. Of particular note in both the original and amended permit is the condition that researchers must immediately stop a particular activity, and the Permit Holder must contact the Chief of the Permits Division for written permission to resume, if take of protected species not exempted occurs. This condition resulted in the MMHSRP halting baseline reasearch activities associated with the capture of the aforementioned ESA-listed sea turtles.

Table 1. Emergency response related enhancement and research activities, incidental harassment, and import/export of marine mammals and marine mammal parts to be 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. exculsive economic zone and at captive facilities and rehabilitation centers.

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,	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
							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	
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;	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.

Line No.	Species	DPS/ Stock	Life Stage	Sex	No. Animals	No. Takes per Animal	Procedures	Details
							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	

Table 2. Authorized research (unrelated to emergency response), incidental harassment, and import/export of marine mammals and marine mammal parts to be 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.

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
1	Dolphin, unidentifie; 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
2	Dolphin, unidentified (Range-wide)	Non-neonat; 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	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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
						(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	
3	Dolphin, unidentified (Range-wide)	Non-neonat; 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
4	Dolphin, unidentified	All; Male and	500	5	Harass/ Sampling	Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey	Small cetacean piggy backing;

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
	(Range-wide)	Female				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	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	Large whale aerial and vessel surveys (manned and unmanned) and associated non-intrusive sampling in the

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
						vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Sample, exhaled air; Tracking; Underwater photo/videography	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
6	Large whale, unidentified (Range-wide)	Non-neonat; 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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
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
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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
							Hawaiian monk seals in the wild and walrus; direct and incidental harassment during any research activity
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;	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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
						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	
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;	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
						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	
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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
							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, suction-cup (e.g., VHF, TDR); Lavage; Mark, freeze brand; Mark, roto tag; Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, monitoring; Observations,	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 tagging, direct and incidental harassment; no captures in the wild; no spider tagging; no
15	Whale, false killer; Main Hawaiian Islands Insular	All; Male and Female	20	5	Harass/ Sampling		

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
16	Whale, killer; Southern Resident	All; Male and Female	20	5	Harass/ Sampling	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	sedation (except in permanent captivity)
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; Range-wide	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			

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
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/ 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; 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;	ESA-listed and MMPA-depleted pinniped 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
26	Seal, bearded; Beringia DPS	All; Male and Female	60	5			
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
						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	
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,	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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
						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	
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;	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
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		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, 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	harassment
35	Dolphin, pantropical spotted; North-eastern Offshore	All; Male and Female	40	5			
36	Pinniped, unidentifie; 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

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
							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
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

Table 3. Annual incidental take of non-target species during research or emergency response anticipated in the incidental take statement in this opinion and exempted from the take prohibitions. Activities may occur year-round on land, beaches, and coastal waters of the U.S and in the U.S. exclusive economic zone.

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
1	Hardshell sea turtle, unidentified (Range-wide)	Non-neonat; Male and Female	5	1	Capture/ Handle/ Release; Harass	Incidental capture and harassment	Incidental take of five total annually of any species including green, hawksbill, Kemp's ridley, loggerhead, or olive ridley sea turtles; live release
2	Leatherback sea turtle, (Range-wide)	Non-neonat; Male and Female	1	1	Capture/ Handle/ Release; Harass	Incidental capture and harassment	Live release
3	Smalltooth sawfish, (Range-wide)	All; Male and Female	2	1	Capture/ Handle/ Release; Harass	Incidental capture and harassment	Live release
4	Atlantic sturgeon, (Range-wide)	Non-neonat; Male and Female	1	1	Capture/ Handle/ Release; Harass	Incidental capture and harassment	Live release

Line No.	Species and Listing Unit/ Stock	Life Stage and Sex	No. Animals	No. Takes/ Animal	Take Action	Procedures	Details
5	Gulf Sturgeon, (Range-wide)	Non-neonat; Male and Female	1	1	Capture/ Handle/ Release; Harass	Incidental capture and harassment	Live release
6	Shortnose sturgeon, (Range-wide)	Non-neonat; Male and Female	1	1	Capture/ Handle/ Release; Harass	Incidental capture and harassment	Live release

In addition to the mitigation measures specified in the application for the original permit, the terms and conditions of the original permit, the PEIS, and our previous biological opinion on the original permit, the Permits Division is also proposing inclusion in the amended permit the mitigation and reporting measures below specifically focused on the incidental take and effects to non-target 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 have been proposed 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 the previous opinions, only those activities in Tables 1 and 2 directed at ESA-listed species were considered, as activities directed on non-listed marine mammals were not anticipated to affect any ESA-listed species. Here we again primarily consider activities directed at ESA-listed marine mammals but now also 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 marine mammals under the NMFS’ jurisdiction, 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 species.
- Temporary holding of non-releasable ESA-listed species until permanent placement is permitted.
- Disentanglement of all 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).

The 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 prinicipal investigator to conduct the specified research activity. More information on the baseline health research component of the Program is Section 2.2.2.

Table 4. Stranding events involving ESA-listed species that were responded to by Stranding Agreement holders under the MMHSRP, from January 2009 through June 2013 (NMFS 2015b).

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	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). The 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 5. Entanglement responses by MMHSRP of ESA-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 5).

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 were two ongoing UMEs that involved ESA-listed species: a cetacean UME in the U.S. Gulf of Mexico, and a pinniped UME in northern Alaska.

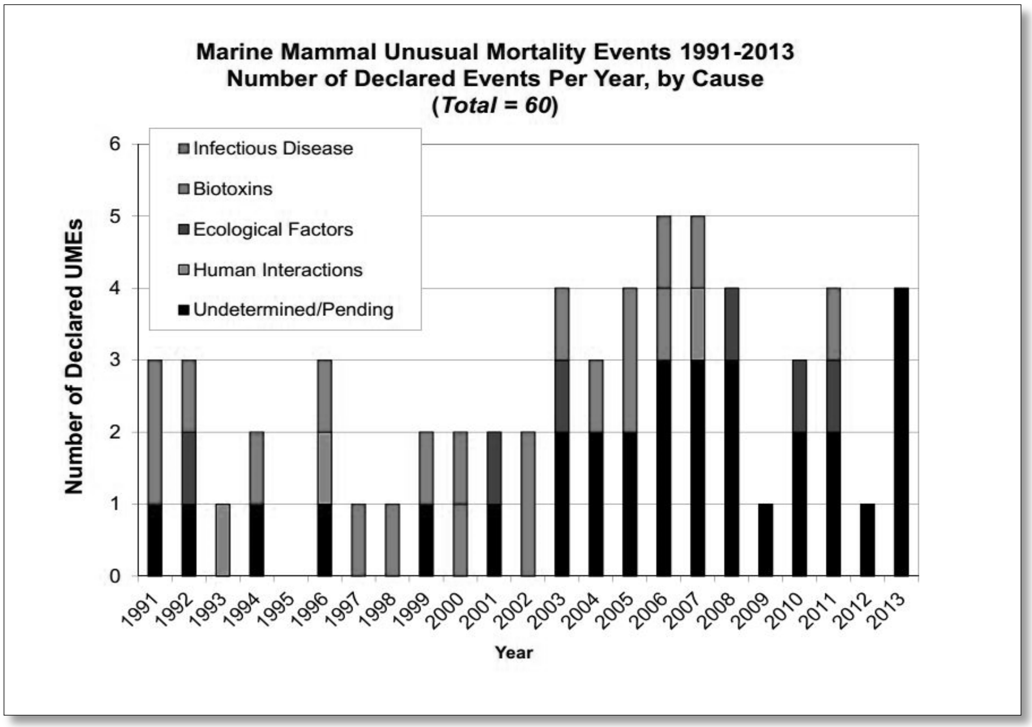

Figure 1. Numbers, and causes, of marine mammal unusual mortality events, from 1991 through 2013. Note that this figure includes both ESA-listed and non-ESA-listed species.

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 prinicipal 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*. 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 the 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*

The NMFS marine mammal veterinarians developed best practices for the release of stranded marine mammals in 2009, called the *Standards for Release*. 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.

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 prinicipal 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. 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 take off 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 ft) at approximately 110 knots (203 km/hr). For right whales, manned surveys would typically be flown at 100 knots (185 km/hr). For smaller cetaceans, manned surveys typically would be flown at an altitude of approximately of 230 meters (750 ft). Large survey aircraft would generally be flown at 110 knots (203 km/hr) and small aircraft would generally be flown at 97 knots (179 km/hr). 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 ft) would be used for pinniped research surveys. The typical altitude would be between 182 to 244 meters (600 to800 ft) at 80 to 100 knots (148-185 km/hr). For Steller sea lion surveys during the breeding season, an altitude of at least 214 meters (700 ft) would be used to collect photographs. In the non-breeding season, surveys would be flown between 150-200 meters (492-655 ft) at a speed of 100-150 knots (185-278 km/hr). 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 take off 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 0 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 next five years. 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 (5-7 meters) outboard motor powered boats. Animals are located by having crew members visually search waters as the boat proceeds at slow speeds (8-16 km/hr). 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 prinicipal 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 dB re µPa at 1 m, 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 harrassment devices are transducers with a source level of 195 dB re µPa and peak energy at 10 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 km 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 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 km, 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 emergency response (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 Atlatnic Costal), killer whales, spinner dolphins (Eastern Tropical Pacific), pantropical spotted dotlphin (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 mamal 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 5-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 4-8 meters deep seine net, deployed at high speed from an 8-meter long commercial fishing motor boat. Small (typically 5-7 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 corrall, 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 mamals 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. 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).

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 (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 *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.

2.2.3.8 *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 and Wells 1972, Irvine et al. 1982, 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.

2.2.3.9 *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.

2.2.3.10 *Holding*

The Permits Division proposes to permit the MMHSRP to oversee short-term holding of animals in a captive setting. Stranded 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 to protect them from becoming oiled. 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 *Minimum Standards for Rehabilitation Facilities*. Facilities holding ESA-listed marine mammals must also follow the *ESA Rehabilitation Procedural*

Directive; under these standards, facilities rehabilitating ESA-listed species are required to have quarantine protocols to minimize the spread of infectious diseases within the facility. Research 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 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.

2.2.3.11 *Release*

Stranded ESA-listed marine mammals are admitted into rehabilitation with the intent to release them back to the wild once healthy. As previously described, animals are assessed following the Standards for Release by the attending veterinarian at the rehabilitation facility. Rehabilitation facilities must also follow Procedural Directive 02-308-01 when rehabilitating ESA-listed marine mammals. Once an animal is deemed releasable by the 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. 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. 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.

2.2.3.12 *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 prinicipal 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 and Wells 1996, Schwacke et al. 2002, Hansen et al. 2004, Wells et al. 2004, Wells and Balmer 2005)). 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 prinicipal 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., (Romano et al. 1992, Bryan et al. 2007, Maucher et al. 2007, Venn-Watson and Ridgway 2007, Mancia et al. 2014).

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 (UAVs) 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 rehabiliatation, 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 and Wells 1996, Schwacke et al. 2002, Hansen et al. 2004, Wells et al. 2004, Wells and Balmer 2005, Norman 2012, Norman et al. 2012). 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 (Wenzel et al. 1993, McHuron et al. 2014), 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 prinicipal 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 (Nachtigall et al. 2007, Mulsow et al. 2012). 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, 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 proposed 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 marine mammal specimens. 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. Importation privileges are also necessary to import live animals of both ESA-listed and non-listed species for treatment. Situations that may warrant exportation of animals includes: animals that were previously imported (alive), animals that stranded in the U.S. but near a foreign border, 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).

The MMHSRP proposes to import or export an unlimited number and kinds of marine mammal specimens, including cell lines, at any time during the year. Specimens would be taken from the all ESA-listed species. 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.

All ESA-listed marine mammal species may be imported for medical treatment or exported for translocation for continued rehabilitation and/or release at an appropriate location any time of the year. Transport will be conducted following the protocols described above (Section 2.2.3.6). If necessary, the 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.

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 this opinion includes all areas where MMHSRP activities may occur, including the land or water within the U.S. coastal zone of the U.S., its territories, and possessions, and adjacent marine waters. The coastal zone includes coastal waters, adjacent shorelands, intertidal areas, salt marshes, wetlands, and beaches. Activities may occur in the marine waters of the U.S. and its territories, including the U.S. exclusive economic zone (Figure 2). Activities may occur in inland waters of the U.S. in response to out-of-habitat marine mammals, as well as in rehabilitation facilities.

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 and responding to entangled marine mammals could occur in international waters worldwide. Transfer of tissue samples may also occur within the U.S. and internationally.

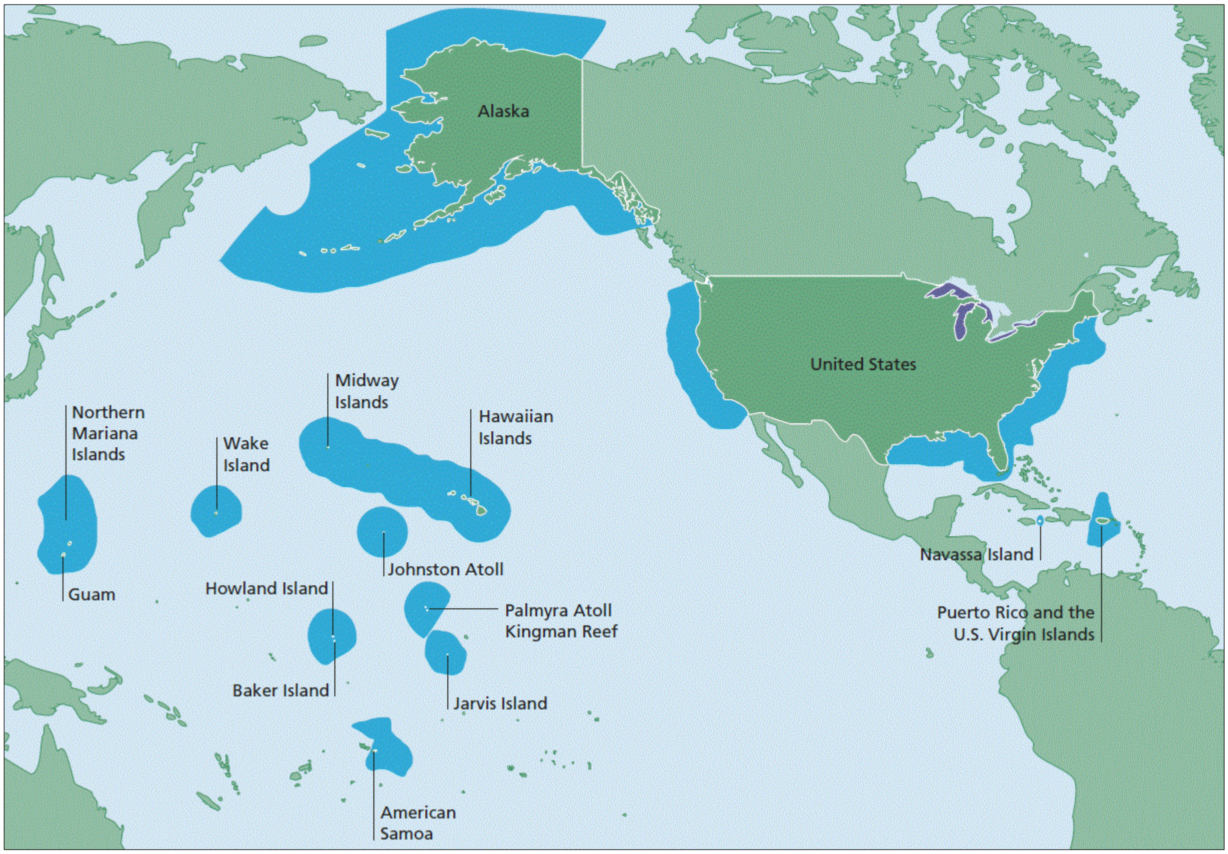

Figure 2. The exclusive economic zone of the United States (shown in dark blue).

2.4 Interrelated and Interdependent Activities

Interrelated actions are those that are part of a larger action and depend on the larger action for their justification. We consider the issuance of the original permit interdependent with the proposed amendment and implementation of the MMHSRPS. Interdependent actions are those that have no independent utility apart from the action under consideration. There are no interdependent activities associated with the proposed action.

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 Overview of the NMFS' 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 ESA-listed and Designated Critical Habitat

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 6 below, along with their regulatory status.

Table 6. ESA-listed species and designated critical habitat that may be affected by the proposed action of permiting and carrying out the marine mammal health and stranding response program.

Marine Mammals – Cetaceans			
Species	**ESA Status**	**Critical Habitat**	**Recovery Plan**
Beluga Whale *(Delphinapterus leucas)* • Cook Inlet DPS	E – 73 FR 62919	76 FR 20180	– –
Blue whale *(Balaenoptera musculus)*	E – 35 FR 18319	– –	1998 document
Bowhead whale (*Balaena mysticetus*)	E – 35 FR 18319	– –	– –
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
Humpback Whale[3] (*Megaptera novaeangliae*)	E – 35 FR 18319 and 80 FR 22304 (Proposed)	– –	55 FR 29646
Killer Whale (*Orcinus orca*) • Southern Resident DPS	E – 70 FR 69903	71 FR 69054	73 FR 4176
North Atlantic Right Whale (*Eubalaena glacialis*)	E – 73 FR 12024	59 FR 28805 81 FR 4837	70 FR 32293
North Pacific Right Whale (*Eubalaena japonicus*)	E – 73 FR 12024	73 FR 19000 71 FR 38277	78 FR 34347

[3] *Humpback whales are currently proposed to be divided into several distinct population segments with updated listing determinations. Two proposed DPS considered in this consulations are proposed to be listed at threatened under the ESA.*

Sei whale (*Balaenoptera borealis*)	E – 35 FR 18319	– –	76 FR 43985
Sperm Whale (*Physeter macrocephalus*)	E – 35 FR 18319	– –	75 FR 81584
Marine Mammals – Pinnipeds			
Species	**ESA Status**	**Critical Habitat**	**Recovery Plan**
Bearded seal (*Erignathus barbatus*) • Beringia DPS[4]	Appeal pending	– –	– –
Guadalupe fur seal (Arctocephalus townsendi)	T – 50 FR 51252	– –	– –
Hawaiian monk seal (*Neomonachus schauinslandi*)	E– 41 FR 51611	53 FR 18988 80 FR 50925	72 FR 46966
Ringed seal (*Phoca hispida hispida*) • Arctic subspecies[5]	Appeal pending	79 FR 73010*	– –
Steller sea lion (*Eumetopias jubatus*) • Western DPS	E– 62 FR 24345	58 FR 45269	1992 document
Sea Turtles			
Species	**ESA Status**	**Critical Habitat**	**Recovery Plan**
Hawksbill sea turtle (*Eretmochelys imbricata)*	E – 35 FR 8491	63 FR 46693	57 FR 38818
Green sea turtle (*Chelonia mydas*) • Central South Pacific DPS • Central West Pacific DPS • Central North Pacific • East Pacific DPS • North Atlantic DPS		63 FR 46693	
Kemp's ridley sea turtle (*Lepidochelys kempii*)	E – 35 FR 18319	__	75 FR 12496
Leatherback sea turtle (*Dermochelys coriacea*)	E – 61 FR 17	44 FR 17710 77 FR 4170	63 FR 28359
Loggerhead sea turtle (*Caretta caretta*) • South Pacific DPS • Northwest Atlantic DPS • North Pacific DPS	T - 76 FR 58868 E - 76 FR 58868	79 FR 39856	63 FR 28359
Olive ridley sea turtle (*Lepidochelys olivacea*) • Mexico Pacific coast breeding colonies • all other populations	E - 43 FR 32800 E - 43 FR 32800	– –	63 FR 28359

[4] *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). NMFS has appealed that decision.*

[5] *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.*

Marine Fishes			
Species	**ESA Status**	**Critical Habitat**	**Recovery Plan**
Atlantic Sturgeon (Atlantic subspecies, *Acipenser oxyrinchus oxyrinchus*) • Gulf of Maine DPS • New York Bight DPS • Chesapeake Bay DPS • Carolina DPS • South Atlantic DPS	T - 77 FR 5880 E - 77 FR 5880 E - 77 FR 5880 E - 77 FR 5914 E - 77 FR 5914	81 FR 41926* 81 FR 36077*	– –
Atlantic Sturgeon (Gulf subspecies, *Acipenser oxyrinchus desotoi*)		68 FR 13370	
Shortnose sturgeon (*Acipenser brevirostrum*)	E – 32 FR4001	-- --	63 FR 69613
Green sturgeon (*Acipenser medirostris*) • Southern DPS		74 FR 52300	
Smalltooth sawfish (*Pristis pectinata*) • U.S. portion of range	E – 68 FR 15674	74 FR 45353	74 FR 3566
Scalloped Hammerhead Shark, (*Sphyrna lewini*) – Eastern Atlantic DPS	E -- 79 FR 38213	-- --	-- --
Scalloped Hammerhead Shark, (*Sphyrna lewini*) – Eastern Pacific DPS	E -- 79 FR 38213	-- --	-- --
Scalloped Hammerhead Shark, (*Sphyrna lewini*) – Central and Southwest Atlantic DPS	T -- 79 FR 38213	-- --	-- --
Nassau grouper (*Epinephelus striatus*)	T -- 81 FR 42268	-- --	-- --
Steelhead Trout, (*Oncorhynchus mykiss*) – Southern California DPS	E -- 71 FR 834	70 FR 52488	77 FR 1669
Steelhead Trout, (*Oncorhynchus mykiss*) – South-Central California Coast DPS	T -- 71 FR 834	70 FR 52488	78 FR 77430
Steelhead Trout, (*Oncorhynchus mykiss*) – Central California Coast DPS	T -- 71 FR 834	70 FR 52488	80 FR 60125
Steelhead Trout, (*Oncorhynchus mykiss*) – California Central Valley DPS	T -- 71 FR 834	70 FR 52488	79 FR 42504
Steelhead Trout, (*Oncorhynchus mykiss*) – Northern California DPS	T -- 71 FR 834	70 FR 52488	80 FR 60125
Steelhead Trout, (*Oncorhynchus mykiss*) – Lower Columbia River DPS	T -- 71 FR 834	70 FR 52630	78 FR 41911
Steelhead Trout, (*Oncorhynchus mykiss*) – Upper Willamette River DPS	T -- 71 FR 834	70 FR 52630	76 FR 52317
Steelhead Trout, (*Oncorhynchus mykiss*) – Middle Columbia River DPS	T -- 71 FR 834	70 FR 52630	74 FR 50165
Steelhead Trout, (*Oncorhynchus mykiss*) – Upper Columbia River DPS	T -- 71 FR 834	70 FR 52630	72 FR 57303

Steelhead Trout, (*Oncorhynchus mykiss*) – Snake River Basin DPS	T -- 71 FR 834	70 FR 52630	Draft Recovery Plan (2011)
Steelhead Trout, (*Oncorhynchus mykiss*) – Puget Sound DPS	T -- 72 FR 26722	81 FR 9251	72 FR 2493
Atlantic Salmon, (*Salmo salar*) – Gulf of Maine DPS	E -- 74 FR 29344	74 FR 29300	Draft Recovery Plan (2016)
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Sacramento River Winter-Run ESU	E -- 70 FR 37160	58 FR 33212	79 FR 42504
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Central Valley Spring-Run ESU	T -- 70 FR 37160	70 FR 52488	79 FR 42504
Chinook Salmon, (*Oncorhynchus tshawytscha)* – California Coastal ESU	T -- 70 FR 37160	70 FR 52488	80 FR 60125
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Upper Willamette River ESU	T -- 70 FR 37160	70 FR 52630	76 FR 52317
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Lower Columbia River ESU	T -- 70 FR 37160	70 FR 52630	78 FR 41911
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Upper Columbia River Spring-Run ESU	E -- 70 FR 37160	70 FR 52630	72 FR 57303
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Puget Sound ESU	T -- 70 FR 37160	70 FR 52630	72 FR 2493
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Snake River Fall-Run ESU	T -- 70 FR 37160	58 FR 68543	Draft Recovery Plan (9/2015)
Chinook Salmon, (*Oncorhynchus tshawytscha)* – Snake River Spring/Summer Run ESU	T -- 70 FR 37160	64 FR 57399	Draft Recovery Plan (2011)
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*) – Southern Oregon & Northern California Coasts ESU	T -- 70 FR 37160	64 FR 24049	79 FR 58750
Coho Salmon, (*Oncorhynchus kisutch*) – Oregon Coast ESU	T -- 73 FR 7816	73 FR 7816	80 FR 61379
Chum Salmon, (*Oncorhynchus keta*) – Columbia River ESU	T -- 70 FR 37160	70 FR 52630	78 FR 41911
Chum Salmon, (*Oncorhynchus keta*) – Hood Canal Summer-Run ESU	T -- 70 FR 37160	70 FR 52630	Recovery Plan (6/2005)
Sockeye Salmon, (*Oncorhynchus nerka*) – Snake River ESU	E -- 70 FR 37160	58 FR 68543	80 FR 32365
Sockeye Salmon, (*Oncorhynchus nerka*) – Ozette Lake ESU	T -- 70 FR 37160	70 FR 52630	74 FR 25706
Bocaccio, (*Sebastes paucispinis*) – Puget Sound/Georgia Basin DPS	E -- 75 FR 22276	79 FR 68041	-- --
Canary Rockfish, (*Sebastes pinniger*) – Puget Sound/Georgia Basin DPS	T -- 75 FR 22276	79 FR 68041	-- --

Yelloweye Rockfish, (*Sebastes rubberimus*) – Puget Sound/Georgia Basin DPS	T -- 75 FR 22276	79 FR 68041	-- --
Eulachon, (*Thaleichthys pacificus*) – Southern DPS	T -- 75 FR 13012	76 FR 65323	-- --
Marine Plants			
Species	**ESA Status**	**Critical Habitat**	**Recovery Plan**
Johnson's seagrass	T -- 63 FR 49035	65 FR 17786	67 FR 62230

Note: "E" denotes "endangered" under the ESA; "T" denotes threatened" under the ESA. If, in the "critical habitat" column, a Federal Register notice is not listed, then critical habitat has not been designated for the species. A * denotes proposed critical habitat.

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 marine fishes, including: bocaccio, eulachon, Nassau grouper, canary rockfish, yelloweye rockfish, Atlantic salmon, all pacific salmon species, scalloped hammerhead shark, and steelhead. In addition, the action area overlaps with the range of the Gulf grouper, which is proposed to be listed as endangered (80 FR 57314). Interactions with any of these fish species during an enhancement activity is not expected to occur because MMHSRP enhancement activites 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). 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 ESA-listed fish species were near a netting activity, they would 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 Critical Habitat

Critical habitat has been designated or proposed for a number of the species listed in Table 6. 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 would interact with these features.

Further, the MMHSRP activities would not interact with 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 will not be affected.

As determined in the original biological opinion for Permit No. 18786 (NMFS 2015b), the MMHSRP activities would not interact with 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 polution 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 will not be affected.

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 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 impacts to the quantity, quality, or availability of the essential physical or biological features such as adequate water quality, salinity levels, 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 affect Johnson’s seagrass and its designated critical habitat.

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)

The beluga whale (*Delphinapterus leucas*) is a small, toothed, white whale. The Cook Inlet DPS resides year-round within Cook Inlet, in the Gulf of Alaska. It was listed as endangered under the ESA, effective December 22, 2008 (73 FR 62919). We used information available in the final rule, the 2008 Status Review (Hobbs et al. 2008), the 2013 stock assessment report (Allen and Angliss 2013d) and the 2015 aerial abundance estimate report (Shelden et al. 2015) to summarize the status of the DPS, as follows.

Life history

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

Population dynamics

The most recent abundance estimate for the Cook Inlet DPS is 340 individuals (Shelden et al. 2015). The population was estimated at 1,300 animals in 1979 (Calkins 1983). A statistically significant declining trend in abundance was detected between 1994 and 1998 when subsistence removals led to an estimated 47 percent decline in the population (Hobbs et al. 2000) (Figure 3). Despite restrictions on subsistence hunts since 1998, the population is not growing as expected, and has instead declined at a rate of -1.3 percent/year over the period since management of the hunt began (1999-2014) (Shelden et al. 2015). The 10-year trend for the period 2004-2014 was -0.4 percent /year (i.e., a declining trend) (Shelden et al. 2015). The annual abundance estimates for the period 1994-2014 are shown in Figure 3.

The Cook Inlet beluga whale DPS is endangered largely as a result of over-exploitation in the form of directed hunting. The enactment of the MMPA made the killing of marine mammals illegal in U.S. waters. However, the killing of Cook Inlet belugas continued as a result of a provision in the MMPA (section 101(b)) that allows for the harvest of marine mammals by Alaska natives for subsistence use. Between 1993 and 1999, the annual subsistence hunt resulted in the deaths of between 30 and over 100 animals, with an average of 77 belugas killed in the years 1995–1998 (Mahoney and Shelden 2000). A steep decline in abundance estimates between 1994 and 1998 led to a federal moratorium on Cook Inlet beluga whale hunts, except for limited subsistence hunts by Alaska Natives. From 2001 through 2004, a total of three Cook Inlet belugas were killed in these hunts, in accordance with federal harvest plans; though legal hunts continued through 2008, no deaths in the population have been recorded as a result of legal hunts since 2004.

Starting in 2010, five year harvest levels were implemented based on the average abundance in the previous five year period and the growth rate over the previous 10-year period; no harvest is allowed if the previous five year average abundance is less than 350 individuals. Because abundance estimates have not exceeded 350 individuals since this rule was established (73 FR 60976; 15 October 2008), no legal hunts have occurred since 2008.

Though subsistence removals through the 1990s are sufficient to account for the declines in abundance, other factors now threaten the population. Since the early 1990s, over 200 belugas have stranded along the mudflats in upper Cook Inlet, often resulting in death; the cause is uncertain but may be linked with the extreme tidal fluctuations, predator avoidance, or pursuit of prey. Additional threats include: changes in prey availability due to natural environmental variability, ocean acidification, and commercial fisheries; climatic changes affecting habitat; competition with fisheries; increased predation by killer whales; contaminants; sound; vessel traffic; urban runoff; construction projects; and physical habitat modifications that may occur as Cook Inlet becomes increasingly urbanized (Moore and Demaster 2000, Lowry et al. 2006).

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 – 75 kHz (Richardson et al. 1995). They call at frequencies of 0.26- 20 kHz and echolocate at frequencies of 40-60 kHz and 100-120 kHz (Blackwell and Greene 2002).

Status summary

The Cook Inlet beluga whale DPS is an endangered “species” that continues to decline in abundance despite the fact that hunting, the initial cause of endangerment, has ended. Its resilience to future perturbation is low because of the following factors: the population is small (N = 340) and has not grown as expected following the harvest moratorium; the population’s limited range means Cook Inlet beluga whales are more vulnerable to catastrophic events; and if the current DPS is extirpated, it is unlikely other belugas would repopulate Cook Inlet, resulting in a permanent loss of a significant portion of the beluga whale range (Hobbs et al. 2008).

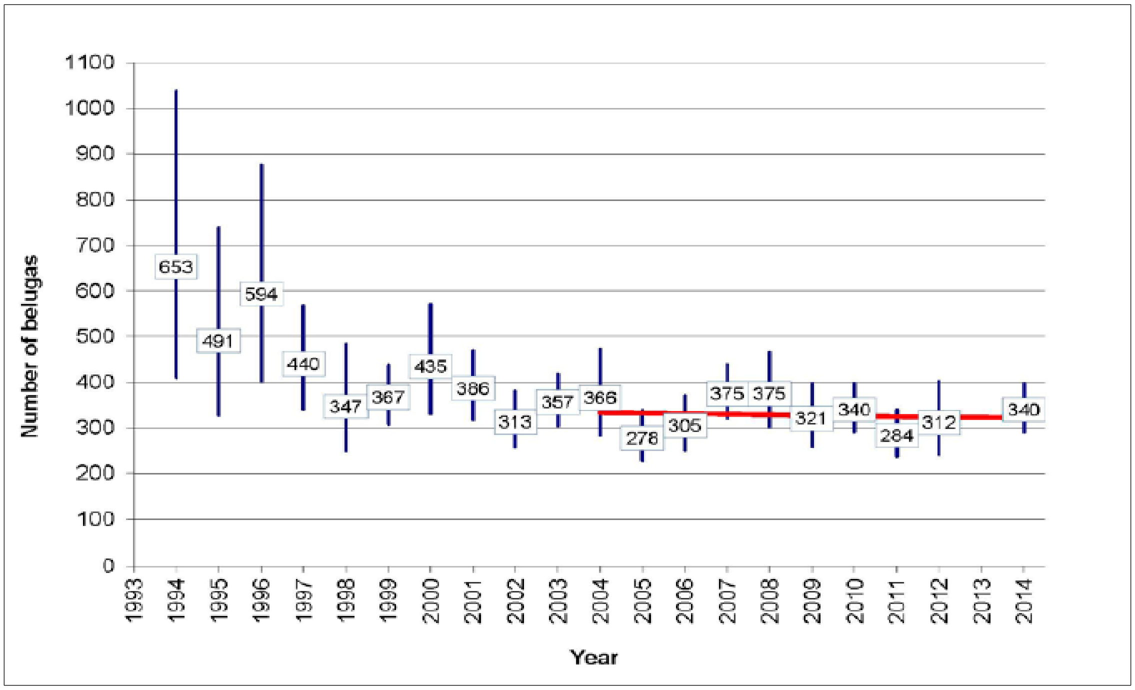

Figure 3. Abundance estimates for Cook Inlet beluga whales (vertical bars represent 95 percent confidence intervals for revised coefficients of variation) (Shelden et al. 2015).

4.2.2 Blue Whale

The blue whale (*Balaenoptera musculus*) is the largest animal on earth and occurs in coastal and pelagic waters in all oceans. Some suggest there may be as many as 10 global populations, while others suggest that the species is composed of a single panmictic population (Gambell 1979, Reeves et al. 1998, Gilpatrick and Perryman. 2009); four stocks are believed to exist in U.S. waters. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the recovery plan (NMFS 1998b) and recent stock assessment and status reports (Sears and Calambokidis 2002, NMFS 2011c) to summarize the status of the species, as follows.

Life history

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

Population dynamics

There are currently an estimated 5,000-12,000 blue whales worldwide. Three stocks occur in U.S. waters: the eastern North Pacific, western North Pacific, and western North Atlantic. For the eastern North Pacific stock, the best estimate of abundance is 1,647 whales (Calambokidis and Barlow 2013); based on mark-recapture estimates, there is no evidence of a population size increase in this population since the early 1990s. There is not currently a reliable estimate of population size for the western North Pacific stock. The limited data collected on the western North Atlantic stock do not allow for an estimate of abundance of this population; a count of 440 recognizable individuals, from photo-identification data solely within the Gulf of St. Lawrence, is considered to be a minimum population estimate. The species 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 1910-1965. Commercial whaling no longer represents a threat to the species, but blue whales are currently threatened by ship strikes, entanglement in fishing gear, pollution, and sound.

Acoustics

Direct studies of blue whale hearing have not been conducted, but it is assumed that blue whales can hear the same low frequencies that they produce and are likely most sensitive in this frequency range (Richardson et al. 1995, Ketten 1997). Blue whales produce prolonged low frequency vocalizations that include moans in the range from 12.5-400 Hz, with dominant frequencies from 16-25 Hz, and songs that span frequencies from 16-60 Hz that last up to 36 seconds, repeated every one to two minutes (see Cummings and Thompson 1971, Cummings and Thompson 1977, Edds 1982, Thompson and Friedl 1982, McDonald et al. 1995, Edds-Walton 1997). Although available data do not presently suggest traumatic injury from sonar, the general trend in increasing ambient low-frequency sound in the deep oceans of the world, primarily from ship engines, could impair the ability of blue whales to communicate or navigate through these vast expanses (Aburto et al. 1997, Clark 2006).

Status summary

The blue whale is an endangered species with global abundance estimated at between 5,000-12,000 animals, which is a fraction of the 200,000 or more that are estimated to have populated the oceans prior to whaling. Commercial whaling, the primary cause of the population's decline over the nineteenth and twentieth centuries, no longer represents a threat to the species. Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, it has not recovered to pre-exploitation levels.

4.2.3 Bowhead Whale

The bowhead whale (*Balaena mysticetus*) has a massive bow-shaped skull that is over 16.5 feet (5 meters) long and about 30-40 percent of their total body length. This large skull allows the bowhead whale to break through thick ice with its head. It has a blubber layer that is 17-19 inches (43-50 centimeters) thick, the thickest blubber of any whale species. Bowhead whales only occur at high latitudes in the northern hemisphere and have a disjunctive circumpolar distribution. Four stocks have been identified, but only the Western Arctic population occurs in U.S. waters (i.e., waters of northern and western Alaska). The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the most recent stock assessment (Allen and Angliss 2013c) to summarize the status of the species, as follows.

Life history

The gestation period of bowhead whales is approximately 12-16 months. The calving interval is 3.5-7 years. Bowhead whales reach sexual maturity at approximately 20 years of age. The stock migrates annually from wintering areas in the northern Bering Sea, through the Chukchi Sea in the spring, to the Beaufort Sea, where they spend most of the summer, before returning to the Bering Sea in the fall to overwinter. During winter and spring, bowhead whales are closely associated with sea ice (Quakenbush et al. 2010). The bowhead spring migration follows fractures in the sea ice around the coast of Alaska. During the summer, most of the population is in relatively ice-free waters in the southeastern Beaufort Sea, an area often exposed to industrial activity related to petroleum exploration (Richardson et al. 1987). Bowhead whales feed on concentrations of zooplankton throughout their range.

Population dynamics

The 2004 population estimate of the Western Arctic stock of bowhead whales was 12,631 individuals, representing an annual increase of 3.4 percent from 1978-2001. Population abundance has more than doubled since the 1970s. The species is endangered as a result of past commercial whaling, which started in the early sixteenth century near Labrador and spread to the Bering Sea by the mid-nineteenth century. Prior to commercial whaling, the minimum global population estimate was 50,000 whales, with 10,400 to 23,000 in the Western Arctic stock. Commercial whaling reduced this stock to less than 3,000 individuals by the mid-twentieth century. Commercial whaling no longer occurs, but bowhead whales are killed by entanglement in fishing gear (minimum average annual entanglement rate = 0.2) and subsistence harvest (average annual take = 38 whales). Other concerns include climate change and oil and gas development in the Arctic, likely leading to ship strikes, pollution, and sound.

Acoustics

Bowhead whales produce songs of an average source level of 185 ±2 dB rms re 1 mPa at 1 meters centered at a frequency of 444 ±48 Hz (Roulin et al. 2012). Given background sound, this allows bowheads whales an active space of 40 to 130 km (Roulin et al. 2012).

Status summary

The bowhead whale is an endangered species, with a U.S. population abundance of approximately 12,631 whales and an increasing population trend. The major threat to its continued existence, commercial whaling, has ceased. Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, it has not recovered to pre-exploitation levels, and new threats (such as climate change and increased vessel traffic in the Arctic) are likely to reduce the species resilience in the near future.

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

The Main Hawaiian Islands insular false killer whale (*Pseudorca crassidens*) is a geographically, genetically, and behaviorally defined DPS of a widely distributed toothed whale. False killer whales are large members of the dolphin family. Females reach lengths of 15 feet (4.5 meters), while males are almost 20 feet (6 meters). In adulthood, false killer whales can weigh approximately 1,500 pounds (700 killograms). They have a small conical head without a beak, their dorsal fin is tall and their flippers (pectoral fins) have a distinctive hump or bulge in the middle of the front edge. Their body shape is more slender than other large delphinids. The DPS was listed as endangered on November 28, 2012 (77 FR 70915). We used information available in the status review (Oleson et al. 2010) and recent stock assessment reports to summarize the status of the species, as follows.

Life history
The Main Hawaiian Islands insular DPS appears to be genetically distinct from pelagic false killer whales, the result of a unique social system, reproductive isolation, and/or habitat specialization. The gestation period of false killer whales is 14-16 months, and calves are nursed for 18-24 months. They reach sexual maturity at 12 years of age, and the average calving interval is seven years. False killer whales feed primarily on fish. Social foraging and prey sharing has been observed.

Population dynamics
The best estimate of population size, based on surveys from 2006-2009, is 170 individuals. This is likely an overestimate, as missed matches were discovered after the mark-recapture analyses were complete (Oleson et al. 2010). In 1989, aerial surveys indicated three large groups of Hawaiian insular false killer whales, with estimates of 470, 460, and 380 individuals; the largest group seen in 1989 is more than three times larger than the current best estimate of the population size for the Main Hawaiian Islands insular DPS. Modeling indicates that the DPS has declined at an average annual rate of nine percent since 1989 (Oleson et al. 2010). The major threats to the species are competition for food with commercial fisheries, fisheries interactions including hooking, entanglement, and intentional harm by fishers, exposure to environmental contaminants, and small population size, including inbreeding depression and Allee effects.

Status summary
The Main Hawaiian Islands insular false killer whale is an endangered DPS with a total abundance of approximately 170 individuals (though this is likely an overestimate). The population is declining. Though relatively little is known about the DPS, its resilience to additional perturbations is assumed to be small due to its small and declining population size.

4.2.5 Fin Whale

The fin whale (*Balaenoptera physalus*) is the second largest baleen whale and is widely distributed in the world's oceans, with the high-latitude limit of their range set by ice and the lower-latitude limit by warm water of approximately 15° C (Sergeant 1977). The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the recovery plan (NMFS 2010d), the five-year review (NMFS 2011a), and recent stock assessment reports to summarize the status of the species, as follows.

Life history

Fin whales reach sexual maturity between 5-15 years of age (Lockyer 1972, Gambell 1985, COSEWIC 2005). Mating and calving occurs primarily from October-January, gestation lasts approximately 11 months, and nursing occurs for 6-11 months (Hain et al. 1992, Boyd et al. 1999). The average calving interval in the North Atlantic is estimated at about 2-3 years (Christensen et al. 1992, Agler et al. 1993). Parturition and mating occurs in lower latitudes during the winter season, while intense foraging occurs at high latitudes during the summer. Although seasonal migration occurs between these foraging and breeding locations, fin whales have been acoustically detected throughout the North Atlantic Ocean and Mediterranean Sea year-round, suggesting that not all individuals follow a set migratory pattern (Notarbartolo-Di-Sciara et al. 1999, Simon et al. 2010). Fin whales eat pelagic crustaceans (mainly euphausiids or krill) and schooling fish such as capelin, herring, and sand lance. The availability of sand lance, in particular, is thought to have had a strong influence on the distribution and movements of fin whales along the Atlantic coast of the United States.

Population dynamics

There are over 100,000 fin whales worldwide. There are two recognized subspecies of fin whales, *Balaenoptera physalus physalus*, which occurs in the North Atlantic Ocean, and *B. p. quoyi*, which occurs in the Southern Ocean. These subspecies and North Pacific fin whales appear to be organized into separate populations, although there is a lack of consensus in the published literature as to population structure. Of the three – seven stocks in the North Atlantic (N approximately 50,000), one occurs in U.S. waters, where the best estimate of abundance is 3,522 whales. There are three stocks in U.S. Pacific waters: Northeast Pacific (N_{min} =5,700), Hawaii (N_{min} = 101), and California/Oregon/Washington (N_{min} = 3,269). Abundance appears to be increasing in Alaska (4.8 percent annually) and possibly California. Trends are not available for other stocks due to insufficient data. Abundance data for the Southern Hemisphere stock are limited. There were an estimated 85,200 whales in 1970. The species is endangered as a result of past commercial whaling. In the North Atlantic, at least 55,000 fin whales were killed between 1910 and 1989. In the North Pacific, at least 74,000 whales were killed between 1910 and 1975. Approximately 704,000 whales were killed in the Southern Hemisphere from 1904 to 1975. Fin whales are still killed under the International Whaling Commission's "aboriginal subsistence whaling" in Greenland, under Japan's scientific whaling program, and via Iceland's formal objection to the Commission's ban on commercial whaling. Additional threats include: ship strikes, reduced prey availability due to overfishing or climate change, and sound.

Acoustics
Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same low frequencies that they produce and are likely most sensitive to this frequency range (Richardson et al. 1995, Ketten 1997). Fin whales produce a variety of low-frequency sounds in the 10-200 Hz range (Watkins 1981, Watkins et al. 1987, Edds 1988, Thompson et al. 1992). Source levels for fin whale vocalizations are 140-200 dB re 1μPa·m (Erbe 2002a, Clark and Ellison. 2004). Although their function is still debated, low-frequency fin whale vocalizations travel over long distances and may aid in long-distance communication (Payne and Webb 1971, Edds-Walton 1997). 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 humpbacks (Croll et al. 2002). These vocal bouts last for a day or longer (Tyack 1999).

Status summary
The fin whale is an endangered species with worldwide abundance of more than 100,000 individuals. The original cause of the species' decline, commercial whaling, has been significantly reduced. The species' large population size may provide some resilience to current threats, but trends are largely unknown.

4.2.6 Humpback Whale

The humpback whale (*Megaptera novaeangliae*) is a widely distributed baleen whale, distinguishable by its long flippers and dark grey appearance, with variable areas of white on the fins, bellies, and flukes. The coloration of flukes is unique to individual whales. The species was listed as endangered under the Endangered Species Preservation Act of 1969 on December 2, 1970 (35 FR 18319), and they remain endangered under the ESA. On March 21, 2015, the NMFS issued a proposed rule to divide the globally-listed endangered species into 14 DPSs, to remove the current species-level listing, and, in its place, to list two DPSs as endangered (the Cape Verde Islands/Northwest Africa and the Arabian Sea DPSs) and two DPSs as threatened (the Western North Pacific and the Central America DPSs) (80 FR 22303). We used information available in the recovery plan (NMFS 1991), recent stock assessment reports (Allen and Angliss 2014a, Carretta et al. 2014, NMFS 2014h), the status report (COSEWIC 2011), NMFS species information (NMFS 2015c), to summarize the status of the species, as follows.

Life history
The lifespan of humpback whales is estimated to be 80-100 years. The gestation period of humpback whales is 11 months, and calves are nursed for 12 months. The average calving interval is 2-3 years and sexual maturity is reached at 5-11 years of age. Humpback whales inhabit waters over or along the continental shelf and oceanic islands. They winter at low latitudes, where they calf and nurse, and summer at high latitudes, where they feed. Humpbacks exhibit a wide range of foraging behaviors and feed on a range of prey types, including small schooling fishes, krill, and other large zooplankton. In a review of humpback whale social

behavior, Clapham (1996) reported that they form small, unstable social groups during the breeding season and form small groups that occasionally aggregate on concentrations of food during the feeding season. The breeding season can best be described as a floating lek or male dominance polygyny (Clapham 1996).

Population dynamics
There are over 60,000 humpback whales worldwide, occurring primarily in the North Atlantic, North Pacific, and Southern Hemisphere. Current estimates indicate approximately 20,000 humpback whales in the North Pacific, with an annual growth rate of 4.9 percent (Calambokidis 2010). As of 1993, there was an estimated 11,570 humpback whales in the North Atlantic, growing at a rate of three percent annually (Stevick et al. 2003). The Southern Hemisphere supports more than 36,000 humpback whales and is growing at a minimum annual rate of 4.6 percent (Reilly et al. 2008). Though all populations of humpback whales are depressed relative to pre-exploitation levels, population growth appears to be positive. Growth rates for populations worldwide vary between 3.1 to 10.0 percent (Katona and Beard 1990, Barlow 1997, Stevick et al. 2003, Angliss and Outlaw 2005, Calambokidis et al. 2008, Punt 2010, Barlow et al. 2011, Hendrix et al. 2012, Saracco et al. 2013, Allen and Angliss 2014a).

The species is endangered as a result of past commercial whaling. The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). Prior to commercial whaling, hundreds of thousands of humpback whales existed. Global abundance declined to the low thousands by 1968, the last year of substantial catches (Reilly et al. 2008). Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the International Whaling Commission. Additional threats include ship strikes and fisheries interactions (including entanglement), and sound. On March 21, 2015, the NMFS issued a proposed rule to divide the globally-listed species into 14 DPSs (Figure 4, Figure 5)(80 FR 22303):

- West Indies (Proposed: Not at Risk)
- Cape Verde Islands/Northwest Africa (Proposed: Endangered)
- Western North Pacific (Proposed: Threatened)
- Hawaii (Proposed: Not at Risk)
- Mexico (Proposed: Not at Risk)
- Central America (Proposed: Threatened)
- Brazil (Proposed: Not at Risk)
- Gabon/Southwest Africa (Proposed: Not at Risk)
- Southeast Africa/Madagascar (Proposed: Not at Risk)
- West Australia (Proposed: Not at Risk)
- East Australia (Proposed: Not at Risk)
- Oceania (Proposed: Not at Risk)
- Southeastern Pacific (Proposed: Not at Risk)
- Arabian Sea (Proposed: Endangered)

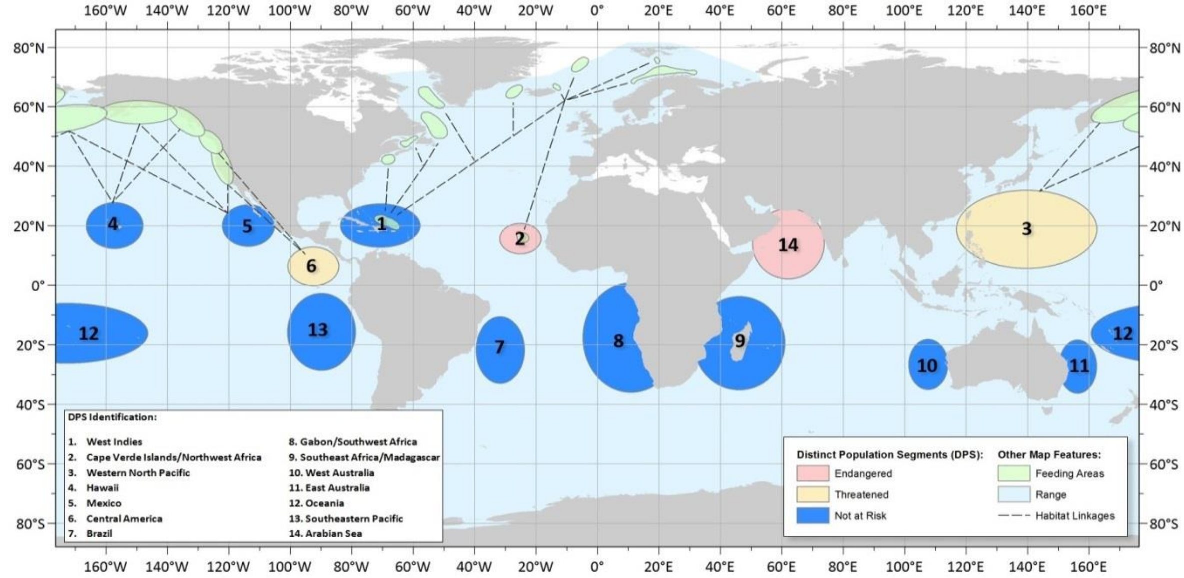

Figure 4. Map identifying 14 distinct population segments (DPS's) with 2 threatened and 2 endangered, based on primary breeding location of the humpback whale, their range, and feeding areas (Bettridge et al. 2015).

The abundance of humpback whales based on their proposed DPSs are summarized in Table 7. Overall population growth rates and total abundance estimates for the Atlantic Ocean, Southern Hemisphere, and Arabian Sea are not available at this time.

Table 7. Estimated abundance of humpback whale distinct population segments. If no reliable information on trend for the DPS is available "unknown" is noted (Information contained in Table 1 is modified from the Five Year Status Review by Bettridge et al. 2015).

Population level (Broken down into 15 DPSs)	>1000 mature individuals (>2000 total)	< 1000 mature individuals (<2000 total)	<250 mature individuals (<500 total)	Annual Growth rate if available	Population trend
Atlantic Ocean					
West Indies	>2000			~3.1%	Increasing moderately
Cape Verde Islands & Northwest Africa					Unknown
Pacific Ocean				4.9%	
Hawaii	~10,000			5.5%-6.0%	Increasing moderately
Central America		~600	~600	8.0%	Unknown

Mexico	~6,000-7,000			6.6%-10.6%	Increasing strongly; moderately; stable/little trend
Okinawa/Philippines		~1,000	~1,000	6.9%	Unknown
Second West Pacific (Not included in Figure 1)	~100+	~100+	~100+		Unknown
Southern Hemisphere					
West Australia	~21,750			~10%	Increasing strongly
East Australia	~6,300-7,800			~10.9%	Increasing strongly
Oceania	~3,827				Unknown
Southeastern Pacific	~6,504				Increasing strongly; moderately; stable/little trend
Brazil	~6,400			~7.4%	Increasing strongly; moderately
Gabon/Southwest Africa	~6,560				Unknown
Southeast Africa/Madagascar	~6,951			~9.0%-12.3%	Increasing strongly; moderately; stable/little trend
Arabian Sea					
Arabian Sea			~82		Unknown

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 144-174 dB (Payne 1970, Winn et al. 1970, Richardson et al. 1995, Au 2000, Frazer and Mercado 2000, Au et al. 2006). Males also produce sounds associated with aggression, which are generally characterized as frequencies between 50 Hz to 10 kHz and having most energy below 3 kHz (Tyack 1983, Silber 1986). Such sounds can be heard up to 9 kilometers away (Tyack and Whitehead 1983). Other social sounds from 50 Hz to 10 kHz (most energy below 3 kHz) are also produced in breeding areas (Tyack and Whitehead 1983, Richardson et al. 1995).

Status summary

The humpback whale is an endangered species with worldwide abundance of approximately 60,000 individuals. Originally endangered by commercial whaling, the threat is now significantly reduced. Though whaling still persists in some areas, the number of humpback whales killed annually as a result of whaling is significantly lower now than it was during the 1800's to mid-1900s. The species' large population size and increasing trends indicate that it is resilient to current threats, and, of the 14 proposed DPSs, two are proposed to have their listings revised from endangered to threatened and ten are proposed to be removed from ESA listing.

4.2.7 Killer Whale (Southern Resident Distinct Population Segment)

The killer whale (*Orcinus orca*) is distributed worldwide, but populations are isolated by region and ecotype (i.e., different morphology, ecology, and behavior). Southern Resident killer whales occur in the inland waterways of Puget Sound, Strait of Juan de Fuca, and Southern Georgia Strait during the spring, summer and fall. During the winter, they move to coastal waters primarily off Oregon, Washington, California, and British Columbia. The DPS was listed as endangered under the ESA on November 18, 2005 (70 FR 69903). We used information available in the final listing rule, the 2011 Status Review (NMFS 2011e), and the 2014 Stock Assessment Report (Carretta et al. 2015)to summarize the status of this species, as follows.

Life history

Southern Resident killer whales are geographically, matrilineally, and behaviorally distinct from other killer whale populations (70 FR 69903). The DPS includes three large, stable pods (called J, K, and L), which occasionally interact (Parsons et al. 2009). Most mating occurs outside natal pods, during temporary associations of pods, or as a result of the temporary dispersal of males (Pilot et al. 2010). Males become sexually mature at 10-17 years of age. Females reach maturity at 12-16 years of age and produce an average of 5.4 surviving calves during a reproductive life span of approximately 25 years. Mothers and their offspring maintain highly stable, life-long social bonds; this natal relationship is the basis for a matrilineal social structure and appears to play a critical role in the pod’s ability to locate prey in times of low prey abundance (NMFS 2014g). They prey upon salmonids, including chinook, coho, chum and steelhead (NMFS 2014g).

Population dynamics

The most recent abundance estimate for the Southern Resident DPS was 82 whales in 2013 (NMFS 2014g). From 1967-1973, a live-capture fishery removed an estimated 47 animals, most of them immature, from the Southern Resident population for display at marine parks (Ford et al. 1994). Since the first complete census of this stock in 1974, when 71 animals were identified, the population has gone through several periods of growth and decline. In the mid-1980s, the population entered an 11-year growth period peaking at 98 animals in 1995 (NMFS 2014g) but has fluctuated since then. Compared to stable or growing populations of killer whales, the DPS reflects a smaller percentage of juveniles and lower fecundity (NMFS 2011e).

The Southern Resident killer whale was listed as endangered in 2005, in response to the population decline from 1996-2001, small population size, and reproductive limitations (i.e., few reproductive males and delayed calving). Threats to its survival and recovery include: contaminants, vessel traffic, and changes in prey availability. Survival and birth rates in the Southern Resident killer whale population are correlated with coastwide salmon abundance (Ford et al. 2005). Many populations of salmonids that represent the preferred prey of Southern Resident killer whales have declined substantially from historical levels due to degradation of habitat, damming of rivers, harvest, and hatchery introgression. These salmonids also contain environmental pollutants (e.g., flame retardants; polychlorinated biphenyls or PCBs; and dichlorodiphenyltrichloroethane or DDT) that become concentrated at higher trophic levels and may lead to immune suppression or reproductive impairment in the killer whales that feed on them (70 FR 69903). The inland waters of Washington and British Columbia support a large whale watch industry, commercial shipping, and recreational boating; these activities generate underwater sound, which may mask whales' communication or interrupt foraging.

Acoustics
Killer whales have a hearing range of 0.5-120 kHz. Their hearing is most sensitive in the 18-42 kHz range (which overlaps with their echolocation clicks) and is less sensitive at higher frequencies (Szymanski et al. 1999)

Status summary
The Southern Resident killer whale DPS is an endangered "species" that has demonstrated weak growth in recent decades. The factors that originally endangered the species persist throughout its habitat: contaminants, vessel traffic, and reduced prey. Its resilience to future perturbation is reduced as a result of its small population size (N = 82); however, it has demonstrated the ability to recover from smaller population sizes in the past and has shown an increasing trend over the last several years. The NMFS is currently conducting a status review prompted by a petition to delist the DPS based on new information, which indicates that there may be more paternal gene flow among populations than originally detected (Pilot et al. 2010).

4.2.8 North Atlantic Right Whale

The North Atlantic right whale (*Eubalaena glacialis*) is a narrowly distributed baleen whale, distinguished by its stocky body and lack of a dorsal fin. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the five-year review (Colligan et al. 2012)and recent stock assessment reports to summarize the status of the species, as follows.

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

Population dynamics
Right whales occur in the eastern and western North Atlantic; however, less than 20 individuals exist in the eastern North Atlantic, and that population may be functionally extinct. There are at least 455 individuals in the western North Atlantic population. This estimate is based on a review of the photo-identification recapture database as it existed in October 2012 and represents a minimum population size. The species demonstrated overall growth rates of two percent over the period 1990-2007, despite two periods of increased mortality during that time span. Pre-exploitation abundance is not available. The population may have numbered fewer than 100 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. With whaling now prohibited, the two major threats to the survival of the species are ship strike and entanglement in fishing gear.

Acoustics
The total hearing range for the North Atlantic right whale predicted from anatomical modeling is 10 Hz-22 kHz with functional ranges probably between 15 Hz-18 kHz (Parks et al. 2007). The source levels for sound production range from 137-162 dB rms *re* 1 μPa-m for tonal calls and 174-192 dB rms for broadband "gunshot" sounds (Parks and Tyack 2005).

Status summary
The North Atlantic right whale is an endangered species with an estimated abundance of 455 individuals. While population trends are positive, the species' resilience to future perturbations is low due to its small population size and continued threats of ship strike and entanglement.

4.2.9 North Pacific Right Whale

The North Pacific right whale (*Eubalaena japonica*) is a baleen whale, distinguished by its stocky body and lack of a dorsal fin. The species was originally listed with the North Atlantic right whale (i.e., "Northern" right whale) as endangered on December 2, 1970 (35 FR 18319). It was listed separately as endangered on March 6, 2008 (73 FR 12024). We used information available in the five-year review (Bettridge and Clapham 2012) and recent stock assessment reports to summarize the status of the species, as follows.

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

Population dynamics
The North Pacific right whale remains one of the most endangered whale species in the world, likely numbering fewer than 1,000 individuals. Pre-exploitation abundance has been estimated at more than 11,000 individuals. Commercial whaling resulted in the decline; current threats to the survival include poaching, ship strike, fisheries interactions (including entanglement).

Acoustics
The hearing range for the North Pacific right whale is likely similar to that of the North Atlantic right whale: 10 Hz-22 kHz with functional ranges probably between 15 Hz-18 kHz (Parks et al. 2007). The source levels for sound production range are also likely similar: from 137-162 dB rms *re* 1 μPa-m for tonal calls and 174-192 dB rms for broadband "gunshot" sounds (Parks and Tyack 2005).

Status summary
The North Pacific right whale is an endangered species with an overall abundance of less than 1,000 individuals. The species' resilience to future perturbations is low due to its small population size and continued threats of poaching, ship strike, and entanglement.

4.2.10 Sei Whale

The sei whale (*Balaenoptera borealis*) is a widely distributed baleen whale, occurring in all oceans of the world except the Arctic. The species was originally listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the recovery plan (NMFS 2011d), the five-year review (NMFS 2012), and recent stock assessment reports to summarize the status of the species.

Life history
Sei whales reach sexual maturity at 6-12 years of age. The average calving interval is 2-3 years; the gestation period of sei whales is 10-12 months, and calves are nursed for 6-9 months. They are thought to migrate long distances from high-latitude feeding areas in summer to low-latitude breeding areas in winter The location of winter areas remains largely unknown (Perry et al. 1999). Throughout their range, they occur predominantly in deep water; they are most common over the continental slope. Sei whales are primarily planktivorous, feeding mainly on euphausiids and copepods, although they are also known to consume fish (Waring et al. 2006). In the Northern Hemisphere, sei whales consume small schooling fish such as anchovies, sardines, and mackerel when locally abundant (Rice 1977, Mizroch et al. 1984, Konishi et al. 2009).

Population dynamics
There are approximately 80,000 sei whales worldwide, in the North Atlantic, North Pacific, and Southern Hemisphere. The best abundance estimate of sei whales in the U.S. exclusive economic zone is 661 animals (N = 357 for Nova Scotia "stock"; N = 178 for Hawaii "stock", N = 126 for Eastern North Pacific "stock"), though the true abundance remains largely unknown due to survey limitations and uncertainties regarding population structure (Waring et al. 2006). Population trends are not available due to insufficient data. The species is endangered as a result of past commercial whaling. Models indicate that total abundance declined from 42,000 to 8,600 individuals between 1963 and 1974 in the North Pacific. In the Southern Hemisphere, pre-exploitation abundance has been estimated at 65,000 whales, with recent abundance estimated at 9,700 whales. There are no estimates of pre-exploitation abundance for the North Atlantic. Currently, sei whales are killed by Japan's "scientific" whale hunts in the Pacific Ocean, with 1,159 documented mortalities from 1986 through 2014 (https://iwc.int/table_permit). Current threats include ship strikes, anthropogenic sound, fisheries entanglements, and loss of prey base due to climate change.

Acoustics
Data on sei whale vocal behavior is limited, but includes records off the Antarctic Peninsula of broadband sounds in the 100-600 Hz range with 1.5 second duration and tonal and upsweep calls in the 200-600 Hz range of one to three second durations (McDonald et al. 2005). Vocalizations

from the North Atlantic consisted of paired sequences (0.5-0.8 s, separated by 0.4-1.0 s) of 10-20 short (4 ms) FM sweeps between 1.5-3.5 kHz (Thomson and Richardson 1995). Source levels of 189 ±5.8 dB re 1lPa at 1m 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.

Status summary

The sei whale is an endangered species with worldwide abundance of approximately 80,000 individuals. Historically, whaling represented the greatest threat to every population of sei whales and was ultimately responsible for listing as an endangered species. Commercial whaling has decreased significantly but still occurs on a smaller scale; sei whales are now hunted only by Japan in relatively small numbers, and therefore the current overall threat to the species as a whole from directed hunts is low. However, if the IWC's moratorium on commercial whaling were ended, hunting could again become a significant threat to sei whales. Current threats to sei whales include ship strikes, anthropogenic sound, fisheries entanglements, and loss of prey base due to climate change. Sei whales are also known to accumulate DDT, DDE, and PCBs (Henry and Best 1983, Borrell and Aguilar 1987, Borrell 1993). No reliable trend information is available for sei whales in any of the three ocean basins where the species occurs.

4.2.11 Sperm Whale

The sperm whale (*Physeter microcephalus*) is the largest toothed whale. It is largely distributed throughout the world's oceans, from the equator to the edges of polar pack ice, with populations in the Atlantic, Pacific, and Indian Oceans. The species was listed as endangered on December 2, 1970 (35 FR 18319). We used information available in the final recovery plan (NMFS 2010b) to summarize the status of the species, as follows.

Life history

The gestation period of sperm whales is 1-1.5 years, and calves are nursed for approximately two years. The calving interval is 4-6 years. Female sperm whales reach sexual maturity at 7-13 years of age; males reach full maturity in their twenties. Breeding occurs in the spring. Females maintain stable, long-term associations with other females and their young male offspring. Males eventually leave these groups to join other males in "bachelor schools" until they reach their breeding prime, at which point they become essentially solitary. Sperm whales feed primarily on squid; other prey items include octopus and demersal fish (including teleosts and elasmobranchs).

Population dynamics

The sperm whale is the most abundant of the large whale species, with total abundance estimates between 200,000 and 1,500,000. The higher estimates may be approaching population sizes prior to commercial whaling, the reason for ESA listing. Commercial whaling is no longer allowed, however, illegal hunting may occur at biologically unsustainable levels. Other threats include:

collision with vessels, entanglement in fishing gear, reduced prey availability due to overfishing, habitat degradation, pollution, and disturbance from anthropogenic sound.

Acoustics
The anatomy of the sperm whale ear indicates hearing tailored for ultrasonic (>20 kilohertz (kHz)) reception. Its inner ear is primarily adapted for echolocation, and the ears have exceptional frequency discrimination abilities. The sperm whale may also possess better low frequency hearing than some of the other toothed whales, although not as low as many baleen whales. The only data on the hearing range of sperm whales are evoked potentials from a stranded male neonate, which suggest that neonatal sperm whales respond to sounds from 2.5-60 kHz, with best sensitivity at 5, 10, and 20 kHz.

Status summary
The sperm whale is an endangered species that was subject to commercial whaling for more than two and a half centuries and in all parts of the world. 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. Continued threats to sperm whale populations include collisions with vessels, direct harvest, and possibly competition for resources, loss of prey base due to climate change, and disturbance from anthropogenic sound. Given its current, large population size, it is somewhat resilience to additional perturbation.

4.2.12 Bearded Seal (Beringia Distinct Population Segment)

The bearded seal (*Erignathus barbatus*) is a large Northern Hemisphere ice seal, reaching lengths of 2.0-2.5 meters and weights of 260-360 kg. It is distinguished by its small head, small square foreflippers, and thick, long, white whiskers that have resulted in the name “bearded.” It is divided into two subspecies, with the Pacific subspecies (*E. b. nauticus*) further divided into two geographically and ecologically discrete DPSs; The Beringia DPS is the only DPS in the Action Area. On December 20, 2012, the NMFS issued a final determination to list the Beringia DPS as threatened under the ESA (77 FR 76739). We used information available in the recent stock assessment report (Allen and Angliss 2014a), the status review (Cameron et al. 2010), listing documents (75 FR 77496;77 FR 76739), the NMFS species information (NMFS 2015a), and a recent biological opinion (NMFS 2014d) to summarize the status of the species, as follows.

Life history
The Beringia DPS is an ice-associated species that inhabits the continental shelf waters of the Bering, Chukchi, Beaufort, and East Siberian Seas. Most seals move seasonally, following the extent of the sea ice; however some remain near the coasts of the Bering and Chukchi Seas during the summer and early fall.

The lifespan of bearded seals is 20-30 years. Males reach sexual maturity at 6-7 years of age; females mature at 5-6 years of age and give birth to a single pup annually. Gestation lasts 9 months and pups are weaned at approximately 3-4 weeks of age. Birthing and nursing occur on sea ice.

Bearded seals feed on a variety of prey items. The majority of their foraging occurs on, in, or near the seafloor for prey such as arctic cod, shrimp, clams, crabs, and octopus, but they also occasionally forage on schooling fishes throughout the water column (Cameron et al. 2010).

Population dynamics

The estimated population size of the Beringia bearded seal DPS is 155,000 individuals (75 FR 77496). 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 Beringia bearded seal DPS was listed as threatened, i.e., likely to become endangered in the foreseeable future, due to the expected loss of sea ice and alteration of prey availability from climate change in the foreseeable future (77 FR 76739). Warming climate trends are likely to result in the loss of essential sea ice habitat, and ocean acidification may alter prey populations (75 FR 77496). To adapt, bearded seals would likely shift their nursing, rearing, and molting areas to ice covered seas, potentially increasing the risks of disturbance, predation, and competition. The large range and population size of the Beringia DPS make it less vulnerable to other perturbations, such as subsistence hunting; therefore, ESA section 4(d) protective regulations and section 9 prohibitions were deemed unnecessary for the conservation of the species.

Acoustics

Male bearded seals vocalize during the breeding season (March through July), with a peak in calling during and after pup rearing. Their complex vocalizations range from 0.02-11 kHz in frequency. These calls are likely used to attract females and defend their territories to other males (Cameron et al. 2010).

Status summary

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.

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 has appealed that decision. While that appeal is pending, our biological opinions will continue to address effects to bearded seals so that action agencies have the benefit of the NMFS' analysis of the consequences of the proposed action on this DPS, even though the ESA listing of the species was not in effect at the time this opinion was written.

4.2.13 Guadalupe Fur Seal

Guadalupe fur seals (*Arctocephalus townsendi*) occur primarily in the waters surrounding Guadalupe Island, Mexico, though a second breeding colony is now established in Mexico's San Benitos Islands, and individuals have been observed in the Channel Islands in recent years. The species was listed as threatened under the ESA in 1985 (50 FR 51252). We used information available in the final listing, the 2000 stock assessment report (Holts 2000), and the International Union for Conservation of Nature's Red List (Aurioles and Trillmich 2008) to summarize the status of the species, as follows.

Life history

Guadalupe fur seal rookeries are located on Mexico's Guadalupe Island and San Benitos Islands in Mexico. Polygynous males establish territories occupied by an average of six females, which give birth to a single pup during the summer and nurse for 9-11 months (Aurioles and Trillmich 2008).

Population dynamics

In 1985, the species was listed as threatened, reflecting the species' extreme reduction as a result of nineteenth century commercial harvest and its small population size at the time of listing (approximately 1,600). There are few estimates of current abundance. The population on Guadalupe Island was estimated at 7,348 animals in 1993 (Gallo et al. 1993). A comparison between abundance estimates from the 1950s and 1990s suggests the population grew exponentially during that period, having increased at an annual rate of 13.7 percent from 1955 to 1993 (Gallo-Reynoso 1994). The size of the population prior to commercial harvest is unknown, with estimates ranging from 20,000-100,000 individuals (Holts 2000). The species was hunted to near extinction in the nineteenth century but was re-discovered in the 1920s, at which point it was again hunted to the point that it was believed to be extinct. In the 1950s the species was re-discovered once more, with the population estimated at just 200-500 individuals at the time (Aurioles and Trillmich 2008). Hunting had reduced the breeding range of the species solely to Guadalupe Island, but a small rookery at the San Benito Islands, an important breeding site for the species prior to the 1890s, was discovered in 1997; this represented the first geographic expansion by the species following its near extinction (Aurioles-Gamboa et al. 2010). A total of 227 animals were counted in the San Benitos archipelago in a 2007 census (Esperon Rodriguez and Reynoso 2009). Based on censuses taken on the San Benito Islands in 1997 and 2007, the population on these islands increased at a rate of 21.63 percent over that period (Esperon Rodriguez and Reynoso 2009). A single pup was also born on San Miguel Island in California, in 1997 (Aurioles and Trillmich 2008). Though hunting has ended, continued threats include entanglements in fishing gear and other marine debris, and the loss of genetic diversity among extant members of the population as a result of the population "bottleneck" that occurred when the species was nearly hunted to extinction (Weber et al. 2004). Specific recovery criteria include: population size of 30,000 animals; establishment of at least one rookery in addition to the Guadalupe rookery (which has occurred); and growth to maximum net productivity.

Acoustics

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

Status summary

The Guadalupe fur seal appears to be increasing in abundance. At least one new rookery has been established (San Benito Islands) since listing, with exponential population growth at that rookery. The species appears to be on the path to recovery and the population is likely resilient to future perturbations; however, the total population size is still relatively low, and the lack of genetic diversity among the extant population may reduce the species' overall resilience.

4.2.14 Hawaiian Monk Seal

The Hawaiian monk seal (*Neomonachus schauinsland*) is a large phocid that inhabits the Northwest Hawaiian Islands (NWHI) and Main Hawaiian Islands (MHI). It was listed as endangered under the ESA in 1976 (41 FR 51611). We used information available in the 2007 5-year review (NMFS 2007a), the 2014 stock assessment report (Allen and Angliss 2014b), and unpublished NMFS data to summarize the status of this species, as follows.

Life History

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

Population dynamics

The best estimate of the total population size is 1,209 (Allen and Angliss 2014b). The species has declined in abundance by over 68 percent since 1958. As of 2011, a total of 146 seals were documented in the MHI, where the subpopulation is growing at a rate of approximately 6.5 percent annually (Baker et al. 2011). Likewise, sporadic beach counts at Necker and Nihoa

Islands suggest positive growth. While these sites have historically comprised a small fraction of the total species abundance, the decline of the six main NWHI subpopulations, coupled with growth at Necker, Nihoa and the MHI, may mean that these latter three sites now substantially influence the total abundance trend. The MHI, Necker and Nihoa Islands estimates, uncertain as they are, comprised 25 percent of the stock's estimated total abundance in 2011. The majority of seals still reside in the NWHI, though this population continues to decline at an annual rate of approximately 3.4 percent. Birth rates in the NWHI declined dramatically in the 1990s, possibly reflecting unfavorable environmental conditions. Concurrently, there was a rapid increase in the number of monk seal sightings and births in the MHI. Hawaiian monk seals were once harvested for their meat, oil and skins, leading to extirpation in the MHI and near-extinction of the species by the twentieth century (Hiruki and Ragen 1992, Ragen 1999). The species experienced a partial recovery by 1960, when hundreds of seals were counted on NWHI beaches. Since then, however, the species has declined in abundance. Though the ultimate causes of the decline remain unknown, threats include: starvation; predation by sharks; competition with fish and fisheries; entanglement in marine debris; male aggression; beach erosion; and environmental changes that reduce prey availability. In the MHI, additional threats include disturbance of nursing pups and illegal killing, which likely reflects conflict over actual or perceived fisheries interactions (Kehaulani Watson et al. 2011, McAvoy 2012).

Acoustics

The Hawaiian monk seal's hearing is most sensitive between 12-28 kHz. Below 8 kHz, the Hawaiian monk seal's hearing was less sensitive, and high-frequency sensitivity dropped off sharply above 30 kHz (Thomas et al. 1990).

Status summary

The Hawaiian monk seal is a critically endangered species that continues to decline in abundance, presumably as a result in changes to their foraging base. With only approximately 1,200 individuals remaining, the species' resilience to further perturbation is low. Other species in the same genus have gone extinct (i.e., Caribbean monk seal) or have been extirpated from the majority of their previous range (i.e., Mediterranean monk seal). We conclude that the Hawaiian monk seal's resilience to further perturbation is low, and its status is precarious.

4.2.15 Ringed Seal (Arctic Subspecies)

The ringed seal (*Phoca hispida*) is the smallest of the Arctic seals, reaching lengths of 1.5 meters and weights of 50 to 70 kilograms. Their coat is dark with silver rings along the back and sides and silver along the underside. It is divided into five subspecies, including the Arctic subspecies (*Phoca hispida hispida*). On December 20, 2012, NMFS issued a final determination to list the Arctic subspecies as threatened under the ESA. We used information available in the recent stock assessment report (Allen and Angliss 2014a), the status review (Kelly et al. 2010b), listing documents (75 FR 77476, 77 FR 76705), NMFS species information (NMFS 2015d), and a recent biological opinion (NMFS 2014d) to summarize the status of the species, as follows.

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. Females give birth in March-April to a single pup annually; they nurse for 5-9 weeks. During this time, pups spend an equal amount of time in the water and in the lair. Females attain sexual maturity at 4-8 years of age, males at 5-7 years. The average lifespan of a ringed seal is 15-28 years. They are trophic generalists, but prefer small schooling prey that form dense aggregations (Kelly et al. 2010b).

Population dynamics

The Arctic ringed seal has a widespread, circumpolar distribution and their population structure is poorly understood. It is likely that population structuring exists in the species, but the extent to which it occurs is not yet known. Under the MMPA, NMFS recognizes one stock, the Alaska stock, in U.S. waters.

No reliable population estimates for the entire DPS are available due to the species' widespread distribution across political boundaries. In the status review, the population of the species was estimated to have approximately two million individuals, however, NMFS considers this to be a crude estimate, as it relies on outdated data collected in a variety of ways and does not include all areas of the DPS's range.

Similarly, a reliable population estimate for the Alaska stock of ringed seals is not available due to inconsistencies in survey methods and assumptions, lack of survey effort in some areas, and because surveys efforts are now more than a decade old. 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, though this is most likely an underestimate of the true abundance because surveys in the Beaufort Sea were limited to within 40 kilometers of the shore.

The Arctic ringed seal DPS was listed as threatened, i.e., likely to become endangered in the foreseeable future. Warming climate trends are likely to result in the loss of essential sea ice and snow cover, and ocean acidification may alter prey populations (Kelly et al. 2010b). The reduced snow cover throughout portions of its range would prevent the excavation of lairs, essential to resting, molting, and pupping. Earlier warming and break-up of ice in the spring would shorten the length of time pups have to grow and mature in a protected setting, which has been shown to reduce overall fitness. The large range and population size of the Arctic subspecies, however, make it less vulnerable to other perturbations, such as subsistence hunts (75 FR 77476). Therefore, ESA section 4(d) protective regulations and section 9 prohibitions were deemed unnecessary for the conservation of the species (77 FR 76705).

Acoustics

Ringed seals can hear frequencies of 1-40 kHz (Richardson et al. 1995, Blackwell et al. 2004). Though they may be able to hear frequencies above this limit (Terhune and Ronald 1976); their sensitivity to such sounds diminishes greatly above 45 kHz (Terhune and Ronald 1975).

Status summary
In summary, the Arctic ringed seal DPS has a large population size and is likely resilient to immediate perturbations. It is, however, threatened by future climate change, specifically the loss of essential sea ice and snow cover, and as a result, is likely to become endangered in the future. Due to insufficient data, population trends for the Arctic subspecies cannot be calculated. It is unknown if the population is stable or fluctuating.

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 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.

4.2.16 Steller Sea Lion (Western Distinct Population Segment)

The Steller sea lion (*Eumetopias jubatus*) ranges from Japan, through the Okhotsk and Bering Seas, to central California. It consists of two morphologically, ecologically, and behaviorally distinct DPSs: the eastern DPS, which includes sea lions in Southeast Alaska, British Columbia, Washington, Oregon and California; and the western DPS, which includes sea lions in all other regions of Alaska, as well as Russia and Japan. On May 5, 1997, NMFS issued a final determination to list the western DPS as endangered under the ESA (62 FR 24345). We used information available in the final listing (62 FR 24345) and the 2013 stock assessment report (Allen and Angliss 2013f) to summarize the status of the Western DPS, as follows.

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

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

Population dynamics

As of 2013, the best estimate of abundance of the western Steller sea lion DPS in Alaska was 52,200, and the best abundance estimate for Alaska and Russia combined was 79,300 (Allen and Angliss 2013f), representing a steep decline since counts in the 1950s (N = 140,000) and 1970s (N = 110,000). Trend site counts continued to decline in the 1990s at an average annual rate of 5.4 percent. Pup counts in the Western DPS in Alaska overall increased at 1.8 percent annually between 2000 and 2014; non-pup counts increased at 2.2 percent annually over the same period (Fritz et al. 2015). Survey data collected since 2000 indicate that the population decline continues in the central and western Aleutian Islands but that populations east of Samalga Pass (approximately 170° W) have increased (Allen and Angliss 2013f). Survival rates east of Samalga Pass have rebounded to nearly the same levels estimated for the 1970s, prior to their decline in abundance. In addition, population models indicate that natality among the increasing population east of Samalga Pass in the period 2000‒2012 may not be significantly different from rates estimated for the 1970s. Given current information, the DPS may satisfy down-listing criterion (to "threatened" status) by 2015. However, due to continued abundance declines west of Samalga Pass, where no survival data are currently available, it is less certain that the down-listing criteria will be achieved (Fritz et al. 2014). The Russian Steller sea lion population (pups and non-pups) declined from about 27,000 in the 1960s to 13,000 in the 1990s, then increased to approximately 16,000 in 2005. Data collected through 2012 indicate that overall Steller sea lion abundance in Russia has continued to increase and is now similar to the 1960s (Allen and Angliss 2013f).

The species was listed as threatened in 1990 (55 FR 49204) because of significant declines in the population. Causes of the steep decline observed in the 1980s may include nutritional stress due to competition with commercial fisheries, environmental change, disease, killer whale predation, incidental take, and shooting (illegal and legal). To protect and recover 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 (62 FR 24345).

Acoustics

Steller sea lions hear within the range of 0.5-32 kHz (Kastelein et al. 2005).

Status summary

The western DPS Steller sea lion is listed as endangered under the ESA. The total population size is relatively large (N = 79,300), and the decline in abundance documented in the 1980s and 1990s appears to have stabilized, though the population remains well below the abundance estimates of the 1950s and 1970s. Given its current large population size and apparent stability in trend, the DPS appears somewhat resilient to future perturbations.

4.2.17 Green Turtle

Green sea turtles spend almost their entire life in the ocean, coming ashore only to lay eggs or occasionally bask in the sun. When hatched, turtles weigh 25 grams and are 50 millimeters long, but can grow to be 135-150 kilograms and be one meter long. They have four flippers and a head that does not fully retract into their shell, which is black, gray, green, brown, or yellow on top and yellowish white on bottom. Green sea turtles have a circumglobal distribution, occurring throughout tropical, subtropical waters, and, to a lesser extent, temperate waters.

Federal listing of the green sea turtle occurred on July 28, 1978, with all populations listed as threatened except for the Florida and Pacific coast of Mexico breeding populations, which are endangered (43 FR 32800). The International Union for Conservation of Nature has classified the green turtle as “endangered.”

On April 6, 2016, NMFS finalized a relisting of green sea turtles as 11 separate DPSs globally (81 FR 20057). 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. Individuals from the East Pacific, Central South Pacific, Central West Pacific, Central North Pacific, and North Atlantic DPSs are likely to be affected by the proposed action.

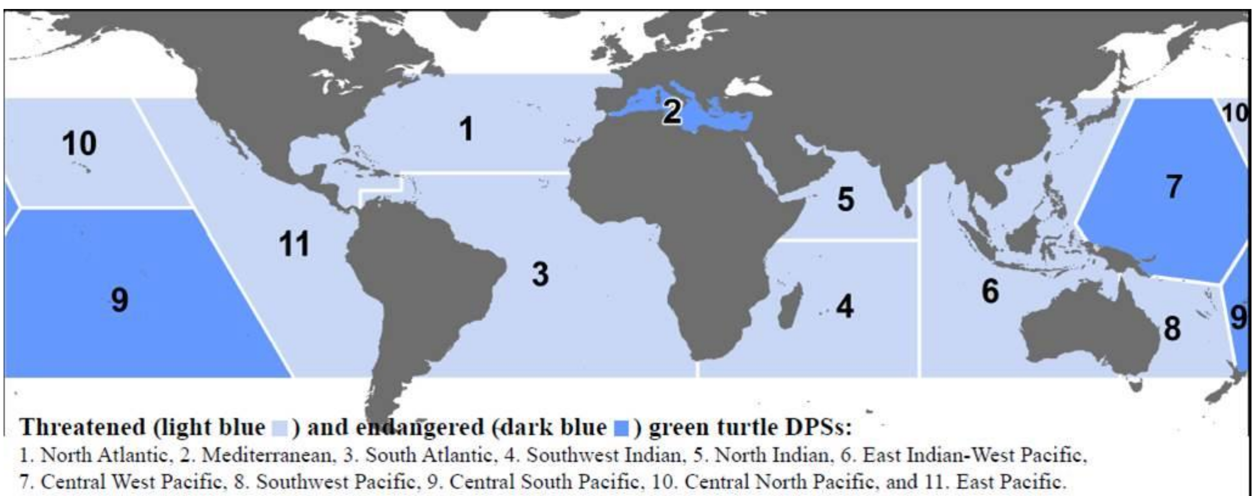

Figure 5. Map depicting ESA-listed distinct population segment boundaries for green turtles.

The North Atlantic DPS extends from the boundary of South and Central America, north to 10.5° N, 77° W, then extending due east across the Atlantic Ocean at 19° North latitude to the African continent, and extending north along the western coasts of Africa and Europe (west of 5.5° W) to 48° N (Figure 5). This DPS is found in the U.S. Atlantic and Gulf of Mexico in inshore and nearshore waters ranging from Texas through Massachusetts.

Individuals from the East Pacific DPS range generally from California (approximately 42°N) to central Chile (approximately 40°S), with significant nesting beaches in Mexico and the

Galapagos Islands, Ecuador (Seminoff et al. 2015). There are no nesting sites in the U.S. for this green turtle DPS.

Green sea turtles in the Central South Pacific DPS generally occupy the waters around New Zealand, Fiji, Tuvalu, Kiribati, French Polynesia, Easter Island, and the American Samoa. The Central West Pacific DPS encompasses the waters of the Pacific Ocean from 41°N south to the eastern tip of Paupa New Guinea, the Island of New Guinea, and West Paupa in Indonesia. The Central North Pacific DPS encompasses the waters surrounding Hawaii and the Johnston Atoll. Because the Hawaiian Archipelago is geographically isolated, individual green sea turtles from this DPS are geographically discrete in their range and movements, and genetically distinct from other DPSs (Seminoff et al. 2015).

We used information available in the 2007 five year review (USFWS 2007) and 2015 status review (Seminoff et al. 2015) to summarize the status of the species, as follows.

Life history

Age at first reproduction for females is 20-40 years. They lay an average of three nests per season with an average of 100 eggs per nest. The remigration interval (i.e., return to natal beaches) is 2-5 years. Nesting occurs primarily on beaches with intact dune structure, native vegetation and appropriate incubation temperatures during summer months. After emerging from the nest, hatchlings swim to offshore areas and go through a post-hatchling pelagic stage where they are believed to live for several years. During this life stage, green sea turtles feed close to the surface on a variety of marine algae and other life associated with drift lines and debris. Adult turtles exhibit site fidelity and migrate hundreds to thousands of kilometers from nesting beaches to foraging areas. Green sea turtles spend the majority of their lives in coastal foraging grounds, which include open coastlines and protected bays and lagoons. Adult green turtles feed primarily on seagrasses and algae, although they also eat jellyfish, sponges and other invertebrate prey.

Population Dynamics

Populations are distinguished generally by ocean basin and more specifically by nesting location. Worldwide, nesting data at 46 sites from 1990-2006 indicate that 108,761-150,521 females nest each year. Nesting populations are doing relatively well in the Pacific, Western Atlantic and Central Atlantic Ocean; whereas, populations are doing poorly in Southeast Asia, Eastern Indian Ocean and Mediterranean. See Table 8 for a summary of nesting abundance for each of the green turtle DPSs.

Table 8. Green sea turtle nesting abundance for Distinct Population Segments within the action area. Adapted from (Seminoff et al. 2015).

Green turtle DPS	North Atlantic	East Pacific	Central South Pacific	Central West Pacific	Central North Pacific
ESA Status	Threatened	Threatened	Endangered	Endangered	Threatened

Total Number Nesting Sites	74	39	59	51	13
Total Nester Abundance	167,528	20,062	2,677	6,518	3,846
Population Trend (PVA)	Increasing	Increasing	Unknown	Unknown	Increasing

The North Atlantic DPS displays high nester abundance compared to other DPSs, and available data indicate an increasing trend in nesting. Four regions that support particularly high density nesting concentrations are: Costa Rica (Tortuguero), Mexico (Campeche, Yucatan, and Quintana Roo), U.S. (Florida), and Cuba.

There is insufficient information to draw conclusions on nesting trends for most of the sites in the East Pacific DPS, with the exception of the nesting site at Colola, Mexico. Populations at this site appear to be increasing. In the Galapagos Islands, nesting at the four primary nesting sites (Quinta Playa and Barahona-Isabela Island, Las Bachas-Santa Cruz Island, and Las Salinas-Baltras Island) has been stable to slightly increasing since the late 1970s (Seminoff et al. 2015).

Nesting for the Central North Pacific DPS is well studied, with all 13 nesting sites monitored and quantified and very low chance of undocumented nesting locations. Green turtle nesting in the Central North Pacific DPS is extremely geographically concentrated with over 96 percent of nests located within the French Frigate Shoals in the Northwest Hawaiian Islands (Seminoff et al. 2015). About one-half of the French Frigate Shoals green turtle nests are located on East Island. Each of the remaining 12 nesting sites in this DPS has fewer than 40 females in their nesting population. There has been a marked increase in nesting at East Island, French Frigate Shoals, since 1973.

The Central West Pacific DPS has low nesting abundance, with about 6,518 nesting females at 51 sites. Only one of the sites shows an increasing trend in nesting females, all others show decreasing trends, thus making the overall population trend for the DPS unknown.

Nesting in the Central South Pacific DPS is widespread throughout the region, and occurs at low levels. Information on nesting abundance is lacking and long-term monitoring programs scarce. The largest nesting site for the DPS is Scilly Atoll (accounting for approximately one-third of nesting abundance for the entire DPS), and has significantly declined since the early 1990s (Seminoff et al. 2015).

Acoustics

Currently it is believed that the range of maximum sensitivity for sea turtles is 200-800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994, Moein et al. 1994). Green turtles are most sensitive to sounds between 200-700 Hz, with peak sensitivity at 300-400 Hz (Ridgway et al. 1969).

Status Summary

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

4.2.18 Hawksbill Turtle

Hawksbill sea turtles are adapted to live in the ocean, like all other sea turtles, and come onto land only to lay eggs. They are the second-smallest sea turtle, growing to only 65-90 centimeters in length and 45-70 kilograms. They get their name from the curved tip of their upper beak, which is more pronounced than in other sea turtle species. The top of the shell is golden brown, streaked with orange, red, and/or black while the bottom shell is yellowish.

The hawksbill sea turtle was listed as endangered under the ESA on June 2, 1970 (35 FR 8491). The hawksbill has a circumglobal distribution throughout tropical and usually occur between latitudes 30° N and 30° S in the Atlantic, Pacific and Indian Oceans and, to a lesser extent, subtropical waters of the Atlantic Ocean. Satellite tagged turtles have shown significant variation in movement and migration patterns. In the western Atlantic, Hawksbills are widely distributed throughout the Caribbean Sea, off the coasts of Florida and Texas in the continental U.S., in the Greater and Lesser Antilles, and along the mainland of Central America south to Brazil (NMFS 2013a). In the Caribbean, distance traveled between nesting and foraging locations ranges from a few kilometers to a few hundred kilometers (Byles and Swimmer 1994, Miller et al. 1998, Hillis-Starr et al. 2000, Horrocks et al. 2001, Prieto et al. 2001, Lagueux et al. 2003). We used information available in the five year reviews (NMFS and USFWS 2007a, NMFS 2013a) to summarize the status of the species, as follows.

Life history

Hawksbill sea turtles reach sexual maturity at 20-40 years of age. Females return to their natal beaches every 2-5 years to nest (an average of 3-5 times per season). Clutch sizes are large (up to 250 eggs). Sex determination is temperature dependent, with warmer incubation producing more females. Hatchlings migrate to and remain in pelagic habitats until they reach approximately 22-25 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.

Population dynamics

Surveys at 88 nesting sites worldwide indicate that 22,004-29,035 females nest annually (NMFS 2013a). Genetic analysis supports roughly 6,000- 9,000 adult females within the Caribbean (Leroux et al. 2012). 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.

Table 9. Estimates of nesting females for hawksbill nesting rookeries in the Pacific, Indian and Atlantic Oceans. Adapted from (NMFS 2013a).

Location	Number of nesting females per season
Pacific Ocean	10,194-12,770
Indian Ocean	< 8,184-10,157
Atlantic Ocean	3,626-6,108

The widely dispersed nesting areas and often low densities are likely a result of overexploitation of previously large colonies that have since been depleted (Meylan and Donnelly 1999, Richardson et al. 1999).

Acoustics

No audiometric data are available for the hawksbill turtle, but based on other sea turtle hearing capabilities, they probably also hear best in the low frequencies. Currently it is believed that the range of maximum sensitivity for sea turtles is 200-800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994, Moein et al. 1994).

Status summary

Hawksbill sea turtles received protection on June 2, 1970 (35 FR 8495) under the Endangered Species Conservation Act and, since 1973, have been listed as endangered under the ESA. Although no historical records of abundance are known, hawksbill sea turtles are considered to be severely depleted due to the fragmentation and low use of current nesting beaches(NMFS and USFWS 2007a). Worldwide, an estimated 21,212-28,138 hawksbills nest each year among 83 sites. Long-term data on the hawksbill sea turtle indicate that 63 sites have declined over the past 20-100 years (historic trends are unknown for the remaining 25 sites). Recently, 28 sites (68 percent) have experienced nesting declines, 10 have experienced increases, three have remained stable and 47 have unknown trends.

The greatest threats to hawksbill sea turtles are overharvesting of turtles and eggs, degradation of nesting habitat and fisheries interactions. Adult hawksbills are harvested for their meat and carapace, which is sold as tortoiseshell. Eggs are taken at high levels, especially in Southeast Asia where collection approaches 100 percent in some areas. In addition, lights on or adjacent to nesting beaches are often fatal to emerging hatchlings and alters the behavior of nesting adults. The species's resilience to additional perturbation is low.

4.2.19 Kemp’s Ridley Turtle

Kemp’s ridley sea turtles live in the ocean and only come onto land to lay eggs. They are grayish-green in color on top but yellow on their bottom shell. Kemp’s ridleys are the smallest sea turtles, growing to only 60-70 centimeters long and 45 kilograms (Zwinenberg 1977, Groombridge 1982, TEWG 2000b).

Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas. The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and has been listed as endangered under the ESA since 1973. Internationally, the Kemp’s ridley is considered the most endangered sea turtle (NRC 1990, USFWS 1999).

We used information available in the revised recovery plan (NMFS et al. 2010) and the five-year review (Conant and Kepple 2015) to summarize the status of the species, as follows.

Life history
Females mature at 12 years of age. The average remigration is two years. Nesting occurs from April-July in large arribadas, large aggregations coming ashore at the same time and location, primarily at Rancho Nuevo, Mexico. Females lay an average of 2.5 clutches per season. The annual average clutch size is 97-100 eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats. Juvenile Kemp’s ridley sea turtles use these nearshore coastal habitats from April-November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 ft (37 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.

Population dynamics
During the mid-twentieth century, the Kemp's ridley was abundant in the Gulf of Mexico. Historic information indicates that tens of thousands of Kemp’s ridleys nested near Rancho Nuevo, Mexico, during the late 1940s (Hildebrand 1963). From 1978 through the 1980s, arribadas were 200 turtles or less, and by 1985, the total number of nests at Rancho Nuevo had dropped to approximately 740 for the entire nesting season, which was a projection of roughly 234 turtles (USFWS and NMFS 1992, TEWG 2000a). Beginning in the 1990s, an increasing number of beaches in Mexico were being monitored for nesting, and the total number of nests on all beaches in Tamaulipas and Veracruz in 2002 was over 6,000; the rate of increase from 1985 ranged from 14-16 percent (TEWG 2000a, USFWS 2002, Heppell et al. 2005). Gallaway et al. (2013) estimated that nearly 189,000 female Kemp’s ridley sea turtles over the age of two years were alive in 2012. Extrapolating based on sex bias, the authors estimated that nearly a quarter million age-two or older Kemp’s ridleys were alive at this time. The vast majority of individuals in the population stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of

Mexico, with some reintroduction resulting in nesting in Texas (Shaver and Caillouet Jr. 2015). There have been over 100 nests at Padre Island, Texas every year since 2006-2014 (Conant and Kepple 2015). Recent calculations of nesting females determined from nest counts show that the population trend is increasing towards recovery goals, with an estimate of 4,047 nesters in 2006 and 5,500 in 2007 (NMFS and USFWS 2007b, Conant and Kepple 2015). Kemp's ridley sea turtles are considered to be a single population, although expansion of nesting may indicate differentiation.

Acoustics

No audiometric data are available for the Kemp's ridley turtle, but based on other sea turtle hearing capabilities, they probably also hear best in the low frequencies. Currently it is believed that the range of maximum sensitivity for sea turtles is 200-800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994, Moein et al. 1994).

Status summary

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, Mexican legal ordinances prohibited the harvest of sea turtles from May-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.

4.2.20 Loggerhead Turtle

Adult loggerhead sea turtles have relatively large heads, which support powerful jaws. Loggerhead sea turtles are one of the larger sea turtle species, growing to 250 pounds (113 kilograms) and about three feet (approximately 1 meter) in length. They have a reddish-brown, slightly heart-shaped top shell with pale yellowish bottom shell. The neck and flippers are usually dull brown to reddish brown on top and medium to pale yellow on the sides and bottom. Hatchlings are brown to dark gray with a yellowish to tan bottom shell. Their flippers are dark gray to brown above with white to white-gray margins. They weigh 0.05 pounds (20 grams) and are two inches (4 centimeters) long.

Loggerheads are circumglobal occurring throughout the temperate and tropical regions. Loggerheads are the most abundant species of sea turtle found in U.S. coastal waters. Individuals of the Northwest Atlantic Ocean DPS are found north of the equator, south of 60° N, and west of 40° W (76 FR 58868).

The species was first listed as threatened under the Endangered Species Act in 1978 (43 FR 32800). In 2011, the listing was revised, and nine DPSs were designated under the ESA (Figure 6) (76 FR 58868). Four DPSs were listed as threatened: Northwest Atlantic Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and the Southwest Indian Ocean. Five DPSs were listed as endangered: Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, North Pacific Ocean, and South Pacific Ocean. Based on the action area, we expect individuals of the Northwest Atlantic, North Pacific Ocean, and South Pacific DPSs to be exposed to the proposed action. We used information available in the 2009 Status Review (Conant et al. 2009) and the final listing rule (76 FR 58868) to summarize the status of the species, as follows.

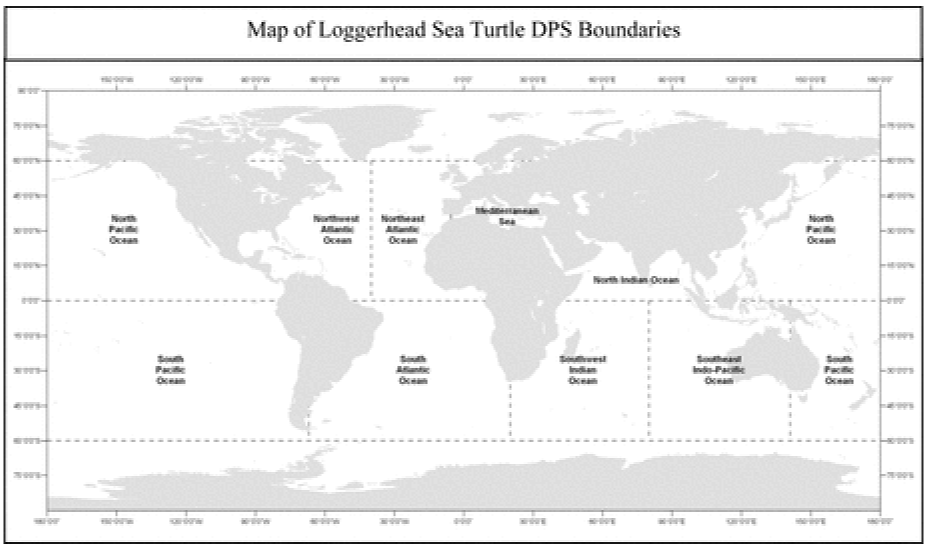

Figure 6. Map depicting the ESA-listed loggerhead sea turtle distinct population segment boundaries.

Life history

Mean age at first reproduction for female loggerhead sea turtles is 30 years (*SD* = 5). Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs primarily on 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. Juveniles are omnivorous and forage on crabs, mollusks, jellyfish and vegetation at or near the surface (Dodd 1988). Sub-adult and adult loggerheads prey on benthic invertebrates such as mollusks and decapod crustaceans in hard bottom, coastal habitats.

Population dynamics

There are nine loggerhead DPSs, which are geographically separated and genetically isolated, as indicated by genetic, tagging and telemetry data. Recent ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based on nesting beaches (Shamblin et al. 2014). The North Pacific DPS has a small nesting population. An 18-year time series of nesting data in Japan indicates a decline in the North Pacific population from 6,638 nests in 1990 to 2,064 nests in 1997. Since then, nesting has gradually increased to 7,000-8,000 nests, based on estimates taken in 2009 (Conant et al. 2009). Nesting for the South Pacific DPS occurs mostly in eastern Australia and New Caledonia. For many years, the nesting population at Queensland was in decline; there were approximately 3,500 females in the 1976-1977 nesting season, and less than 500 in 1999. From 2000-2009, there has been an increasing number of females nesting. The Northwest Atlantic Ocean DPS is considered one of the most significant nesting assemblages in the world, with nesting showing signs of stabilizing. Based on the small sizes of almost all nesting aggregations in the Atlantic, the large numbers of individuals killed in fisheries, and the decline of the only large nesting aggregation, we expect the DPS to be in decline .

Acoustics
Currently it is believed that the range of maximum sensitivity for sea turtles is 200-800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994, Moein et al. 1994). Juvenile loggerhead turtles hear sounds between 250-1,000 Hz and, therefore, often avoid low-frequency sounds (Bartol et al. 1999).

Status summary
The loggerhead sea turtle was listed under the ESA as a result of bycatch mortality, resulting from domestic and international commercial fishing, particularly in gillnet, longline and trawl fisheries. Additional causes for the decline stem from directed harvest, coastal development, increased human use of nesting beaches and pollution. These threats are expected to continue into the future. The global abundance of nesting female loggerhead turtles is estimated at 43,320–44,560 (Spotila 2004).

4.2.21 Olive Ridley Turtle (breeding populations on the Pacific Coast of Mexico)

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution. The species was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations on the Pacific coast of Mexico and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range). We used information available in the 2014 five-year review (NMFS and USFWS 2014) to summarize the status of the species, as follows.

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

Population dynamics

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

Acoustics

No audiometric data are available for the olive ridley turtle, but based on other sea turtle hearing capabilities, they probably also hear best in the low frequencies. Currently it is believed that the range of maximum sensitivity for sea turtles is 200-800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994, Moein et al. 1994).

Status summary

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

4.2.22 Olive Ridley Turtle (all other areas)

The olive ridley sea turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution. The species was listed under the ESA on July 28, 1978 (43 FR 32800). The species was separated into two listing designations: endangered for breeding populations on the Pacific coast of Mexico and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range). We used information available in the 2014 five year review (NMFS and USFWS 2014) to summarize the status of the threatened listing, as follows.

Life history

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

Population dynamics

Threatened olive ridley sea turtles nest in arribadas at a few beaches in the eastern Pacific, western Atlantic and northern Indian Oceans. Solitary nesting is observed on many tropical beaches throughout the Atlantic, Pacific and Indian Oceans. Arribadas now range in size from 335-2,000 nests in the western Atlantic, from 1,300-200,000 turtles in the eastern Pacific and from 1,000-200,000 in the Indian Ocean.

Acoustics

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

Status summary

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 sea turtles continue to be harvested as eggs and adults, legally in some areas and illegally in others. Incidental capture in fisheries is also a major threat. The olive ridley sea turtle is the most abundant sea turtle in the world; however, several populations are declining as a result of continued harvest and fisheries bycatch. Its large population size, however, allows some resilience to future perturbation.

4.2.23 Leatherback Turtle

The leatherback sea turtle is unique among sea turtles for its large size, wide distribution (due to thermoregulatory systems and behavior) and lack of a hard, bony carapace. The species ranges from tropical to subpolar latitudes, worldwide, from nearshore habitats to oceanic environments (Schroeder and Thompson 1987, Shoop and Kenney 1992, Grant and Ferrell 1993, Starbird et al. 1993).

Leatherback sea turtles have a primarily black shell with pinkish-white coloring on their belly. Leatherback sea turtles are by far the largest sea turtle and the heaviest of all reptiles. Unlike all other sea turtles, they do not have a hard outer shell, but rather a tough black leathery hide (except for it being white on the animal’s underside). A leatherback's top shell (carapace) is about 1.5 inches (4 centimeters) thick and consists of leathery, oil-saturated connective tissue overlaying loosely interlocking dermal bones. Their carapace has seven longitudinal ridges and tapers to a blunt point, which help give the carapace a more hydrodynamic structure. Adults weigh up to 2,000 pounds (900 kilograms) and measure 6.5 feet (2 meters) long. Hatchlings weigh 1.5-2 ounces (40-50 grams) and are 2-3 inches (50-75 centimeters) in length.

The species was first listed under the Endangered Species Conservation Act (35 FR 8491) and has been listed as endangered under the ESA since 1973. We used information available in the five year review (TEWG 2007) to summarize the status of the species, as follows.

Life history

Age at maturity remains unknown, with estimates ranging from 5-29 years (Spotila et al. 1996, Avens et al. 2009). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing >80 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) in approximately 50 percent worldwide (Eckert et al. 2012). Females nest every 1-7 years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic and Indian Oceans. Leatherback sea turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh approximately 33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005, Wallace et al. 2006). Sea turtles must meet an energy threshold before returning to nesting beaches (Rivalan et al. 2005, Sherrill-Mix and James 2008, Casey et al. 2010). Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000, Price et al. 2004).

Population dynamics

The global population of adult females has declined over 70 percent in less than one generation, from an estimated 115,000 adult females in 1980 to 34,500 adult females in 1995 (Pritchard 1982, Spotila et al. 1996). There may be as many as 34,000-94,000 adult leather backs in the North Atlantic alone (TEWG 2007), but dramatic reductions (> 80 percent) have occurred in several populations in the Pacific, which was once considered the stronghold of the species (Sarti-Martinez 2000). Most stocks in the Pacific Ocean are faring poorly, as nesting populations there have declined more than 80 percent since 1982 (Sarti-Martinez 2000), while western Atlantic and South African populations are generally stable or increasing (TEWG 2007). Worldwide, the largest nesting populations now occur off of Gabon in equatorial West Africa (5,865-20,499 females nesting per year (Witt et al. 2009)), in the western Atlantic in French Guiana (4,500-7,500 females nesting per year (Dutton et al. 2007)) and Trinidad (estimated 6,000 turtles nesting annually (Eckert 2002), and in the western Pacific in West Papua (formerly Irian Jaya), Indonesia (about 600-650 females nesting per year (Dutton et al. 2007)). By 2004, 203 nesting beaches from 46 countries around the world had been identified (Dutton 2006). Of these, 89 sites (44 percent) have generated data from beach monitoring programs. Although these data are beginning to form a global perspective, unidentified sites likely exist, and incomplete or no data are available for many known sites. Genetic studies have been used to identify two discrete leatherback populations in the Pacific Ocean (Dutton 2006): an eastern Pacific Ocean population, which nests between Mexico and Ecuador; and a western Pacific Ocean population, which nests in numerous countries, including Indonesia, Papua New Guinea, Solomon Islands, and Vanuatu. Detailed population structure is unknown but is likely dependent upon nesting beach location.

Acoustics

Sea turtles do not have an external ear pinnae or eardrum. Instead, they have a cutaneous layer and underlying subcutaneous fatty layer that function as a tympanic membrane. The subcutaneous fatty layer receives and transmits sounds to the middle ear and into the cavity of the inner ear (Ridgway et al. 1969). Sound also arrives by bone conduction through the skull. Sound arriving at the inner ear via the columella (homologous to the mammalian stapes or stirrup) is transduced by the bones of the middle ear.

Sea turtle auditory sensitivity is not well studied, though a few preliminary investigations suggest that it is limited to low frequency bandwidths, such as the sounds of waves breaking on a beach. The role of underwater low-frequency hearing in sea turtles is unclear. It has been suggested that sea turtles may use acoustic signals from their environment as guideposts during migration and as a cue to identify their natal beaches (Lenhardt et al. 1983).

Currently it is believed that the range of maximum sensitivity for sea turtles is 200-800 Hz, with an upper limit of about 2,000 Hz (Lenhardt 1994, Moein et al. 1994). In terms of sound emission, nesting leatherback turtles produce sounds in the 300-500 Hz range (Mrosovsky 1972). No audiometric data are available for the leatherback turtle, but based on other sea turtle hearing capabilities, they probably also hear best in the low frequencies.

Status

The leatherback sea turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. The primary threats to leatherback sea turtles include fisheries bycatch, harvest of nesting females and egg harvesting. As a result of these threats, once large rookeries are now functionally extinct and there have been range-wide reductions in population abundance. Other threats include loss of nesting habitat due to development, tourism and sand extraction. Lights on or adjacent to nesting beaches alter nesting adult behavior and are often fatal to emerging hatchlings as they are drawn to light sources and away from the sea. Plastic ingestion is common in leatherbacks and can block gastrointestinal tracts leading to death. Climate change may alter sex ratios (as temperature determines hatchling sex), range (through expansion of foraging habitat) and habitat (through the loss of nesting beaches, as a result of sea-level rise). The species's resilience to additional perturbation is low.

4.2.24 Smalltooth Sawfish – United States Distinct Population Segment

The smalltooth sawfish (Figure 7) is a tropical marine and estuarine elasmobranch fish (sharks and rays). Sawfishes physically more 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. In the western Atlantic, the smalltooth sawfish has been reported from Brazil through the Caribbean and Central America, the Gulf of Mexico, and the Atlantic coast of the U.S.. The smalltooth sawfish has also been recorded from Bermuda (Bigelow and Schroeder 1953b). Smalltooth sawfish can be found in Florida waters, primarily in the southern tip of the state, centered around Charlotte Harbor, Everglades National Park, and Florida Bay (Figure 7). The U.S. smalltooth sawfish DPS was listed as endangered under the ESA on April 1, 2003 (68 FR 15674).

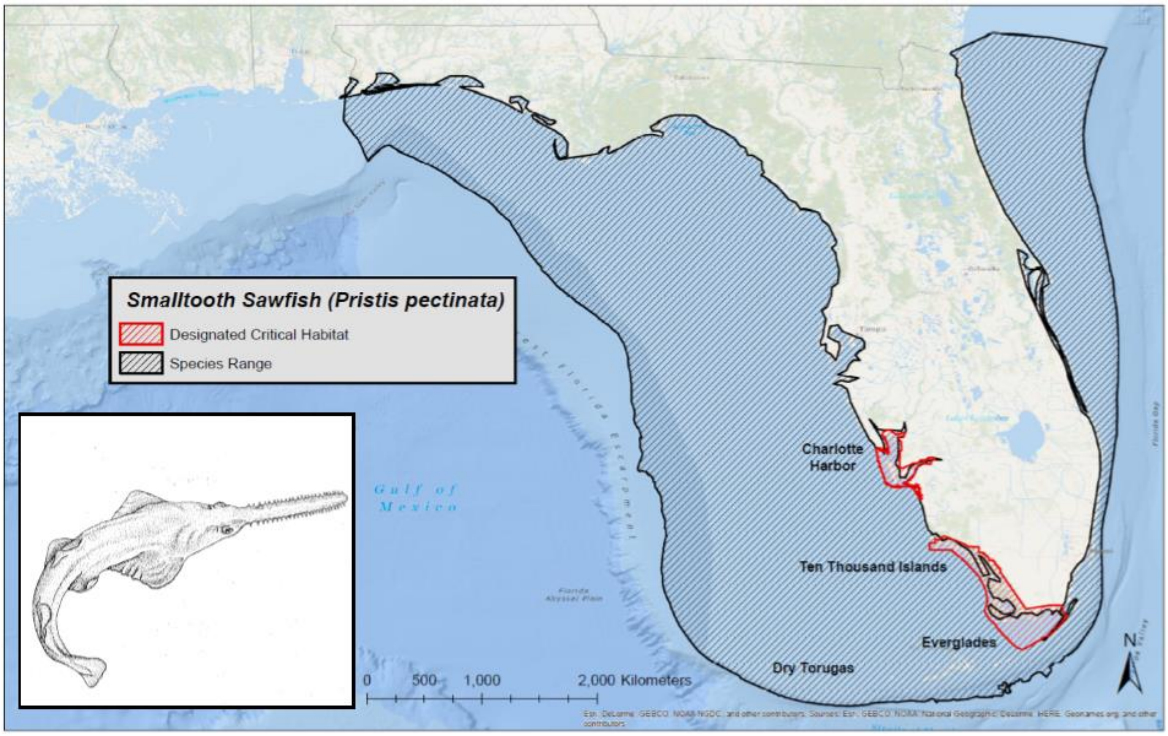

Figure 7. Smalltooth sawfish range.

We used information available in the 2009 Recovery Plan (NMFS 2009e), the five year Review (NMFS 2010e), and the proposed listing of other sawfish (78 FR 33300) to summarize the status of the species, as follows.

Life history

As in all elasmobranchs, fertilization in smalltooth sawfish is internal. Bigelow and Schroeder (1953b) report the litter size as 15-20. Simpfendorfer and Wiley (2004), however, caution this may be an overestimate, with recent anecdotal information suggesting smaller litter sizes (about ten). Smalltooth sawfish mating and pupping seasons, gestation, and reproductive periodicity are all unknown. Gestation and reproductive periodicity, however, may be inferred based on that of the largetooth sawfish, which shares the same genus and has similarities in size and habitat. Smalltooth sawfish size at sexual maturity has been reported as 360 and 415 centimeters total length by (Simpfendorfer 2005)and Carlson (unpublished) respectively. Sexual maturity for females occurs between 7-11 years of age (Carlson and Simpfendorfer 2015).

Smalltooth sawfish are euryhaline, occurring in waters with a broad range of salinities from freshwater to full seawater (Simpfendorfer 2001). Younger, smaller individuals tend to inhabit very shallow mud banks, and tides are a major factor in their movement (Simpfendorfer et al. 2010). Small juvenile smalltooth sawfish spend the vast majority of their time on shallow mud or sand banks that are less than 30 centimeters deep. As they grow, juveniles tend to occupy deeper habitat, but shallow areas (less than one meters depth) remain preferred habitat (Simpfendorfer et al. 2010). Larger animals are more likely to be found in deeper waters. Poulakis and Seitz (2004) reported that almost all of the sawfish less than three meters in length were found in water less than 10 meters deep, and 46 percent of encounters individuals greater than three meters in Florida Bay and the Florida Keys were reported at depths between 70-122 meters. Since large animals are also observed in very shallow waters, it is believed that smaller (younger) animals are restricted to shallow waters, while large animals roam over a much larger depth range (Simpfendorfer 2001).

Population dynamics

The abundance of smalltooth sawfish in U.S. waters has decreased dramatically over the past century. Current abundance estimates are based on encounter data, genetic sampling, and geographic extent. There are no reliable estimates of smalltooth sawfish population size; however, encounter densities estimate the female population size to be 600 (Carlson and Simpfendorfer 2015). Genetic analyses indicate an effective population size of 250-350 (Chapman et al. 2011). Despite the lack of data on abundance, recent encounters with neonates (young-of-the-year), juveniles, and sexually mature sawfish indicate that the Florida population is reproducing (Seitz and Poulakis 2002, Simpfendorfer and Wiley 2004). The low intrinsic rates of population increase suggests that smalltooth sawfish are particularly vulnerable to excessive mortality and rapid population declines due to stochastic events, after which recovery may take decades.

This information and recent encounters in new areas beyond the core abundance area suggest that the population may be increasing. From 1989-2004, smalltooth sawfish relative abundance has increased by about five percent per year (Carlson et al. 2007). However, recovery of the species is expected to be slow based on the species' life history and other threats remaining (see below). Based on genetic sampling, the estimates of current effective population size are between 269.6-504.9 individuals (95 percent CI 139.3-1,515) (NMFS 2011b). This number is usually 25-50 percent of census population size (breeding adults) in elasmobranchs, so it is likely that the breeding population consists of high hundreds to low thousands of individuals (NMFS 2011b).

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 >90 percent of its current genetic diversity over the next century.

Status summary

It is believed that sawfish are at less than five percent of its population size than at the time of European settlement (Simpfendorfer 2002). Historically common in coastal waters from Texas to North Carolina, the range of the DPS has been contracted to southwestern Florida. Like other elasmobranchs, smalltooth sawfish are a k-selected species, characterized by a low rate of intrinsic population growth and able to maintain relatively small population sizes in stable environments, but vulnerable to excessive mortalities. The decline in sawfish abundance is attributed to bycatch in fisheries, entanglement in marine debris, and loss of juvenile habitat through destruction of mangroves and dredging and filling projects. These factors continue to be significant threats to smalltooth sawfish survival and recovery. Therefore, the species has little resilience to additional perturbations.

4.2.25 Atlantic Sturgeon

The Atlantic sturgeon (Mitchill, 1815) is a long-lived (approximately 60 years), estuarine dependent fish. Atlantic sturgeon are anadromous, spawning in freshwater, but spending most of their subadult and adult life in the marine environment. Atlantic sturgeon can grow to approximately 14 feet (4.3 meters) long and can weigh up to 800 pounds (370 kilograms). They are bluish-black or olive brown dorsally (on their back) with paler sides and a white belly. They have five major rows of dermal "scutes". Atlantic sturgeon are similar in appearance to shortnose sturgeon, but can be distinguished by their larger size, smaller mouth, different snout shape, and scutes (Bigelow and Schroeder 1953a, Vladykov and Greely 1963, Mangin 1964, Pikitch et al. 2005, Dadswell 2006, ASSRT 2007). The range of Atlantic sturgeon includes the St. John River in Canada, to St. Johns River in Florida.

Five DPSs of Atlantic sturgeon were designated and listed under the ESA on February 6, 2012 (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic) (77 FR 5880, 77 FR 5914). Atlantic sturgeon is considered endangered within four DPSs and threatened within one (Figure 8), as listed below.

- ESA Endangered: New York Bight DPS, Chesapeake Bay DPS, Carolina DPS, South Atlantic DPS
- ESA Threatened: Gulf of Maine DPS

Life history

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

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

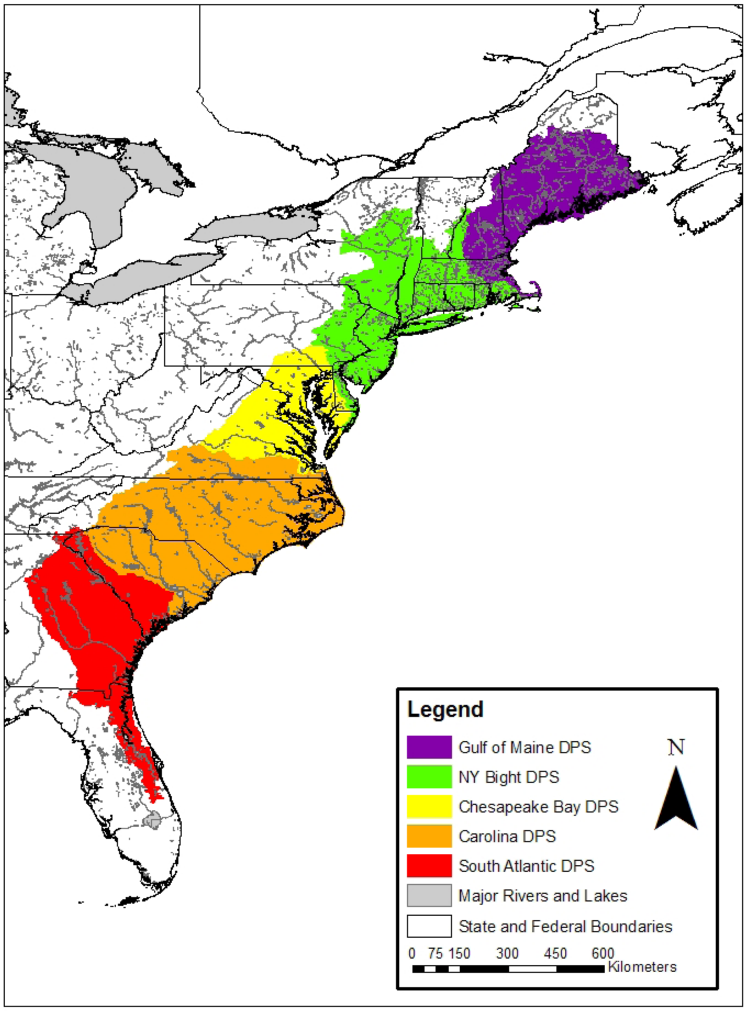

Figure 8. Range and boundaries of the five Atlantic sturgeon distinct population segments.

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

Population dynamics

The Atlantic sturgeon's historic range included major estuarine and riverine systems that spanned from Hamilton Inlet on the coast of Labrador to the Saint Johns River in Florida (Smith and Clugston 1997, ASSRT 2007). Atlantic sturgeon underwent significant range-wide declines from historical abundance levels due to overfishing in the mid to late nineteenth century when a caviar market was established (Scott and Crossman 1973, Taub 1990, Maine State Planning Office 1993, Smith and Clugston 1997, Dadswell 2006, ASSRT 2007). Abundance of spawning-aged females prior to this period of exploitation was predicted to be greater than 100,000 for the Delaware River, and at least 10,000 females for other spawning stocks (Secor and Waldman 1999, Secor 2002).

Historically, Atlantic sturgeon were present in approximately 38 rivers in the United States from St. Croix, Maine to the Saint Johns River, Florida, of which 35 rivers have been confirmed to have had historical spawning populations. Atlantic sturgeon are currently present in approximately 32 rivers, and spawning occurs in at least 20 of these (ASSRT 2007).

Subadult and adult Atlantic sturgeon spend time in oceanic waters during coastal migrations. Using bycatch data and the USFWS sturgeon tagging database, NMFS Northeast Fisheries Science Center estimated mean abundance of oceanic Atlantic sturgeon population index for 1999-2009 to be 417,934 (95 percent CI: 165,381-744,597); this estimate did not include Atlantic sturgeon residing year-round in rivers (Kocik et al. 2013). Another population abundance estimate was derived from the 2007-2012 Northeast Area Monitoring and Assessment Program (NEAMAP) trawl surveys from Cape Cod, Massachusetts to Cape Hatteras, North Carolina and assumed estimates of gear efficiency; these results are in Table 10 .

Table 10. Modeled results of estimated Atlantic sturgeon abundance from the Atlantic Sturgeon Population Index and NEAMAP.

Model Run	Model Years	95 percent low	Mean	95 percent high
A. Atlantic Sturgeon Population Index (Kocik et al. 2013)	1999-2009	165,381	417,934	744,597
B.1 NEAMAP Survey, swept area assuming 100 percent efficiency	2007-2012	8,921	33,888	58,856
B.2 NEAMAP Survey, swept area assuming 50 percent efficiency	2007-2012	13,962	67,776	105,984
B.3 NEAMAP Survey, swept area assuming 10 percent efficiency	2007-2012	89,206	338,882	588,558

Because it relied on fewer model assumptions, we consider the NEAMAP estimate of ocean population abundance resulting from the 50 percent catchability rate (67,776 individuals), as the best available information on the number of subadult and adult Atlantic sturgeon in the ocean. However, this cannot be considered an estimate of the total number of subadults because it only considers those subadults that are of a size vulnerable to capture in commercial sink gillnet and otter trawl gear in the marine environment and are present in the marine environment, which is only a fraction of the total number of subadults. Additionally, we can estimate that 10.7 percent of this population abundance (calculated from Table 2 of (Kocik et al. 2013)) comprised of adults, or individuals greater than 150 centimeters.

A description of each Atlantic sturgeon DPS, with details regarding the smaller, in-river populations is below.

4.2.25.1 *Gulf of Maine Distinct Population Segment*

The Gulf of Maine (GOM) DPS includes all Atlantic sturgeon that are spawned in the Gulf of Maine watersheds from the Maine/Canada border to Chatham, MA. The GOM DPS was listed as threatened (77 FR 5880). An interim 4(d) Rule to apply take prohibitions to the GOM DPS was established (78 FR 69310; November 19, 2013). The rulemaking identified several activities that may take GOM DPS Atlantic sturgeon, including incidental bycatch in fisheries, habitat alteration, and "entrainment and impingement of all life stages of GOM DPS Atlantic sturgeon during the operation of water diversions, dredging projects, and power plants…"

Population dynamics
In the early 1800s, there were estimated to be 10,240 adult Atlantic sturgeon in the Kennebec River, Maine; currently, the existing spawning population is thought to be less than 300 adults annually. Spawning still occurs in the Kennebec River, and possibly still occurring in the Penobscot River as well (ASSRT 2007). Recent evidence indicates that spawning may also be occurring in the Androscoggin River. During the 2011 spawning season, the Maine Department of Marine Resources captured a larval Atlantic sturgeon below the Brunswick Dam. There is no evidence of recent spawning in the remaining rivers.

There is no current population estimate for the GOM DPS. The Atlantic sturgeon Status Review Team (2007) presumed that the Gulf of Maine DPS was comprised of less than 300 spawning adults per year, based on abundance estimates for the Hudson and Altamaha River riverine populations of Atlantic sturgeon. Surveys of the Kennebec River over two time periods, 1977-1981 and 1998-2000, resulted in the capture of nine adult Atlantic sturgeon (Squiers 2003). However, since the surveys were primarily directed at capture of shortnose sturgeon, the capture gear used may not have been selective for the larger-sized, adult Atlantic sturgeon; several hundred subadult Atlantic sturgeon were caught in the Kennebec River during these studies.

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

The removal of dams on the Kennebec and Penobscot rivers is seen as a positive step towards restoring habitat, for the GOM DPS and for other anadromous species in the area. Recent research has detected the presence of adults, age-1 fish, and eggs in rivers where sturgeon were unknown to occur or had not been observed for many years. These observations suggest that abundance of the Gulf of Maine DPS of Atlantic sturgeon is sufficient such that recolonization to rivers historically suitable for spawning may be occurring. All directed Atlantic sturgeon fishing as well as retention of Atlantic sturgeon by-catch has been prohibited since 1998. Nevertheless, mortalities associated with bycatch in fisheries occurring in state and federal waters still occur. In the marine range, Gulf of Maine DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein et al. 2004). Habitat disturbance and direct mortality from anthropogenic sources are the primary concerns. However, despite some positive signs, there is not enough information to establish a trend for this DPS. NMFS concludes that the GOM DPS is vulnerable to further perturbations.

4.2.25.2 *New York Bight Distinct Population Segment*

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

Population dynamics

The NYB DPS contains two known spawning population on the Delaware and Hudson rivers. The Hudson River is thought to support one of the more robust Atlantic sturgeon populations in its entire range. In the late 1800s, an estimated 6,000 to 8,000 females contributed to the Hudson River stock; current estimates are that 870 adults spawn annually in the Hudson River (600 males and 270 females). The current spawning population is thought to be 1-2 orders of magnitude less than historic, pre-harvest levels. Peterson et al. (2000) reported that there were approximately 4,300 age-1 and -2 Atlantic sturgeon in the Hudson River between 1985-1995. In June 2014, several presumed age-0 Atlantic sturgeon were captured in the Connecticut River. These captures represent the only contemporary records of possible natal Atlantic sturgeon in the Connecticut River. Capture of age-0 Atlantic sturgeon strongly suggests that spawning is occurring in that river (T. Savoy, Connecticut Department of Environmental Protection, pers. comm. to NMFS; CDEP 2014).

Before 1890, the Delaware River is estimated to have supported around 180,000 adult female Atlantic sturgeon. There have been attempts to generate a population estimate for Atlantic sturgeon on the Delaware River; estimates of juveniles have ranged from 5,600 to less than 1,000. A directed survey by the Delaware Division of Fish and Wildlife from conducted 1991-1998 captured more than 1,700 juveniles, with a high of 565 individuals in 1991, and 14 in 1998.

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

In the marine range, New York Bight DPS Atlantic sturgeon are incidentally captured in federal and state managed fisheries, reducing survivorship of subadult and adult Atlantic sturgeon (Stein et al. 2004, ASMFC 2009). Current available estimates indicate that at least four percent of adults may be killed as a result of bycatch in fisheries authorized under Northeast FMPs. Based on mixed stock analysis results presented by Wirgin and King (2011), over 40 percent of the Atlantic sturgeon bycatch interactions in the Mid Atlantic Bight region were sturgeon from the New York Bight DPS.

Status summary

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

Although the Hudson River is believed to support one of the more robust populations, the status of Atlantic sturgeon in other rivers of the NYB DPS is either unknown or severely depleted from historic levels due to overfishing. The threats facing the NYB DPS are expected to continue into the future. A loss of any one of the riverine populations within this DPS would represent a loss in genetic diversity, reduction in the number of reproducing individuals, a gap in the range of the DPS that is unlikely to be recolonized, and lower recruitment. NMFS concludes that the resiliency of the NYB DPS to further perturbations is low.

4.2.25.3 *Chesapeake Bay Distinct Population Segment*

The Chesapeake Bay DPS includes Atlantic sturgeon that are spawned in the watersheds that drain into the Chesapeake Bay from Fenwick Island to Cape Henry, Virginia. Major rivers that are a part of the Chesapeake Bay DPS include the York, James, Potomac, Susquehanna, and Rappahannock rivers. The Chesapeake Bay DPS is listed as endangered (77 FR 5880).

Population dynamics

Pre-harvest (i.e., before 1890) levels of Atlantic sturgeon in the Chesapeake Bay and its tributaries are estimated to be approximately 20,000 adult females. The current spawning population in the James River is thought to be less than 300 individuals per year. Spawning was recently confirmed in the Pamunkey River (a tributary to the York River) (ASSRT 2007, Greene et al. 2009, Hager et al. 2014, Kahn et al. 2014). Hager et al. (2014) recently documented Atlantic sturgeon spawning in the York River. The presence of adult sturgeon suggests that spawning may also occur in Marshyhope Creek (a tributary to the Nanticoke River in Maryland). Investigations of spawning are also ongoing in the Mattaponi River where adult sturgeon have been observed. Status of spawning on other major tributaries in the Chesapeake Bay DPS is unknown, although spawning once occurred on the Potomac, Susquehanna, and Rappahannock rivers.

Status summary

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

4.2.25.4 *Carolina Distinct Population Segment*

The Carolina DPS includes Atlantic sturgeon that originated from the Roanoke, Tar/Pamlico, Cape Fear, Winyah Bay, and Santee-Cooper rivers in North and South Carolina. The Carolina DPS is listed as endangered (77 FR 5914).

Population dynamics

Before commercial harvest began in 1890, it is estimated that there were 7,000-10,500 adult females in North Carolina (Armstrong and Hightower 2002). Secor (2002) estimated that 8,000 adult females were present in South Carolina during that same time-frame. Riverine spawning populations are thought to be at less than three percent of their historic levels. The ASSRT estimated the remaining river populations within the DPS to have fewer than 300 spawning adults; this is thought to be a small fraction of historic population sizes (ASSRT 2007).

Rivers known to have current spawning populations within the range of the Carolina DPS include the Roanoke, Tar-Pamlico, Cape Fear, Waccamaw, and Pee Dee Rivers. Spawning was determined to occur if young-of-the-year (YOY) were observed, or mature adults were present, in freshwater portions of a system (ASSRT 2007). The spawning population in the Sampit River, part of the Winyah Bay system, is believed to have been eliminated; the status of other spawning populations in the Carolina DPS remain uncertain, with possible spawning occurring in the Neuse, Santee and Cooper Rivers.

Status summary

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

4.2.25.5 *South Atlantic Distinct Population Segment*

The South Atlantic (SA) DPS includes Atlantic sturgeon originating from the ACE Basin (Ashepoo, Combahee, and Edisto rivers) in South Carolina, the Savannah, Ogeechee, Altamaha, and Satilla rivers in Georgia, and the St. Mary's and St. Johns rivers in Florida. The SA DPS is listed as endangered (77 FR 5914).

Population dynamics
Prior to 1890, there were thought to be approximately 11,000 adult females in Georgia, and approximately 8,000 in South Carolina. The Altamaha River is thought to be the largest spawning population in the southeastern United States; Peterson et al. (2008) reported that approximately 324 (in 2004) and 386 (in 2005) adults per year returned, or about six percent of historic levels. Schueller and Peterson (2010) reported that age-1 and age-2 Atlantic sturgeon population densities in the Altamaha River, Georgia, ranged from 1,000-2,000 individuals over a four year period from 2004-2007. Other water systems suspected of still supporting a spawning population are the ACE Basin, the Savannah, Ogeechee, and Satilla rivers, and each is believed to have fewer than 300 adults annually. The Ogeechee River subpopulation is considered to be particularly stressed as research has found that juvenile abundance is rare with high inter-annual variability, indicating spawning or recruitment failure. Spawning populations in the St. Mary's and St. Johns rivers are believed to be eliminated.

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

4.2.26 Gulf Sturgeon

The Gulf sturgeon, also known as the Gulf of Mexico sturgeon, is an anadromous fish, inhabiting coastal rivers during the warmer months and overwintering in estuaries, bays, and the Gulf of

Mexico. Currently, Gulf sturgeon are distributed from the Suwannee River, Florida, to Lake Pontchartrain and the Pearl River system, Louisiana.

Gulf sturgeon are a nearly cylindrical primitive fish embedded with bony plates or scutes. The head ends in a hard, extended snout; the mouth is inferior and protrusible and is preceded by four conspicuous barbels. The tail (caudal fin) is distinctly asymmetrical, the upper lobe is longer than the lower lobe (heterocercal). Adults range from 1.2-2.4 meters (4-8 feet) in length, with adult females larger than males. The Gulf sturgeon is distinguished from the geographically disjunct Atlantic coast subspecies by its longer head, pectoral fins, and spleen (Vladykov 1955, Wooley and Crateau 1985).

Gulf sturgeon were listed as threatened on September 30, 1991 (56 FR 49653). Gulf sturgeon historically occurred in coastal river systems from the Mississippi River to the Suwannee River, Florida, and in the Gulf of Mexico to the Florida Bay. Factors that led to the listing include: dams blocking access to habitat, channel improvement and maintenance activities, dredging, water quality degradation and contaminants.

We used information available in the 1995 Recovery Plan (USFWS and GSMFC 1995), the 2009 five Year Status Review (NMFS 2009f), the critical habitat designation (68 FR 13370) and the final listing rule (56 FR 49653) to summarize the status of the species, as follows.

Life history

As members of the family Acipenseridae, Gulf sturgeon share similar reproductive strategies and life history patterns with other sturgeon species. Evidence of Gulf sturgeon spawning has been found in the Suwannee, Pascagoula, and Choctawhatcee rivers (Fox et al. 2000, Heise et al. 2004). Gulf sturgeon eggs average between 2.1-2.2 millimeters in diameter and larvae are 6.9 millimeters in length after hatching. Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Gulf sturgeon eat isopods, amphipods, polychaete and oligochaete annelids, as well as crustaceans. Evidence shows that most sub-adult and adult Gulf sturgeon feed for 3-4 months while in the marine environment, and then do not feed for the next 8-9 months after they enter freshwater. Gulf sturgeon less than two years old reside in riverine and estuarine habitats throughout the year, while sub-adults and adults spend eight to nine months in freshwater, and the rest of the year in estuarine or Gulf waters.

Population dynamics

There are no range-wide population estimates for Gulf sturgeon, although particular river systems have been studied, including the Suwannee and Apalachicola rivers. The Suwannee River is considered to have the most robust population of Gulf sturgeon, with a population size estimated at 2,250-3,300 (87-211 centimeter, 18 kilogram fish). 93-131 fish were estimated to be below the dam on the Apalachicola River. About 100 Gulf sturgeon (>45 centimeters) were estimated to be at the Jim Woodruff Lock and Dam on the Apalachicola (which is likely an underestimate, based on high rates of tag loss); 293 Gulf sturgeon were captured from 1982-1991 (Zehfuss et al. 1999). Population estimates for Gulf sturgeon in the Yellow River ranged from

500-911 fish over a three year period, and the age structure of that population indicated successful recruitment (Berg 2006).

Status summary

Like other sturgeon species, Gulf sturgeon were historically overfished, which played a large role in the decline in its population. Although no directed fisheries are in operation today, Gulf sturgeon are still at risk from incidental bycatch in other state and federal fisheries. Habitat reduction from dams blocking access to spawning areas, dredging, groundwater extraction, poor water quality and contaminants all remain current threats, which will likely continue into the future. According to the Gulf sturgeon five year review, NMFS considers the population stable, with seven riverine systems showing evidence of spawning, although variability in population size has been noted. This variability is attributed to Hurricanes Ivan (2004) and Katrina (2005). The 5-year review concluded that the threatened status for Gulf sturgeon was still appropriate. We conclude that Gulf sturgeon population is stable and somewhat resilient to further perturbation.

4.2.27 Shortnose Sturgeon

Shortnose sturgeon resemble other sturgeon species. Their body surface contains five rows of bony plates, or "scutes." They are typically large, long-lived fish that inhabit a great diversity of riverine habitat, from the fast-moving freshwater riverine environment downstream to the offshore marine environment of the continental shelf. Shortnose sturgeon are anadromous, inhabiting large coastal rivers or nearshore estuaries with river systems. This species migrates periodically into fresh water areas to spawn but regularly enter saltwater habitats during their life cycle (Kieffer and Kynard 1993, SSSRT 2010).

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

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

We used information available in the Shortnose Sturgeon Recovery Plan (NMFS 1998a), the 2010 NMFS Biological Assessment (SSSRT 2010), and the listing document (32 FR 4001) to summarize the status of the species, as follows.

Life history

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

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

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

Juvenile shortnose generally move upstream during spring and summer and downstream for fall and winter; however, these movements usually occur above the salt- and freshwater interface. During winter, adult shortnose sturgeon inhabit freshwater reaches of rivers reaches influenced by tides. During summer, at the southern end of its range, shortnose sturgeon congregate in cool, deep, areas of rivers taking refuge from high temperatures. Adult shortnose sturgeon prefer deep, downstream areas with soft substrate and vegetated bottoms, if present. Because they rarely leave their natal rivers, shortnose sturgeon are considered to be freshwater amphidromous (i.e. adults spawn in freshwater but regularly enter saltwater habitats during their life).

Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Shortnose sturgeon forage over sandy bottom, and eat benthic invertebrates like amphipods.

Population dynamics

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along nearly the entire east coast of North America. The Shortnose Sturgeon Recovery Plan (NMFS 1998a) describes 19 shortnose sturgeon populations that exist in the wild, but are not formally recognized by NMFS as DPSs under the ESA. Two additional geographically separate populations occur behind dams in the Connecticut River (above the Holyoke Dam) and in Lake Marion on the Santee-Cooper River system in South Carolina (above the Wilson and

Pinopolis Dams). Although these populations are geographically isolated, genetic analyses suggest individual shortnose sturgeon move between some of these populations each generation (Quattro et al. 2002, Wirgin et al. 2005, Wirgin et al. 2010).

Currently, there is no range-wide population estimate for shortnose sturgeon, although many individual river systems have been studied and population estimates have been generated for several rivers. Some rivers have been more intensely studied than others, allowing for multiple estimates. Rivers with the largest shortnose sturgeon population estimates are the Hudson (ranging up to 61,000), Delaware (about 12,000), and Altamaha (6,320).

Despite the life span of adult sturgeon, the viability of sturgeon populations is highly sensitive to juvenile mortality resulting in lower numbers of sub-adults recruiting into the adult breeding population (Anders et al. 2002, Gross et al. 2002, Secor et al. 2002). This relationship led to the conclustion that sturgeon populations can be grouped into two demographic categories: populations having reliable (albeit periodic) natural recruitment and those that do not (Secor et al. 2002). The shortnose sturgeon populations without reliable natural recruitment are at more risk. Several authors have also demonstrated that sturgeon populations generally, and shortnose sturgeon populations in particular, are much more sensitive to adult mortality than other species of fish. Sturgeon populations cannot survive fishing related mortalities exceeding five percent of an adult spawning run and they are vulnerable to declines and local extinction if juveniles die from fishing related mortalities (Secor et al. 2002).

Status summary

The shortnose sturgeon is endangered, and much remains unknown about the population status in many rivers throughout its range. Commercial harvest of shortnose sturgeon at the beginning of the twentieth century is a principal cause for population decline. Harvest peaked in the 1880s, with seven million pounds of shortnose sturgeon landed in 1890; landings later dropped off dramatically, to only 22,000 pounds landed in 1920. Shortnose sturgeon populations are at risk from incidental bycatch, loss of habitat, dams, dredging and pollution. Heavy industrial development during the twentieth century in rivers inhabited by sturgeon impaired water quality and impeded these species' recovery. These threats are likely to continue into the future. We conclude that the shortnose sturgeon's resilience to further perturbation is low.

4.2.28 Green sturgeon - Southern Distinct Population Segment

Green sturgeon resemble other sturgeon species. The backbone of the green sturgeon curves upward into the caudal fin, forming their shark-like tail. On the ventral, or underside, of their flattened snouts are sensory barbels and a siphon-shaped, protrusible, toothless mouth. The skeleton of sturgeons is composed mostly of cartilage. Sturgeon lack scales; however, they have five rows of characteristic bony plates on their body called "scutes".

Green sturgeon occur in coastal Pacific waters from San Francisco Bay to Canada. Green sturgeon have been divided into two separate DPSs, with the Southern DPS listed as threatened under the ESA (71 FR 17757; April 7, 2006). The Southern DPS consists of populations south of the Eel River (Humboldt, CA), coastal and Central Valley populations, and the spawning population in the Sacramento River, CA. On June 2, 2010, NMFS issued a 4(d) Rule for the Southern DPS, applying certain take prohibitions (75 FR 30714).

We used information available in the 2002 Status Review and 2005 Status Review Update (Adams et al. 2002, BRT 2005), Recovery Outline (NMFS 2010a), and the proposed and final listing rules (70 FR 17836; 71 FR 17757) to summarize the status of the species, as follows.

Life history

Green sturgeon are long-lived, slow-growing fish and the most marine-oriented of the sturgeon species. Maximum ages of adult green sturgeon are likely to range from 60-70 years (Moyle 2002). Mature males range from 4.5-6.5 feet (1.4-2 meters) in "fork length" and do not mature until they are at least 15 years old, while mature females range from 5-7 feet (1.6-2.2 meters) fork length and do not mature until they are at least 17 years old.

Spawning is believed to occur every 2-5 years (Moyle 2002). Adults typically migrate into fresh water beginning in late February; spawning occurs from March-July, with peak activity from April-June (Moyle et al. 1995). Females produce 60,000-140,000 eggs (Moyle et al. 1992). Green sturgeon have relatively large eggs compared to other sturgeon species (4.34 millimeters) and grow rapidly, reaching 66 millimeters in three weeks. The Sacramento River is the location of the single, known spawning population for the green sturgeon Southern DPS (Adams et al. 2007).

Green sturgeon are believed to spend the majority of their lives in nearshore oceanic waters, bays, and estuaries. Juvenile green sturgeon spend 1-4 years in fresh and estuarine waters before dispersal to saltwater (Beamesderfer and Webb 2002). Upon outmigration from fresh water, subadult green sturgeon disperse widely along through continental shelf waters of the west coast within the 110 meter contour (Moyle et al. 1992, BRT 2005, Erickson and Hightower 2007). Green sturgeon appear to prefer marine areas with high seafloor complexity and boulder presence (Huff et al. 2011). Preferred areas also include depths of 20-60 m, with temperatures of 9.5-16° C (Huff et al. 2011). In the San Joaquin River, green sturgeon appear to prefer slopes or shoulders of navigational channels, not shallower shoals of less than seven meters (Peterson et al. 2011). Channel centers are also frequently utilized (Peterson et al. 2011).

Generally, sturgeon are benthic omnivores, feeding on benthic invertebrates that are abundant in the substrate in that area. Little is known specifically about green sturgeon foraging habits; generally, adults feed upon invertebrates like shrimp, mollusks, amphipods and even small fish, while juveniles eat opossum shrimp and amphipods.

Population dynamics

Trend data for green sturgeon is severely limited. Available information comes from two predominant sources, fisheries and tagging. Only three data sets were considered useful for the population time series analyses by NMFS’ biological review team: the Klamath Yurok Tribal fishery catch, a San Pablo sport fishery tag returns, and Columbia River commercial landings.

Using San Pablo sport fishery tag recovery data, the California Department of Fish and Game produced a population time series estimate for the southern DPS. San Pablo data suggest that green sturgeon abundance may be increasing, but the data showed no significant trend. The data set is not particularly convincing, however, as it suffers from inconsistent effort and since it is unclear whether summer concentrations of green sturgeon provide a strong indicator of population performance. Although there is not sufficient information available to estimate the current population size of southern green sturgeon, catch of juveniles during state and federal salvage operations in the Sacramento delta are low in comparison to catch levels before the mid-1980s.

Status summary

The 5-year status review for the Southern DPS was initiated in 2012 (77 FR 64959). Loss of spawning habitat and bycatch in the white sturgeon commercial fishery are two major causes for the species decline. Current threats to the Southern DPS include reduction in spawning habitat (mostly from impoundments), entrainment by water projects, contaminants, incidental bycatch and poaching. Given the small population size, the species' life history traits (e.g., slow to reach sexual maturity), and that the threats to the population are likely to continue into the future, we conclude that the Southern DPS is not resilient to further perturbations.

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° C 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-1971 (IPCC 2013). On a global scale, ocean warming is largest near the surface, and the upper 75 meters warmed by 0.11°C 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 (Learmonth et al. 2006, Issac 2009). 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 2014a). 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 (Kovacs and Innes. 1990, Kruse 1991, Wells and Scott 1997, Samuels and Gifford. 1998, Bejder et al. 1999, Colburn 1999, Cope et al. 1999, Mann et al. 2000, Samuels et al. 2000, Boren et al. 2001, Constantine 2001, Nowacek et al. 2001).

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 (Watkins 1986, Corkeron 1995, Au and Green. 2000, Erbe 2002b, Magalhaes et al. 2002, Williams et al. 2002a, Williams et al. 2002b, Richter et al. 2003, Scheidat et al. 2004). 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. 1995).

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. 1995).

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 (Grant and Ross 2002, Garrett 2004, 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 (Mearns 2001, Grant and Ross 2002).

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 11). 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 11: 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 (Stabeno et al. 2004, Mundy and Cooney 2005, Mundy and Olsson 2005). 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 (Shane 1994, 1995, Benson et al. 2002, Lusseau et al. 2004, Norman et al. 2004, Danil and Chivers 2005). 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 (Trites and Donnelly 2003, Baker 2008). 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 12). 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 12: 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 degredation, entrapment in fishing gear, dredging, pollutants, 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, Reyff 2003, Illingworth and Rodkin Inc. 2004), 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 2008). 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 2008).

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 (Lutcavage et al. 1997, Laist et al. 1999). 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 (O'Hara et al. 1988, NRC 1990, Lutcavage et al. 1997, Laist et al. 1999). 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 (O'Hara et al. 1988, NRC 1990, Lutcavage et al. 1997, Laist et al. 1999).

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 (Reddering 1988, Whitfield and Bruton 1989, Gilmore 1995). 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 2010e). 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 2009e). 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[6]" (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 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.

[6] *"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.*

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, 2005, 2007b).

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 13 and Table 14). 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 13. 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 14. 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 (MMS 1998, Rabalais et al. 2002, LUMCON 2005, 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 (USN 2008, BOEMRE 2010). 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 km 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 (USDOI 2012, Powers et al. 2013). 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; Marsh et al. 1992, Law and Hellou 1999), but generally do not bioaccumulate or biomagnify in finfish (Varanasi et al. 1989, Meador et al. 1995, Baussant et al. 2001, 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 (Vargo et al. 1986, NOAA 2003, 2010b). 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, 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 2016a). 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 2016a). 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 2016a).

A comprehensive biological opinion that covers all power plant cooling water intakes was issued by the USFWS 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.

Atlantic and shortnose sturgeon are susceptible to impingement on cooling water intake screens at power plants (NMFS 1998a, ASSRT 2007). Electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. A smalltooth sawfish was also impinged upon cooling water intake structures at the St. Lucie Nuclear Power Plant, but released alive and in apparently good condition (NMFS 2016a). The operation of power plants can have unforeseen and extremely detrimental impacts to water quality which can affect shortnose and Atlantic sturgeon, and has been identified as a concern to both species throughout their range (ASSRT 2007, SSSRT 2010).

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 km/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; USCG 2003, 2005, NMMA 2007). 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.

Tables 15 to 24 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 15. Green turtle takes in the Atlantic Ocean (all distinct population segments (DPSs); mostly North Atlantic DPS).

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**	**1,666**	**1,656**	**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 16. 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**	**5,260**	**1,536**	**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 17. 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**	**4,084**	**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 18. 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**	**1,485**	**1,206**	**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 19. Loggerhead sea turtle takes in the North Atlantic Ocean (all DPSs, mostly Northwest Atlantic Ocean DPS).

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**	**1,420**	**1,804**	**1,541**	**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 20. 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**	**2,120**	**2,805**	**2,805**	**790**	**800**

Permit numbers: 1475, 1538, 13330, 15802, 17316, and 17787.

Table 21. Atlantic sturgeon takes in the North Atlantic Ocean (all DPSs).

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**	**4,650**	**800**	**1,285**	**1,620**	**42,030**	**150**	**48,185**

Permit numbers: 16253, 16323, 16375, 16422, 16431, 16436, 16438, 16442, 16482, 16507, 16508, 16526, 16547, and 17095.

Table 22. 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**	**3,810**	**5,405**	**70**	**360**

Permit numbers:16253, 16323, 16375, 16422, 16431, 16436, 16438, 16442, 16482, 16507, 16508, 16526, 16547, and 17095.

Table 23. 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**	**1,791**	**3,215**	**13,042**	**45,086**	**639**	**57,409**	**4,716**

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 24. 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	**4,300**	**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 ON ESA-LISTED SPECIES

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 turtles 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 and Vessel Surveys

As described above in the *Description of the Proposed Action* (Section 2.2.3), 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 including health assessment, disentanglement, biopsy sampling, breath sampling, tagging, photo identification, and collection of sloughed skin and feces. These 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 (Harrington and Veitch 1992, Lima 1998, Gill et al. 2001, Frid and Dill 2002, Frid 2003, Beale and Monaghan 2004, 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 (Sapolsky et al. 2000, Frid and Dill 2002, Romero 2004, 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 (Feare 1976, Daan 1996, Bearzi 2000). 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 (Barton 2002, Bayunova et al. 2002, Wagner et al. 2002, Lankford et al. 2005, Busch and Hayward 2009, McConnachie et al. 2012, Atkinson et al. 2015). 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, Guyton and Hall 2000, Dierauf and Gulland 2001, Wagner et al. 2002, Romero 2004, NMFS 2006a, Busch and Hayward 2009, Omsjoe et al. 2009, Queisser and Schupp 2012), particularly over long periods of continued stress (Sapolsky et al. 2000, Desantis et al. 2013). 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, 2002, Herraez et al. 2007, Cowan and Curry 2008). 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 (Hall 1982, Baker et al. 1983, Au and Green. 2000, 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, Wursig et al. 1998b, Gauthier and Sears 1999, Hooker et al. 2001, Lusseau 2004, Koehler 2006, Richter et al. 2006, Weilgart 2007). Observations of large whales indicate that cow-calf pairs, smaller pods, and pods with calves appear to be particularly responsive to vessel approaches (Hall 1982, Bauer 1986, Bauer and Herman 1986, Clapham and Mattila 1993). 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 (Calkins and Pitcher 1982, Allen et al. 1984, Ono et al. 1987, Engelhard et al. 2002, Maniscalco et al. 2007, 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 100-200 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 195-250 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. 2010a). On-ice ringed seals have been documented exhibiting short-term escape reactions (i.e., temporarily entered the water) when a ship came within 0.25-0.5 kilometers (Brueggeman et al. 1992).

Figure 9. One type of unmanned aerial system that has been used in the field by NOAA/NMFS personnel 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 9) 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 (Wysocki et al. 2007, Popper et al. 2014).

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 (Section 2.2.3.4), 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* (Section 2.2.3.5), 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 (Harrington and Veitch 1992, Lima 1998, Gill et al. 2001, Frid and Dill 2002, Frid 2003, Beale and Monaghan 2004, 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 (Sapolsky et al. 2000, Frid and Dill 2002, Romero 2004, 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 (St Aubin and Geraci 1990, Fair and Becker 2000). 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, Hoopes et al. 1998, Gregory and Schmid 2001, Jessop et al. 2003, Jessop et al. 2004, Thomson and Heithaus 2014), sturgeon (Lankford et al. 2005, Kahn and Mohead 2010), and other fishes including smalltooth sawfish (Moberg 2000, Sapolsky et al. 2000, Korte et al. 2005). 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, Hoopes et al. 2000, Gregory and Schmid 2001, Harms et al. 2003, 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 (Hoopes et al. 2000, Gregory and Schmid 2001). 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 look out 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 (Henwood and Stuntz 1987, Epperly et al. 2002). 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 2009e), 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° C), high salinity, or low dissolved oxygen, potentially resulting in mortality or failure to breed (Hastings et al. 1987, Jenkins et al. 1993, Moser and Ross 1995, Secor and Gunderson 1998, Niklitschek 2001, Secor and Niklitschek 2001, Secor and Niklitschek 2002, Kynard et al. 2007, Niklitschek and Secor 2009). 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 2009e).

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 with 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* (Section 2.2.3.6), 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 Attachment of Tags and Scientific Instruments

As discussed in the *Description of the Proposed Action* (Section 2.2.3.7), 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, Guynn Jr et al. 1987, Hernandez-Divers et al. 2001, Lander et al. 2005, Green et al. 2009). 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 10. Crossbow deployment of a satellite tag (visible in the dorsal fin) on an adult male killer whale (M007) at Marion Island, South Africa (Reisinger et al. 2014b).

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 degrees 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 (White and Garrot 1990, Walker and Boveng 1995). 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).

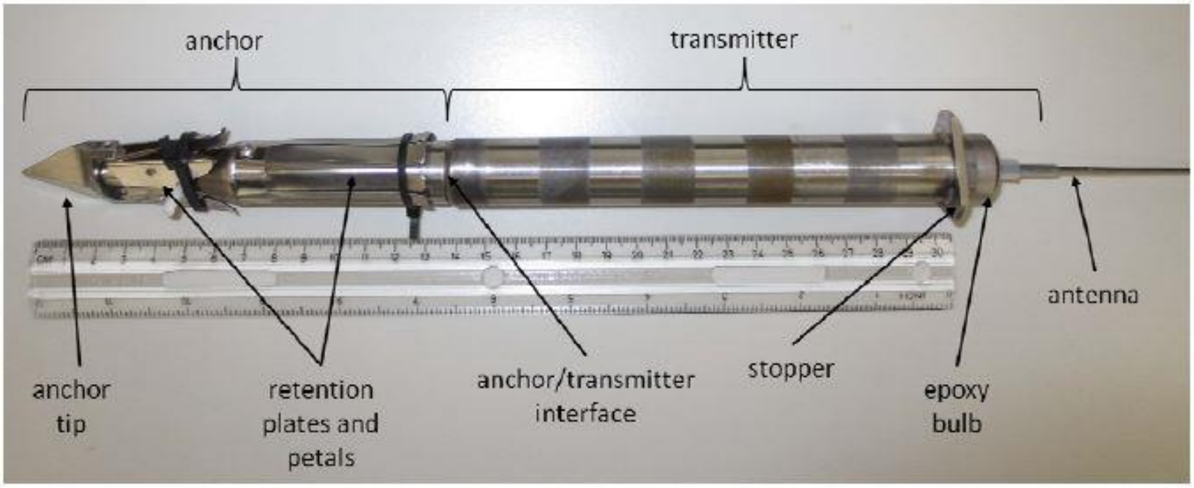

Figure 11. Example of an implantable satellite tag currently used in various large cetacean studies. Retention plates and petals are shown in pre-deployment position. Equally spaced etchings along the body of the tag are used to assess the rate at which it is ejected from the animal, using photo-identification 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, NMML, pers. comm. to J. Carduner, NMFS, March 25, 2015). 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 11), 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 (Schorr et al. 2009, Baird et al. 2012, Ford et al. 2013, Moore et al. 2013, Reisinger et al. 2014a, 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).

Figure 12. North Atlantic right whale (Eg4092) shortly after the attachment of an external tag tagging. Activities depicted authorized by NMFS permit 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).

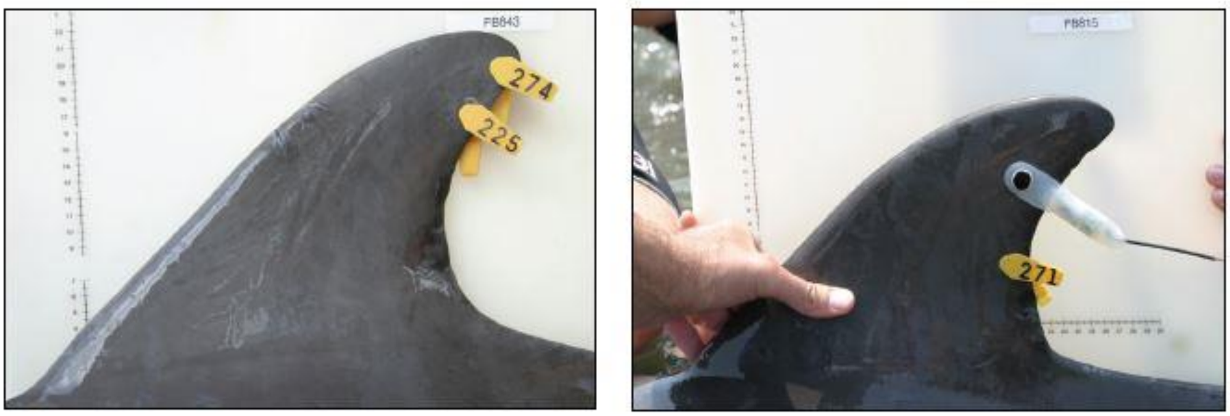

Figure 13. Roto tags (left); radio tag and roto tags (right) affixed to dorsal fins of bottlenose dolphins.

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, Guynn Jr et al. 1987, Hernandez-Divers et al. 2001, Lander et al. 2005, Green et al. 2009). 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 (Mellish et al. 2007b, Horning et al. 2008, 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, Elbin and Burger 1994, Keck 1994, Jemison et al. 1995, Clugston 1996, Skalski et al. 1998, Hockersmith et al. 2003). 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.

6.2.6 Potential Response to Marking

As described above (Section 2.2.3.8) 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 6.2.5).

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 2013b). 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 (<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 14), heated to "red-hot" (about 500° F) 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 14).

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)

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

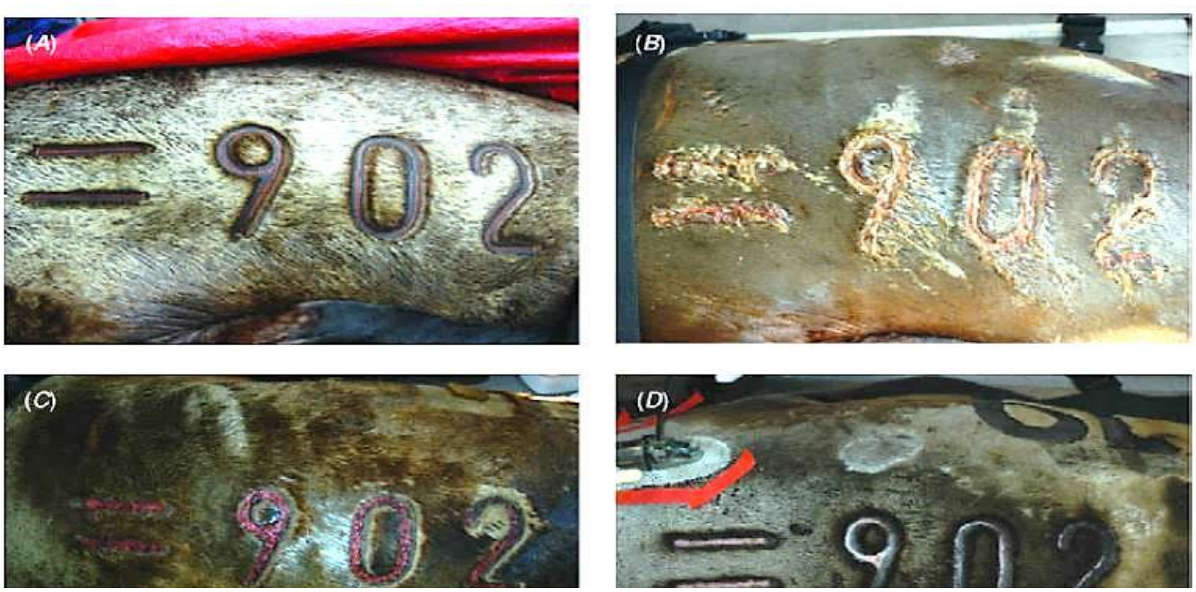

Figure 14. Stages of hot brand healing in a juvenile Steller sea lion, shown as (A) day of brand, (B) one week post-brand, (C) three weeks post-brand, and (D) eight weeks post-brand (Mellish et al. 2007a).

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.

6.2.7 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 6.2.8), 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 6.2.9.

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).

6.2.8 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 (Brown et al. 1991, Clapham and Mattila 1993, Barrett-Lennard et al. 1996, Gauthier and Sears 1999, Hooker et al. 2001, Jahoda et al. 2003, Best et al. 2005). 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 (Weller et al. 1997, Krützen et al. 2002a). 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. (2002b) 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. 2002b). 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 6.2.9) 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 in the next five years. 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.

6.2.9 Potential Response to Administration of Medications

As described above (Section 2.2.3), 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 (Gales 1989, Gage et al. 1993). 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, Lynch et al. 1999, Haulena and Heath 2001)).

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).

Administration of Vaccines

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, McInnes et al. 1992, SutherlandSmith et al. 1997, Ek-Kommonen et al. 2003, 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 2016b). 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 (12 mo) 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.

6.2.10 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 (Szymanski et al. 1998, Szymanski et al. 1999, Yuen et al. 2005, Mooney et al. 2008, Mooney et al. 2012, Castellote et al. 2014).

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.

6.2.11 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 entangeled 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 6.2.8). 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 15. 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 15). 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 centimers 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).

6.2.12 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).

6.2.13 Potential Response to Permanent Captivity

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.

6.2.14 Potential Response to Import/Export of Marine Mammal Parts and Sample Analysis

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.

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. Table 3 summarizes the proposed exposure to ESA-listed turtle and fish species. To estimate the likely exposure of ESA-listed species to the proposed activities over the next five years, 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, sample collection, acoustic playbacks, ABR/AEP testing, hazing and attractants, disentanglements, 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).

Though it is not possible to precisely predict the marine mammal health emergencies that will occur over the next five years that will warrant enhancement activities from the MMHSRP, we used data on previous exposures of ESA-listed species to MMHSRP activities to inform our estimate of likely exposures over the next five years 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 8.

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 8 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 8). 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) (see Table 25 and Figure 16). 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 next five years 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 25).

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 next five years 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 next five years, 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 to estimate the number of takes that are *likely* to occur over the next five years 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 25: Takes of ESA-listed marine mammals associated with MMHSRP 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 MMHSRP's 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.

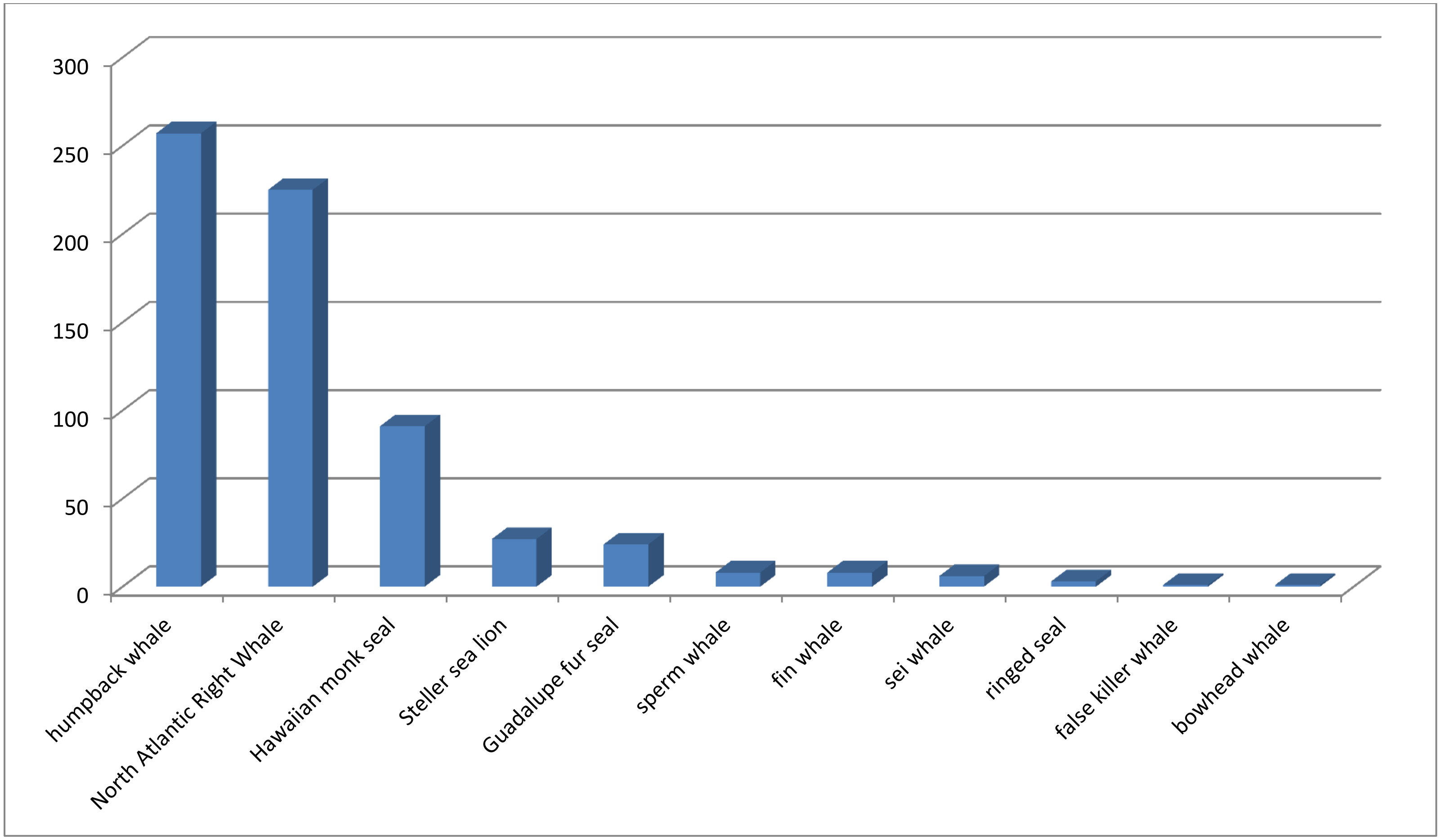

Figure 16.Takes of ESA-listed marine mammal species associated with enhancement activities of the marine mammal health and stranding response program (MMHSRP), January 2009 through June 2014.

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 next five years 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 next five years 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 next five years 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 next five years 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 next five years, 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 26. 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 26 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 MMHSPR'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 27 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 26. 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 27. Summary of data used to estimate annual incidental takes of non-target ESA-listed species.

Listed Species	Baseline Research	Emergency Response	Incidental Take Rate	Baseline Research (Predicted)	Baseline Research (Requested)	Emergency Response (Predicted)	Incidental Take Rate	Incidental Take (Predicted)	Incidental Take (Requested)[7]	Estimated take
Green sea turtle (Central South Pacific)	0	0	--	1	1000	2	1.21%	0	12	10
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	
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	3
Atlantic sturgeon (New York Bight)	0	0	0.00%	1	3000	31	1.75%	1	53	
Atlantic sturgeon (Chesapeake Bay)	0	0	--	1	3000	2	1.75%	0	53	
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

[7] *value represents a minimum since an unlimited number of net deployments for emergency response would be authorized in the permit.*

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, we would estimate the annual take of ESA-listed marine mammals over the next five years 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; and one ringed seal. 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 next five years 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, transport, hazing and attractants, capture, restraint, handling, tagging, attachment of scientific instruments, marking, diagnostic imaging, sample collections that include biopsy samples, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, and disentanglement on beaches and in waters of the U.S., its territories and possessions, and international waters. The proposed permit would also authorize the MMHSRP to euthanize an unlimited number of ESA-listed marine mammals.

The 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. 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 next five years 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 (Hall 1982, Bauer 1986, Bauer and Herman 1986, Clapham and Mattila 1993). 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 (Weinrich et al. 1991, Clapham and Mattila 1993).

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 ft 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 (Sapolsky et al. 2000, Frid and Dill 2002, Romero 2004, 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 prinicipal 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 (as described in the *Exposure Analysis* (Section 6.4.2)), we believe it is reasonably certain that the MMHSRP will conduct more baseline research in the next five years of the permit than has been conducted previously, thus more pinniped captures for baseline health research are expected to occur over the next five years than has occurred historically. As such, the Permits Division proposes to authorize up to sixteen mortalities of ESA-listed pinnipeds over the next five years, 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 1994)). The population of Guadalupe fur seals is increasing exponentially at an average annual growth rate of 13.7 percent (Gallo-Reynoso 1994); 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 2013f). 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 2013f); 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 2013e); the population trend is unknown (Allen and Angliss 2013e). 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 2013e); 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 6.2.5) 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 (Henderson and Johanos 1988, Baker and Johanos 2002, Hastings et al. 2009). 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, Elbin and Burger 1994, Keck 1994, Jemison et al. 1995, Clugston 1996, Skalski et al. 1998, Hockersmith et al. 2003). 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 (Robbins et al. 2013, Gendron et al. 2014). 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 next five years 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 next five years.

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 (Baker and Johanos 2002, Mate et al. 2007, Eskesen et al. 2009, Walker et al. 2012, Baird et al. 2013). 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 6.2.6), 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. As described in Section 6.2.6, 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 2013b). 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, Mellish et al. 2007a, Di Poi et al. 2009, Hastings et al. 2009).

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 6.2.7) 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 6.2.8), 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 (Henderson and Johanos 1988, Ponganis et al. 1993, Kanatous et al. 1999, Baker and Johanos 2002). 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 (Whitehead et al. 1990, Weinrich et al. 1991, Weinrich et al. 1992, Brown et al. 1994, Barrett-Lennard et al. 1996, Weller et al. 1997). 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 EIS (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 (Petrauskas et al. 2008, Harcourt et al. 2010, Champagne et al. 2012). However, as described above (Section 6.2.9), 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 and Mattlin 1998, Gales et al. 2005).

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 (Welter et al. 1999, Wimsatt et al. 2003, Bronson et al. 2007, Connolly et al. 2013). 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 (Quinley et al. 2013, NMFS 2016b). 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 non-intervention 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 (Harwood and Hall 1990, Osterhaus et al. 1997, Raga et al. 1997, Costas and Lopez-Rodas 1998, Miller et al. 2002, Conrad et al. 2005, Honnold et al. 2005, Stoddard et al. 2005). Moreover, infectious diseases may have important influences on genetic structure and evolution of some species, particularly those with small populations (Weber et al. 2000, Lehman et al. 2004). 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 1990's 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), 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 next five years 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 6.2.10), AEP testing has been conducted on several marine mammal species with no documented adverse effects (Szymanski et al. 1998, Szymanski et al. 1999, Yuen et al. 2005, Mooney et al. 2008, Mooney et al. 2012, Castellote et al. 2014). 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 next five years 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 next five years 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 6.2.11) 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 2000-2013, 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 next five years 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 next five years 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.

6.6 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, Hoopes et al. 1998, Gregory and Schmid 2001, Jessop et al. 2003, Jessop et al. 2004, Thomson and Heithaus 2014), sturgeon (Lankford et al. 2005, Kahn and Mohead 2010), and other fishes including smalltooth sawfish (Moberg 2000, Sapolsky et al. 2000, Korte et al. 2005).

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 (Henwood and Stuntz 1987, Epperly et al. 2002).

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 encounting 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 2009e), 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°C), high salinity, or low dissolved oxygen, potentially resulting in mortality or failure to breed (Hastings et al. 1987, Jenkins et al. 1993, Moser and Ross 1995, Secor and Gunderson 1998, Niklitschek 2001, Secor and Niklitschek 2001, Secor and Niklitschek 2002, Kynard et al. 2007, Niklitschek and Secor 2009, Niklitscheka and Secor 2009). 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 2009e).

6.7 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.

6.8 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 *NMFS and USFWS ESA Section 7 Handbook* (USFWS and NMFS 1998b), 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.

6.8.1 Enhancement Activities

As described in the *Exposure Analysis* (Section 6.4), we would estimate the annual take of ESA-listed marine mammals over the next five years during enhancement activities, based on historical takes that have occurred during enhancement 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; and one ringed seal. 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 next five years 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, transport, hazing and attractants, capture, restraint, handling, tagging, attachment of scientific instruments, marking, diagnostic imaging, sample collections that include biopsy samples, administration of medications that include vaccinations, hearing tests, active acoustic playbacks, and disentanglement on beaches and in waters of the U.S., its territories and possessions, and international waters. 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 next five years 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 ESA-listed beluga whales (Cook Inlet DPS), blue whales, bowhead whales, false killer whales (Main Hawaiian Islands insular DPS), fin whales, humpback whales, killer whales (Southern resident DPS), North Atlantic right whales, North Pacific right whales, sei whales, sperm whales, Guadalupe fur seals, Hawaiian monk seals, and Steller sea lions (Western DPS), by reducing their reproduction, numbers, or distribution.

Further, we find that enhancement activities are not likely to reduce appreciably the likelihood of both the survival and recovery of species proposed to be listed under the ESA: humpback whale Western North Pacific DPS and Central America DPS both proposed as threatened.

Lastly, for the bearded seals (Beringia DPS) and ringed seals (Arctic subspecies), which are currently not listed under the ESA because of court rulings that are under appeal, we find that if the ESA-listing status be reinstated for these species that enhancement activities are not likely to reduce appreciably the likelihood of both the survival and recovery of by reducing their reproduction, numbers, or distribution.

6.8.2 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 next five years. Instead, we believe the takes for baseline health research as described in Table 2 are reasonably certain to occur over the next five years. 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 next five years. 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 1994), 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 4.3.13), the *Environmental Baseline* (Section 5) 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 2013f)). 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 4.3.16), the *Environmental Baseline* (Section 5) 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 4.3.15), the *Environmental Baseline* (Section 5) 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 4.3.12), the *Environmental Baseline* (Section 5) 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 next five years. 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), the *Environmental Baseline* (Section 5) 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 whale (Cook Inlet DPS), blue whale, bowhead whale, false killer whale (Main Hawaiian Islands insular DPS), fin whale, humpback whale, killer whale (Southern resident DPS), North Atlantic right whale, North Pacific right whale, sei whale, sperm whale, and Hawaiian monk seal.

Further, we find that baseline health research activities not likely to reduce appreciably the likelihood of both the survival and recovery of the proposed humpback whale DPSs.

6.8.3 Sea Turtles, Sturgeon, and Sawfish

Based on the information available, endangered and threatened sea turtles, may have a brief startle response, 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 MMSHRP 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. These would not be expected to appreciably reduce the likelihood of the survival or recovery of these species in the wild by reducing their reproduction, numbers, or distribution.

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 species - beluga whale (Cook Inlet DPS), blue whale, bowhead whale, false killer whale (Main Hawaiian Islands insular DPS), fin whale, humpback whale, killer whale (Southern resident DPS), North Atlantic right whale, North

Pacific right whale, sei whale, sperm whale, bearded seal (Beringia DPS), Guadalupe fur seal, Hawaiian monk seal, ringed seal (Arctic subspecies), and Steller sea lion (western DPS).

Further the proposed action is not likely to jeopardize the continued existence of the non-targeted species that may be incidentally taken – 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; leatherback turtles; smalltooth sawfish; Atlantic sturgeon from the Gulf of Maine DPS, New York Bight DPS, Chesapeake Bay DPS, Carolina DPS or South Atlantic DPS; Gulf sturgeon; shortnose sturgeon; and green sturgeon from the Southern DPS.

It is NMFS' conference opinion that the proposed action is not likely to jeopardize the continued existence or of the proposed Central America DPS of humpback whales.

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. Harm is further defined by the USFWS to include significant habitat modification or degradation that results in death or injury to ESA-listed species by significantly impairing essential behavioral patterns, including breeding, feeding, or sheltering. Harass is defined by the USFWS as intentional or negligent actions that create the likelihood of injury to ESA-listed species to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding or sheltering. 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 permited activies, 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 mimimize 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 mamals 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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