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

**Title:** Biological and Conference Opinion on the Issuance of Permit No. 24359 to the Marine Mammal Health and Stranding Response Program and the Proposed Implementation of a Program for 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, National Oceanic and Atmospheric Administration, U.S. Department of Commerce

**Action Agency:** Marine Mammal Health and Stranding Response Program, Marine Mammal and Sea Turtle Conservation Division, National Marine Fisheries Service

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

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# 1 INTRODUCTION

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

The Federal action agency shall confer with NMFS under ESA Section 7(a)(4) for species under NMFS jurisdiction 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 C.F.R. §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, NMFS provide a biological opinion stating whether the Federal agency's action is likely to jeopardize ESA-listed species or destroy or adversely modify designated critical habitat. If NMFS determines that the action is likely to jeopardize ESA-listed species or destroy or adversely modify critical habitat, in accordance with the ESA Subsection 7(b)(3)(A), NMFS provides a reasonable and prudent alternative (RPA) that allows the action to proceed in compliance with section 7(a)(2) of the ESA. If an incidental take is expected, section 7(b)(4) requires NMFS to provide an incidental take statement that specifies the impact of such incidental taking on the species and includes reasonable and prudent measures NMFS considers necessary or appropriate to minimize such impacts and terms and conditions to implement the reasonable and prudent measures.

The Federal action agencies for this consultation are the NMFS, Office of Protected Resources, Marine Mammal and Sea Turtle Conservation Division (hereafter referred to as "the Marine Mammal Division") for the implementation of their 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 MMPA and NMFS, Office of Protected Resources, Permits and Conservation Division (hereafter referred to as "the Permits Division"). The Permits Division proposes to implement a program for the issuance of research and enhancement permits to the MMHSRP pursuant to section 10(a)(1)(A) of the ESA. The MMHSRP proposes to take all species of marine mammals (ESA-listed and non-ESA-listed) by various means in implementing its program and the Permits Division proposes to authorize this take.

*Programmatic Consultations*

NMFS and the U.S. Fish and Wildlife Service (USFWS) have developed a range of techniques to streamline the procedures and time involved in ESA section 7 consultations for broad agency programs or numerous similar activities with predictable effects on listed species and critical habitat. Programmatic ESA section 7 consultations allow the Services to consult on the effects of programmatic actions such as: (1) multiple similar, frequently occurring or routine actions expected to be implemented in particular geographic areas; and (2) a proposed program, plan, policy, or regulation providing a framework for future proposed actions (50 C.F.R. §402.02). For the purposes of an ITS, the Services specifically identified two types of programmatic actions for the purposes of section 7(a)(2) consultation (50 C.F.R. §402.02). The most basic type of programmatic action is a framework programmatic action, which approves a framework for the development of future action(s) that are authorized, funded, or carried out at a later time, and any take of a listed species would not occur unless and until those future action(s) are authorized, funded, or carried out and subject to further section 7 consultation. For framework programmatic actions, an ITS is issued, but no take is exempted. The other type is a mixed programmatic action, which also establishes a framework for the development of future actions that are authorized, funded, or carried out at a later time but also includes the direct approval of actions that will not be subject to further ESA section 7(a)(2) consultation. For mixed programmatic actions, such as this consultation, NMFS issues an incidental take statement which exempts take for the actions taken within the programmatic framework not subject to a future section 7 consultation. Any future actions within the established programmatic framework that will be subject to future, tiered consultations when those actions are authorized, funded, or carried out, will require an ITS.

A programmatic ESA section 7 consultation should identify project design criteria (PDCs) or standards that will be applicable to all future projects implemented under the program. PDCs[1] are conservation measures that serve to prevent adverse effects to listed species, or to limit adverse effects to predictable levels that are not likely to jeopardize the continued existence of listed species or destroy or adversely modify their critical habitat. Avoidance and minimization of adverse effects to listed species and their critical habitat is accomplished by implementing PDCs at the individual project level or taken together from all projects under the programmatic consultation. For those activities that meet the PDCs, there is no need for project-specific consultation. For actions that do not meet the PDCs but are within the scope of the proposed action, or for which specifics of individual activities are not yet known, project-specific review is required and tiered consultations may be needed.

This biological and conference opinion (opinion) and ITS were prepared by the NMFS Office of Protected Resources (OPR) Endangered Species Act Interagency Cooperation Division (hereafter referred to as “we” or “us”). This opinion reflects the best available scientific information on the stressors resulting from the proposed action, the status and life history of ESA-listed species targeted by this action, the baseline conditions in the action area, the likely effects of those stressors on ESA-listed species and their habitats in the action area, the

[1] *For this consultation, the PDCs correspond to the best management practices (BMPs) required by the MMHSRP.*

cumulative effects in the action area, the consequences of the sum of those effects to the fitness and survival of individuals, and the risk that those consequences pose to the survival and recovery of the threatened or endangered populations they represent.

On July 5, 2022, the U.S. District Court for the Northern District of California issued an order vacating the 2019 regulations that were revised or added to 50 CFR part 402 in 2019 ("2019 Regulations," see 84 FR 44976, August 27, 2019) without making a finding on the merits. On September 21, 2022, the U.S. Court of Appeals for the Ninth Circuit granted a temporary stay of the district court's July 5 order. On November 14, 2022, the Northern District of California issued an order granting the government's request for voluntary remand without vacating the 2019 regulations. The District Court issued a slightly amended order two days later on November 16, 2022. As a result, the 2019 regulations remain in effect, and we are applying the 2019 regulations here. For purposes of this consultation, we considered whether the substantive analysis and conclusions articulated in the biological opinion and incidental take statement would be any different under the pre-2019 regulations. We have determined that our analysis and conclusions would not be any different. This document represents NMFS' opinion on the effects of the implementation of the MMHSRP and the issuance of MMHSRP research and enhancement permits on endangered and threatened species and designated critical habitat for those species (see Section 5). A complete digital record of this consultation is electronically filed at NMFS OPR in Silver Spring, Maryland.

## 1.1 Background

The NMFS has the statutory authority, delegated from the Secretary of Commerce, to take stranded marine mammals under section 109(h) of the MMPA (16 USC 1379) and to establish and manage the MMHSRP (established in 1992) under Title IV of the MMPA (16 USC 1421 et seq.). Title IV charged the Secretary of Commerce to develop a marine mammal health and stranding response program with three goals: (1) facilitate the collection and dissemination of reference data on the health of marine mammals and health trends of marine mammal populations in the wild, (2) correlate the health of marine mammals and marine mammal populations, in the wild, with available data on physical, chemical, and biological environmental parameters, and (3) coordinate effective responses to marine mammal unusual mortality events. In addition, pursuant to Section 408 of the MMPA, the MMHSRP administers the John H. Prescott Marine Mammal Rescue Assistance Grant Program. This includes providing grants to eligible stranding network participants for the recovery or treatment of threatened or endangered marine mammals, the collection of data from living or dead stranded threatened or endangered marine mammals for scientific research on marine mammal health, and facility operation costs directly related to those purposes. 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 been analyzed on several occasions. On March 25, 1999, the Permits Division 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 species that were ESA-listed at the time of consultation, 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 species that were ESA-listed at the time of consultation, nor adversely modify designated critical habitat (NMFS 2009b). Subsequently, the NMFS published a Notice of Availability (74 FR 9817) of the final PEIS (FPEIS) on March 6, 2009, which included our biological opinion, as well as mitigation measures to avoid or minimize the potential adverse effects on marine mammals and other environmental resources (NMFS 2009c). 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 2009g).

On January 9, 2013, the Permits Division requested reinitiation 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 the consultation. On February 5, 2014, we issued our biological opinion (Public Consultation Tracking System (PCTS) Number 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 species that were ESA-listed at the time of consultation, nor adversely modify designated critical habitat (NMFS 2014d). Following this, on June 30, 2014, the Permits Division issued a one-year extension to permit No. 932-1905-01/MA-009526.

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

In September of 2015, the MMHSRP incidentally captured two ESA-listed turtles during a baseline bottlenose dolphin (*Tursiops truncatus*) health assessment study in Brunswick, Georgia. These incidental captures were unexpected, and not authorized under either an ESA permit or our previous biological opinion (NMFS 2015a). As a result of these events, we reinitiated formal consultation with the MMHSRP and Permits Division on June 21, 2016, in order to reevaluate effects to the non-marine mammal listed species. On July 13, 2016, we completed our biological opinion on the implementation of the MMHSRP and the modified permit (No. 18786-01) in which we authorized take of several ESA-listed turtle and fish species in an ITS, 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. We subsequently identified several typographical errors in this opinion, which were corrected in an updated opinion on July 28, 2016 (NMFS 2016a).

On January 30, 2017, we met with the Permits Division and the MMHSRP to discuss a possible permit amendment in order to separate humpback whale takes by Distinct Population Segments (DPSs), given NMFS designation of 14 DPSs of humpback whales (September 8, 2016, 81 FR 62259) and to authorize the possible import of vaquita (*Phocoena sinus*). Given that import of all marine mammals world-wide was previously authorized under Permit No. 18786-01, it was decided that the only action likely required was to confirm our previous conference opinion on humpback whales as a biological opinion. However, after this meeting it came to our attention that the effects analysis in our previous biological opinion on Permit No. 18786-01 did not include the import of live, foreign ESA-listed marine mammals because, at the time of that consultation, such import was not reasonably certain to occur (NMFS 2016a). In a meeting on February 17, 2017, we discussed this issue with the Permits Division and the MMHSRP and decided to convene a larger meeting with NOAA's Offices of General Counsel and International Affairs, as well as staff from NMFS Southwest Fisheries Science Center who were involved in the import of vaquita. Prior to this larger meeting, we again met with the Permits Division and the MMHSRP to discuss if any additional activities required reinitiation. On April 7, 2017, we met with the Permits Division, the MMHSRP, NOAA's Offices of General Counsel and International Affairs, and the Southwest Fisheries Science Center, and it was decided that reinitiation was required in order to evaluate effects to foreign species from live import. On the same day, the MMHSRP requested reinitiation of formal consultation on the issuance of Permit No. 18786-01 and the implementation of the MMHSRP. The initiation package was sufficient and we reinitiated formal consultation on April 7, 2017. The biological opinion was issued on July 3, 2017.

## 1.2 Consultation History

This opinion is based on information in the MMHSRP's draft Environmental Impact Statement (EIS) and supplemental information provided throughout the consultation process. This opinion also considers information provided by the Permits Division, including its Biological Assessment (BA) and request for ESA section 7 consultation, which included the proposed Federal regulations under the MMPA proposing to authorize the incidental take of ESA-listed fish and sea turtles specific to the proposed MMHSRP activities (87 FR 48159).

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

- On October 5, 2020, the Marine Mammal Division requested early technical guidance from us on their draft EIS. We provided comments on October 13, 2020.
- On January 22, 2021, the Marine Mammal Division and the Permits Division agreed to conduct a programmatic consultation with us, in lieu of future issuances of five-year permits to the MMHSRP.
- On March 8, 2021, the Marine Mammal Division and Permits Division agreed to hold off on a 12-month extension to the MMHSRP's current permit (18786-05), as we anticipated completing the programmatic biological opinion prior to the expiration of the current permit on December 31, 2021.
- On May 25, 2021, the Marine Mammal Division and the Permits Division sent us their BA and request for formal consultation. We considered their initiation package to be complete and initiated consultation on June 17, 2021.
- On August 9, 2021, the Permits Division informed us of a report from the Center for Coastal Studies of a non-lethal vessel strike to a fin whale during an emergency MMHSRP response to an entangled humpback whale. We met with the Marine Mammal Division and the Permits Division on August 13, 2021 and the Marine Mammal Division agreed to re-visit their permit application to determine if their current permit covered vessel strikes. The MMHSRP sent a memo to us and the Permits Division on September 10, 2021, saying that they believed they current permit included coverage from vessel strikes.
- On September 20, 2021, we informed the Permits Division and MMHSRP that completion of the programmatic consultation would be delayed due to staff commitments until likely 2022.
- On December 7, 2021, we met with the Permits Division and Marine Mammal Division regarding the rationale for accidental vessel strike coverage to ESA-listed species.

- On December 15, 2021, the Permits Division sent us an ESA Section 7(a)(1)7(d) memo requesting coverage for MMHSRP activities conducted under an extension of the current permit while we complete the programmatic consultation.
- On December 21, 2021, the Permits Division issued the MMHSRP a 12-month permit extension, Permit No. 18786-06.
- On April 12, 2022, we sent a memo to the Marine Mammal Division and Permits Division, explaining that we would aim to complete the programmatic consultation by June 15, 2022.
- On May 10, 2022, we sent a 60-day consultation extension memo to the Marine Mammal Division and Permits Division, explaining that we would aim to complete the programmatic consultation by August 14, 2022.
- On April 14, 2022, we shared a draft of the proposed action and action area sections of our biological opinion with the Permits Division and the Marine Mammal Division for their review and comment.
- On May 19, 2022, the Permits Division sent us comments on the proposed action and action area sections.
- On July 8, 2022, we sent the revised proposed action and action area sections to the Permits Division and Marine Mammal Division for their review and comment.
- On July 27, 2022, the Permits Division and Marine Mammal Division agreed to extend the programmatic consultation conclusion date to October 15, 2022 to allow more time for proposed action review and incorporation of the revised permit into our consultation.
- On August 26, 2022, we received comments on the proposed action and action area sections from the Permits Division.
- On September 20, 2022, we received comments on the proposed action and action area sections from the Marine Mammal Division.
- On October 3, 2022, the Permits Division and Marine Mammal Division agreed to extend the programmatic consultation conclusion date until November 15, 2022.
- On November 1, 2022, the Permits Division and Marine Mammal Division agreed to extend the programmatic consultation conclusion date until December 18, 2022. This date was revised to December 20, 2022 to coincide with the issuance of the Marine Mammal Division's Record of Decision.
- On November 3, 2022, we asked the Permits Division whether they wanted to conference on the recently proposed for ESA-listing queen conch and proposed designated critical habitat for Nassau grouper and asked for their effects determinations when they responded affirmatively. We received their determinations on November 4, 2022.

# 2 THE ASSESSMENT FRAMEWORK

Section 7(a)(2) of the ESA requires Federal agencies, in consultation with 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.

*"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 recovery of an ESA-listed species in the wild by reducing the reproduction, numbers, or distribution of that species" (50 C.F.R. §402.02).

*"Destruction or adverse modification"* means a direct or indirect alteration that appreciably diminishes the value of critical habitat as a whole for the conservation of an ESA-listed species as a whole (50 C.F.R. §402.02).

This ESA section 7 consultation involves the following steps:

Description of the Proposed Action (Section 3): We describe the programmatic framework as well as all actions (all activities or programs of any kind authorized, funded, or carried out, in whole or in part, by Federal agencies in the United States or upon the high seas (50 C.F.R. §402.02)) that will be assessed in this opinion and those components of the proposed action (or modifications to land, water, or air (50 C.F.R. §402.02)) that may have effects on the physical, chemical, and biotic environment for listed species and their critical habitat (stressors). This section also includes the PDCs that have been incorporated into the project to reduce the effects to ESA-listed species. We also deconstruct the action into the component elements such that we can identify those aspects of the proposed action that are likely to result in stressors from the action that may result in effects on the physical, chemical, and biotic environment within the action area.

*Action Area* (Section 4): We describe the action area with the spatial extent of the stressors from the action. Action area is defined as all areas that are affected directly, or indirectly, by the Federal action, and not just the immediate area involved in the action (50 CFR §402.02).

Species and Designated Critical Habitat that May be Affected (Section 5): We identify the ESA-listed species and designated critical habitat that are likely to co-occur with those stressors in space and time and evaluate the status of those species and critical habitats. During consultation, we determined that some ESA-listed species and critical habitat that occur in the action area were not likely to be adversely affected by the proposed action and detail our effects analysis for these species (Section 5.1). We then describe the status of those species that are likely to be adversely affected by the proposed action (Section 5.2).

Environmental Baseline (Section 6): We describe the environmental baseline in the action area and the condition of the listed species or critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency's discretion to modify are part of the environmental baseline (50 C.F.R. §402.02).

Effects of the Action (Section 7): We evaluate the effects of the action on ESA-listed species. Effects of the action are all consequences to listed species that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 C.F.R. 402.02). We evaluate the available evidence to determine how individuals of ESA-listed species are likely to respond to each stressor given their probable exposure. This is our response analysis. During our evaluation, we determined that some stressors were not likely to adversely affect ESA-listed species (or categories of ESA-listed species; e.g., marine mammals; Section 7.1). For those stressors likely to adversely affect ESA-listed species, we identify the number, age (or life stage), and gender if possible, of ESA-listed individuals that are likely to be exposed to the stressors and the populations or subpopulations to which those individuals belong to the extent possible based on available data (Section 7.3). This is our effects analysis.

Cumulative Effects (Section 8): We describe the cumulative effects in the action area. Cumulative effects are the effects to ESA-listed species and designated critical habitat 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 C.F.R. §402.02).

Integration and Synthesis (Section 9): We integrate and synthesize by adding the effects of the action and cumulative effects to the environmental baseline in full consideration of the status of the species and critical habitat likely to be adversely affected, to formulate our opinion as to whether the action would reasonably be expected to: 1) Reduce appreciably the likelihood of both the survival and recovery of the ESA-listed species in the wild by reducing its reproduction, numbers, or distribution; or 2) Appreciably diminish the value of designated critical habitat as a whole for the conservation of an ESA-listed species.

Conclusion (Section 10): We state our conclusions regarding whether the action is likely to jeopardize the continued existence of ESA-listed species or result in the destruction or adverse modification of designated 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 of ESA-listed species or destroy or adversely modify designated critical habitat, we must identify a reasonable and prudent alternative(s) to the action, if any, or indicate that to the best of our knowledge there are no reasonable and prudent alternatives (see 50 C.F.R. §402.14(h)(2)).

Incidental Take Statement (Section 11): An Incidental Take Statement (ITS) is included for those actions for which take of ESA-listed species is reasonably certain to occur (50 C.F.R. 402.14(g)(7). The ITS specifies the impact of the take, reasonable and prudent measures considered necessary or appropriate to minimize the impact of the take, and terms and conditions to implement the reasonable and prudent measures (ESA section 7 (b)(4); 50 C.F.R. §402.14(i)). The ITS must also include reasonable and prudent measures with implementing terms and conditions. Section 3 of the ESA defines take 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 regulation (50 C.F.R. §222.102) to include acts that actually kill or injure wildlife and acts that may cause significant habitat modification or degradation that actually kill or injure fish or wildlife by significantly impairing essential behavioral patterns, including breeding, spawning, rearing, migrating, feeding, or sheltering. Under the ESA take is defined as "to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture or collect, or to attempt to engage in any such conduct." Harm is defined by regulation (50 C.F.R. §222.102) as "an act which actually kills or injures fish or wildlife. Such an act may include significant habitat modification or degradation which actually kills or injures fish or wildlife by significantly impairing essential behavioral patterns, including, breeding, spawning, rearing, migrating, feeding or sheltering." NMFS does not have a regulatory definition of "harass." We rely on our interim guidance, which interprets harass as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavioral patterns which include, but are not limited to, breeding, feeding, or sheltering" (NMFSPD 02-110-19).

Conservation Recommendations (Section 12): Consistent with the ESA section 7(a)(1), we also provide discretionary conservation recommendations that may be implemented by the action agency (50 C.F.R. §402.14(j)).

Reinitiation Notice (Section 13): Finally, we identify the circumstances in which reinitiation of consultation is required (50 C.F.R. §402.16).

## 2.1 Evidence Available for the Consultation

To conduct the analyses necessary for this opinion and to comply with our obligation to use the best scientific and commercial data available, we considered all lines of evidence available through published and unpublished sources. We conducted electronic literature searches throughout this consultation, including within the NMFS Office of Protected Resources' electronic library. These searches were used to identify information relevant to the potential stressors and responses of ESA-listed species and designated critical habitat under NMFS' jurisdiction that may be affected by the proposed action to draw conclusions on risks the action may pose to the continued existence of these species and the value of designated (or proposed) critical habitat for the conservation of ESA-listed species. We relied on information submitted by the Permits Division (including the MMHSRP's BA(NMFS 2021c)) and the Marine Mammal Division (including the FPEIS) (NMFS 2022h) and 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.

# 3 Description of the Proposed Action

The proposed actions for this consultation are the continued issuance of scientific and enhancement permits (currently Permit No. 24359) to the MMHSRP by the Permits Division and the continued implementation of the MMHSRP by the Marine Mammal Division for take, import, and export activities for all species of cetaceans and pinnipeds under NMFS jurisdiction during emergency response (enhancement), biomonitoring (research and/or enhancement), and health-related research studies (research and/or enhancement). The proposed implementation of a program for the issuance of permits for the MMHSRP by the Permits Division and the ongoing implementation of the MMMHSRP by the Marine Mammal Division are considered programmatically in this consultation.

## 3.1 Issuance of Permit No. 24359 and the Implementation of Future Scientific and Enhancement Permits

Under the proposed action, the Permits Division would authorize the MMHSRP to:

1. Carry out:
    a. Emergency response-related and other enhancement and research activities involving but not limited to response, rescue, translocation, rehabilitation, and release of threatened and endangered marine mammals under NMFS' jurisdiction;
    b. Entanglement response of all ESA-listed and non ESA-listed marine mammals under NMFS' jurisdiction;
    c. Biomonitoring and research (e.g. activities such as diagnostic sampling of ESA-listed species undergoing rehabilitation or biological sampling during and after Unusual Mortality Events (UMEs)) of all ESA-listed and non-ESA-listed marine mammals under NMFS' jurisdiction; and
    d. Emergency-related research and method/tool development and testing on all ESA-listed and non-ESA-listed marine mammals under NMFS' jurisdiction.

These activities would be authorized pursuant to Sections 104(c), 109(h), 112(c), and Title IV of the MMPA; and 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 NMFS' jurisdiction, including but not limited to research that may involve compromised animals, research on healthy animals that have not been subject to emergency response (e.g., biomonitoring and research for baseline health studies), and development of new tools used during research. These activities would be authorized pursuant to Sections 104(c) and Title IV of the MMPA and Section 10(a)(1)(A) of the ESA.

3. Unintentionally (incidentally) harass non-target ESA-listed marine mammal species under NMFS jurisdiction during MMHSRP activities.

4. Collect, salvage, receive, possess, transfer, import, export, analyze, and curate marine mammal parts under NMFS jurisdiction for purposes delineated in numbers (1) and (2).

The purpose of the permit program is to allow an exemption to the moratoria on takes established under the MMPA and to the prohibition of take established under the ESA. The permit authorizes take of all marine mammal species under NMFS's jurisdiction (including the import of foreign live ESA-listed marine mammals and their parts), and provides measures to minimize the impact of take of several non-mammalian ESA-listed marine species (green turtles, *Chelonia mydas*; hawksbill turtles, *Eretmochelys imbricata*; 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*; and green sturgeon, *Acipenser medirostris*). Previous assessments have determined incidental take of these species is reasonably certain to occur (NMFS 2016a). Takes that are authorized under Permit No. 24359, which would be in effect from January 1, 2023 to December 31, 2027, are shown in Section 15.1. Import of live ESA-listed marine mammals would only occur as part of enhancement activities (personal communication with Stephen Manley, MMHSRP, June 7, 2017).

The Permits Division's proposed action is issuance of consecutive permits to the MMHSRP over the duration of their program, pursuant to Sections 104(c), 112(c), and 109(h) of the MMPA, and Section 10(a)(1)(A) of the ESA of 1973, as amended (16 U.S.C. 1531 *et seq.*), to conduct scientific research and enhancement on marine mammals. The BA for the Programmatic Consultation under Section 7 of the ESA on the Permits Division's Cetacean Permitting Program

[2] Under the MMPA, ***bona fide*** research means 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.

((NMFS 2019c); hereafter cetacean programmatic BA) and the Biological and Conference Opinion on the aforementioned program ((NMFS 2019b); hereafter cetacean programmatic), describes the Permits Division's permit program and process for reviewing and processing cetacean scientific research and enhancement permits, which serves as a model for this consultation with the MMHSRP. The MMHSRP's permit will be processed independently from the cetacean programmatic application cycles described in the cetacean programmatic BA.

The MMHSRP's activities are mandated by the MMPA. This programmatic consultation covers issuance of permits pursuant to Sections 104(c), 112(c), and 109(h) of the MMPA, and Section 10(a)(1)(A) of the ESA. The effects of this program are not expected to change and have no end date. As such, this programmatic opinion will remain valid until there is a need to reinitiate consultation. The incidental take statement of this opinion provides the anticipated amount and extent of incidental take of ESA-listed marine mammals and non-mammalian ESA-listed species for the permit program and provides an exemption to the prohibition of take for those species pursuant to section 7(o)(2) of the ESA.

## 3.2 Implementation of the MMHSRP 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." Descriptions of both enhancement activities and baseline health research are discussed below.

### 3.2.1 Enhancement Activities

Enhancement activities conducted by the MMHSRP include:

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

- Other activities that enhance the survival of the species.

Enhancement activities are described in further detail below.

#### 3.2.1.1 *Stranding Response*

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

NMFS authorizes the National Marine Mammal Stranding Network, a group of approximately 122 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 (83 of 122 at the time of the opinion) are pre-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 or working under the direction of a Co-Investigator that is authorized to oversee others conducting ESA-listed species emergency response (*e.g.,* the NMFS Regional Stranding Coordinator).

Since 2009, the format of the Stranding Agreement has been standardized across all the NMFS regions with the creation of a Stranding Agreement template (Appendices VIII and IX of the MMHSRP FPEIS (NMFS 2022h)). 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 IV 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 Articles III through V, or any combination of Articles.

Any activities performed on ESA-listed species under these Stranding Agreement Articles would be considered "emergency response" under the permit (i.e., not considered baseline health research); responders conducting emergency response may be authorized as a Co-Investigator under the permit, or may be working under the direction of a Co-Investigator that is authorized to oversee others conducting ESA-listed species emergency response (*e.g.,* the NMFS Regional Stranding Coordinator). In order to conduct research on animals that they respond to, or hold in rehabilitation, a Stranding Agreement holder would need to be a Co-Investigator under the permit with the explicit authorization from the Principal Investigator to conduct the specified activity. More information on the baseline health research component of the Program is described in Section 3.2.2.

**Table 1.** Stranded ESA-listed marine mammals that were responded to by the national marine mammal stranding network and received a Level A form, 2011-2020, by species (NMFS 2022f). *The number of Cook Inlet beluga whales is significantly underestimated, as this species mass strands and Level A forms may not be filled out for all individuals that stranded, but only those animals that are recovered or handled. ** Humpback whale strandings in the WCR and AKR were prorated per (Wade 2017a). † The Western DPS of Steller sea lion was defined as strandings that were initially observed west of 144 degrees (although we recognize there is some mixing between DPSs across this line).

| Species | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 | 2020 | Total | Annual Avg |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Beluga whale (Cook Inlet)* | 5 | 41 | 5 | 87 | 5 | 8 | 13 | 7 | 19 | 30 | 220 | 22 |
| Blue whale | 1 | 0 | 1 | 0 | 1 | 2 | 1 | 2 | 2 | 2 | 12 | 1.2 |
| Bowhead whale | 0 | 1 | 6 | 1 | 15 | 6 | 1 | 6 | 11 | 0 | 47 | 4.7 |
| False killer whale (HI insular) | 0 | 0 | 1 | 0 | 1 | 2 | 0 | 0 | 1 | 0 | 5 | 0.5 |
| Fin whale | 4 | 11 | 8 | 11 | 15 | 5 | 7 | 9 | 5 | 8 | 83 | 8.3 |
| Humpback Whale (pre-division into DPSs) | 34 | 25 | 47 | 29 | 60 | 0 | 0 | 0 | 0 | 0 | 195 | 19.5 |
| Humpback whale (Mexico/Central America DPSs)** | 0 | 0 | 0 | 0 | 0 | 28 | 9 | 11 | 14 | 10 | 72 | 7.2 |
| Killer whale (Southern resident) | 0 | 1 | 1 | 1 | 1 | 5 | 0 | 2 | 0 | 0 | 11 | 1.1 |
| Rice's Whale | 0 | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 3 | 0.3 |
| Right whale (North Atlantic) | 5 | 2 | 1 | 6 | 0 | 3 | 7 | 5 | 2 | 4 | 35 | 3.5 |
| Sei whale | 2 | 0 | 0 | 4 | 3 | 0 | 1 | 1 | 3 | 1 | 15 | 1.5 |
| Sperm whale | 14 | 14 | 11 | 8 | 2 | 11 | 11 | 11 | 4 | 7 | 93 | 9.3 |
| **ESA-listed Cetacean total** | **65** | **97** | **81** | **147** | **103** | **70** | **50** | **54** | **62** | **62** | **791** | **79.1** |
| Bearded seal (presumed Beringia DPS) | 5 | 9 | 7 | 14 | 4 | 1 | 7 | 38 | 53 | 10 | 148 | 14.8 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Guadalupe fur seal | 31 | 65 | 10 | 14 | 117 | 106 | 78 | 62 | 208 | 141 | 832 | 83.2† |
| Hawaiian monk seal | 28 | 25 | 21 | 33 | 29 | 26 | 34 | 28 | 32 | 28 | 284 | 28.4 |
| Ringed seal (presumed Arctic subspecies) | 32 | 11 | 6 | 12 | 19 | 19 | 17 | 44 | 37 | 9 | 206 | 20.6 |
| Spotted seal (Southern DPS) | 1 | 4 | 0 | 8 | 5 | 3 | 9 | 22 | 25 | 8 | 85 | 8.5 |
| Steller sea lion (Western DPS)[†] | 10 | 12 | 15 | 23 | 34 | 14 | 16 | 8 | 25 | 24 | 181 | 18.1 |
| **ESA-listed Pinniped total** | **107** | **126** | **59** | **104** | **208** | **169** | **161** | **202** | **380** | **220** | **1736** | **173.6** |
| **ESA-listed Marine Mammal Total** | **172** | **223** | **140** | **251** | **311** | **239** | **211** | **256** | **442** | **282** | **2527** | **252.7** |

From 2011 to 2020, a total of 2,527 ESA-listed cetaceans and pinnipeds (excluding walrus) stranded in the United States and were responded to by the National Stranding Network (Table 1). This represents an average of 252 animals per year. These strandings are spread throughout the five NMFS Regions in the United States. 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.

#### 3.2.1.2 *Entanglement Response*

The MMHSRP defines entanglements as both external processes where foreign materials (gear, line, debris, etc.) have become wrapped around, hooked into, or otherwise associated with the outside of an animal's body, as well as internal processes whereby animals have ingested gear including hooks, line, or other marine debris. Marine mammals become entangled in, or ingest, many different types of lines, gear and debris; depending upon the configuration of the entanglement or ingestion, it may cause serious injuries and can restrict the ability to move, dive, feed, reproduce, or nurse young. Responses to entanglements are targeted to assess the entanglement and identify the most appropriate action to remove the gear (if warranted), increasing the chance of survival for the individual animal. In some cases of ingested gear or marine debris, the response may entail capture and surgical or non-surgical removal of the gear or debris (specifically for pinnipeds and small cetaceans). NMFS authorizes and oversees numerous external partners to conduct the activities of the MMHSRP, including large whale entanglement response (collectively known as the National Large Whale Entanglement Response Network). Over the period January 2017 through December 2020, most (71 percent) of entangled ESA-listed species that the MMHSRP responded to were Western DPS Steller sea lions (Table 2).

**Table 2.** Entanglement responses by Marine Mammal Health and Stranding Response Program of Endangered Species Act-listed species, and takes that occurred during those responses, during the period January 2017 through December 2020.

| Species | Number of takes | Number of individual animals | Percentage of ESA-listed species involved in entanglement responses |
|---|---|---|---|
| Fin whale | 2 | 2 | 0.7 |
| Humpback whale (multiple DPSs) | 54 | 46 | 16.9 |
| North Atlantic right whale | 10 | 7 | 2.6 |
| Steller sea lion | 193 | 193 | 71.0 |
| Sei whale* | 6 | 6 | 2.2 |
| Sperm whale | 1 | 1 | 0.4 |
| Hawaiian monk seal | 17 | 17 | 6.3 |

* Takes were from incidental harassment during an entanglement response to a North Atlantic right whale.

### 3.2.1.3 *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. Since then, there have been 71 formally recognized UMEs in the U.S. involving a variety of marine mammal species and dozens to hundreds of individual marine mammals per event. UMEs have occurred along the U.S. coasts of the Atlantic, Gulf of Mexico, and Pacific, including Alaska and Hawaii. Causes have been determined for 40 of the 71 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 have not involved ESA-listed species. Marine mammal UME investigations are coordinated by the MMHSRP in collaboration with the Regional Stranding Coordinators and the National Stranding Network. UME investigations are conducted in accordance with the National Contingency Plan for Response to Unusual Marine Mammal Mortality Events (Wilkinson 1996).

At the time of this opinion, there are two ongoing UMEs that involve ESA-listed species: North Atlantic right whale UME and Alaska ice seal UME.

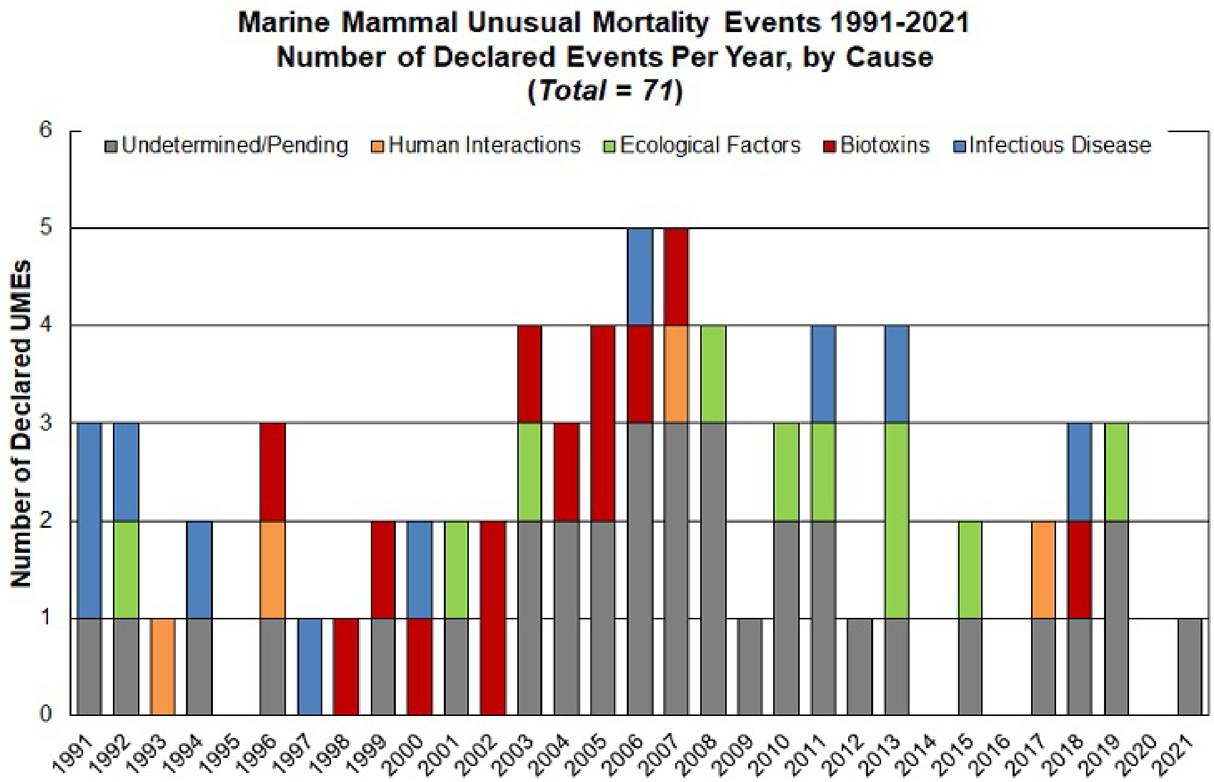


**Figure 1. Numbers, and causes, of marine mammal unusual mortality events, from 1991 through 2021. Note that this figure includes both Endangered Species Act-listed and non-listed species.**

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

- A marked increase in the magnitude or a marked change in the nature of morbidity, mortality or strandings when compared with prior records.
- A temporal change in morbidity, mortality or strandings is occurring.
- A spatial change in morbidity, mortality or strandings is occurring.
- The species, age, or sex composition of the affected animals is different than that of animals that are normally affected.
- Affected animals exhibit similar or unusual pathologic findings, behavior patterns, clinical signs, or general physical condition (e.g., blubber thickness).

- Potentially significant morbidity, mortality or stranding is observed in species, stocks or populations that are particularly vulnerable (e.g., listed as depleted, threatened or endangered or declining). For example, stranding of three or four right whales may be cause for great concern whereas stranding of a similar number of fin whales may not.
- Morbidity is observed concurrent with or as part of an unexplained continual decline of a marine mammal population, stock, or species.

#### 3.2.1.4 *Research Activities*

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.
2. Research during temporary holding of ESA-listed marine mammals undergoing rehabilitation and on non-releasable marine mammals (ESA-listed and non-ESA-listed) until permanent placement is permitted.

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

#### 3.2.1.5 *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* (Appendix XVII of NMFS 2021a). These standards identify minimum requirements for rehabilitation facilities based upon taxa (cetaceans or pinnipeds) in several sections including: facilities, housing and space; water quality; quarantine; sanitation; food, handling and preparation; veterinary medical care; and record keeping and data collection. Some of these minimum requirements relate to the physical facility (e.g., adequacy of perimeter fencing), while others address actions on the part of the stranding agreement holder (e.g., how data is reported, or how records are maintained).

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

#### 3.2.1.6 *Release of Animals from Rehabilitation Facilities*

NMFS marine mammal veterinarians developed best practices for the release of stranded marine mammals in 2009, called the *Standards for Release* (Appendix V of NMFS 2021a). 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, under the jurisdiction of the U.S. Fish and Wildlife Service and not considered in this opinion), 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 are judged likely to be able to be successful in the wild 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. For ESA-listed species, release determination of rehabilitated threatened and endangered marine mammals must be approved by the permit Principal Investigator or designee.

### 3.2.2 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 3.2.1) 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"). No baseline research activities would be conducted on ESA-listed species in foreign territorial waters under NMFS' permits but may occur on such species on the high seas.

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 if ESA-listed species were included.

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*, authorized, scientific research takes of ESA-listed species must be submitted to the Permits Division in advance of the proposed activities as required by the Permits Division (e.g., for new activities such as tool development or research not fully described in the permit application). As necessary, the protocols will be reviewed in consultation with the Marine Mammal Commission, the U.S. Department of Agriculture Animal and Plant Health Inspection Service, and the NMFS OPR Interagency Cooperation Division. Approvals for specific research projects will be granted at the discretion of the Permits Division. These research projects will only be conducted by Co-Investigators listed on the permit and must receive prior approval by the Principal Investigator and the Permits Division following a review by the MMHSRP of a detailed research proposal and qualifications of the personnel. This requirement does not apply in cases in which baseline health research is "piggy-backed" on other, external research permitted by the NMFS.

### 3.2.3 Permitted Procedures

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 proposed permit includes all activities described below.

#### 3.2.3.1 *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 unintentional (incidental) harassment for marine mammals. 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 unintentional (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. Unintentional (incidental) harassment of non-target marine mammals 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.

### 3.2.3.2 *Aerial Surveys*

The Permits Division proposes to authorize the MMHSRP to use aerial surveys to: survey populations; 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; locate carcasses; and for other purposes as appropriate to achieve the objectives of the MMHSRP. 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. UAS may be either remotely-operated or autonomous. Common types of UAS currently in use include fixed wing aircraft and vertical takeoff and landing multi-rotor craft (e.g., quad and hexa-copters), but the field is rapidly advancing and additional types are likely to be available during the project period. The frequency of surveys depends on the circumstances of the involved stranded or entangled animals, the disease, or the occurrence of a UME. Aerial surveys using manned aircraft are typically flown along predetermined transect lines at a set altitude and air speed while observers scan the water or the shoreline for signs of marine mammals.

The speed and altitude of the aircraft depend on the aircraft and the response or research situation and may vary depending upon the research or response need. For large cetaceans, manned surveys typically would be flown at an altitude of 230 to 300 meters (750 to 1,000 feet) at approximately 110 knots (203 kilometers per hour). For right whales, manned surveys would typically be flown at 100 knots (185 kilometers per hour). For smaller cetaceans, manned surveys typically would be flown at an altitude of approximately of 230 meters (750 feet). Large survey aircraft would generally be flown at 110 knots (203 kilometers per hour) and small aircraft would generally be flown at 97 knots (179 kilometers per hour). When an animal or group of animals is sighted, the survey aircraft may descend to 300 feet and circle over the animal or animals for short durations (less than approximately 10 minutes) for healthy animals to obtain photographs (including thermal photographs when appropriate) and assess the animal(s), as needed. If the animal is imperiled (entangled or injured) the plane may circle for hours to guide responders to the location, and then to standby to document and aid in the response. Number of manned aerial surveys would be as warranted for emergency response or emergency-response related research, and typically fewer than 20 for research activities, although this would vary depending upon the study design.

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

The Program proposes to fly unmanned aircraft at lower altitudes than those listed above, but no lower than necessary to collect the data sought. The most frequent use of UASs would be to carry a small camera to relay images to responders in real time or to record video and still images of animals in distress that may be reviewed later, or to carry another digital sensor such as thermal imaging. Currently available vertical takeoff and landing UASs are typically no heavier than five pounds in weight, but may be up to 55 pounds under the FAA definition of small UAS. The battery life typically averages 20 to 30 minutes. Currently available fixed wing UASs are typically 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 5 to 10 feet (1.5 to 3 meters)). If the UAS is equipped to take skin scrapes, collect a biopsy sample, or apply a tag, then the minimum altitude is zero feet as the UAS will make contact with the animal for a brief period of time. These techniques are currently in development and may be used within the duration of the permit. Recent field efforts have applied suction cup tags to baleen whales using UAVs by hovering over the whale and releasing the tag at an altitude of 2.5 to 8.5 meters (8.2 to 27.9 feet). 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.

#### 3.2.3.3 *Vessel Surveys*

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

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

#### 3.2.3.4 *Hazing and Attractants*

The Permits Division proposes to authorize the MMHSRP to conduct and oversee 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. Unintentional (incidental) harassment of non-target marine mammals may occur as a result of hazing activities.

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

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

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

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

Mid-frequency sonar may be used to deter cetaceans. It has caused deterrence in killer whales in Haro Strait during the 2003 *USS Shoup* transit episode (Miller 2009). The sonar had a source level of approximately 235 dB (exact level is classified) and the frequency ranged from 2.6 to 3.3 kHz over one to two second signals emitted every 28 seconds. Mid-frequency sonar could be effective over 25 kilometers, which would be important for deterring animals during a large oil spill. Low-frequency sonar may also be used, especially for mysticete deterrence, but is too low for some cetaceans to hear.

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

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

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

### 3.2.3.5 *Capture, Restraint, and Handling*

The Permits Division proposes to authorize the MMHSRP to capture any species of ESA-listed cetacean and pinniped as may be necessary during enhancement activities, and to capture any species of ESA-listed 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 3.2.2, 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).

During enhancement activities, including import and export activities related to enhancement, capture, restraint, and handling may occur on any age class, sex, and species of cetacean or pinniped. For baseline health research activities, capture, restraint, and handling may occur on Steller sea lions (Eastern and Western DPSs), Guadalupe fur seals, ringed seals (Arctic subspecies), and bearded seals (Beringia DPS), 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 unintentionally (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 unintentional mortality. If a non-target marine mammal is accidentally killed during emergency response activities, the circumstances surrounding the death would immediately be reviewed and future similar responses would be modified as appropriate, which may include cessation (in the example given, ceasing all capture operations for free-swimming entangled dolphins) if appropriate modifications or mitigation cannot be identified. If the target (entangled, debilitated, injured) marine mammal is accidentally killed (i.e. not euthanized) during the response, the circumstances would likewise be reviewed, but these deaths are more likely given the compromised nature of the target animals in these instances.

Capture and restraint of cetaceans may occur during enhancement activities, such as emergency response and disentanglement, and baseline health research. Capture methods for cetaceans may include, but are not limited to: hand, nets, traps, behavioral conditioning, and anesthesia/chemical immobilization. Typical methods currently used during health assessment studies and for emergency response are described below. These methods may vary depending on the species and location, and may change during the requested permit authorization period depending upon advances in technology. Typically, 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 to 600 meters (1,312 to 1,969 feet) long by four to eight meters deep seine net, deployed at high speed from an eight-meter (26-foot) long commercial fishing motor boat of a kind typically used for commercial fishing. Small (typically five to seven meters (16 to 23 feet)) 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 to 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., ESA-listed turtle or fish) researchers will follow the procedures appropriate for that species. While the MMHSRP may coordinate its activities with available fish and turtle biologists, any sampling or further data collection on incidentally captured turtles or fishes would not be conducted under the MMHSRP’s permit, and thus these activities are not considered here further. While these handlers check the outside of the corral, the remaining 10 to 20 or more team members prepare for sampling and data collection and begin the process of isolating the first individual marine mammal for capture. Isolation may be accomplished by pinching the net corral into several smaller corrals. Handlers may be able to hand catch the selected marine mammal as it swims slowly around the restricted enclosure. After marine mammals are restrained by handlers, an initial evaluation would be performed by a trained veterinarian. Once cleared by the veterinarian, the cetacean would be transported to the processing boat via a floating mat (e.g., Navy mat) or in the water by a team of handlers, accompanied by a veterinarian. A specially-designed sling is used to bring the marine mammal 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). Larger 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).

#### 3.2.3.6 *Transport*

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

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

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

Transport procedures for marine mammals used in scientific research and enhancement 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 will make every attempt 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) as warranted in remote locations or for short transports, particularly those that may be organized on an emergency basis and have to use an available plane or vehicle..

#### 3.2.3.7 *Holding*

The Permits Division proposes to permit the MMHSRP to oversee and conduct short-term holding of animals in a captive setting for enhancement (including emergency response-related research) or other research purposes. Holding is proposed and may be authorized for baseline health research on non-releasable marine mammals temporarily held under the MMHSRP permit until a permanent home is identified. Stranded and/or imported animals may be held for rehabilitation purposes in a facility holding a Stranding Agreement following a medical determination that rehabilitation is the appropriate course of action. Additionally, healthy animals may be held in short-term holding as a mitigation measure during an oil spill or other disaster or circumstance for protection. As previously described, all facilities holding a Stranding Agreement will have been evaluated by the MMHSRP under the Stranding Agreement Criteria and will have been determined by the MMHSRP to meet the criteria for an issuance of a

Stranding Agreement as well as the *Standards for Rehabilitation Facilities* (Appendix XVII of NMFS 2022h). Facilities holding ESA-listed marine mammals must also follow *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012c), which have been incorporated into the Draft Standards for Rehabilitation Facilities, planned to be finalized in 2022 with the issuance of the Programmatic EIS (Appendix XVII of NMFS 2022h); under these standards, facilities rehabilitating ESA-listed species are required to have quarantine protocols to minimize the spread of infectious diseases within the facility. ESA-listed and non-listed animals may be held (short term) under this permit in rehabilitation facilities or research facilities authorized by the U.S. Department of Agriculture Animal and Plant Health Inspection Service.

The MMHSRP aims to return animals to the wild to their natural range and habitat (which may include export to foreign countries) following intervention. However, certain situations may prevent the release of animals back to the wild. For instance, if an animal is unlikely to thrive in the wild due to medical status or habituation, the animal will be deemed non-releasable and a permanent placement in humane care will be sought; if an animal poses a risk to the wild population, such as being a carrier of a novel pathogen (one not found in the wild population), 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 until permanent placement.

#### 3.2.3.8 *Release*

Stranded and/or imported ESA-listed marine mammals are admitted into rehabilitation with the intent to release them back to the wild or export them back to their home country once healthy. As previously described, animals are assessed following the *Standards for Release* (Appendix XVII of NMFS 2022h) by the attending veterinarian at the rehabilitation facility. Rehabilitation facilities must also follow *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012c) when rehabilitating ESA-listed marine mammals. Once an animal is deemed releasable by NMFS, the animal would be captured from its rehabilitation pool or pen, loaded into an appropriate container based on species and size, and transported to a release site, which may involve export to a foreign country if the animal was originally imported or stranded outside of its species range. As described above, transport may occur by truck, boat, aircraft, or any combination of the three. Animals may be released from the beach or may be transported some distance offshore for an at-sea release. If an animal was imported for enhancement purposes, it may be exported and released to its country of origin, at which point the foreign country may release it into the wild with assistance from the MMHSRP, or may further hold the animal in captivity. In accordance with the *Standards for 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.

#### 3.2.3.9 *Attachment of Tags and Scientific Instruments*

The Permits Division proposes to permit the MMHSRP to use a variety of tags (including scientific instruments) that may be attached to, or implanted in, an animal during both enhancement and baseline health research activities. During emergency response and other 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 cetacean calves less than six months of age or females accompanying such calves, or small cetaceans less than one year of age. 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 (dart or deep-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 (livestock 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), blood collection tags (i.e., hemotags), and video cameras.

Tags may be affixed to an animal in hand (stranding, 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 3.2.3.14).

Tags would generally be attached to free-swimming cetaceans by crossbow, compound bow, rifles, spear guns, slingshot (or throwing device), pole or jab spears, or UAS. 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 (for penetrating tags) or models (for external tags, including suction cup tags) 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, or deployed by UAS hovering over the animal. Tags would be attached on the dorsal surface of the animal behind the blowhole, closer to the dorsal fin, or on the dorsal fin for some species, 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 (0.79 centimeters) 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 an approximately sized, typically 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. Adhesives may also need to be used to attach suction-cup tags to cetaceans. 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 has been 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 approximately 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.

#### 3.2.3.10 *Marking*

The Permits Division proposes to authorize the MMHSRP to mark all ESA-listed marine mammals, regardless of age, sex, or species for enhancement and baseline health research 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 3.2.3.14).

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

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

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

#### 3.2.3.11 *Disentanglement*

The Permits Division proposes to permit the MMHSRP to conduct and oversee entanglement response activities. Close approach, documentation, and disentanglement may occur on any age class, sex, and species of marine mammal that is observed entangled. For ESA-listed large whales, entanglement response efforts may include vessel and aerial surveys as described above for the affected animal and unintentional (incidental) harassment of non-entangled marine mammals during these searches. Close approaches may occur to assess and document the extent of the entanglement and the health of the animal. 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. For large whales, 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 ESA-listed pinnipeds and small cetaceans, disentanglement efforts may include capture with unintentional (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. Unintentional (incidental) harassment of all ESA-listed marine mammals may occur during disentanglement.

#### 3.2.3.12 *Diagnostic Imaging*

The Permits Division proposes to permit the MMHSRP to conduct and 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 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 24 of the *CRC Handbook of Marine Mammal Medicine* will be used as a reference for equipment and methods of ultrasonography for marine mammals (Dennison and Saviano 2018). 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, age estimation, and dental health. 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 24 of the *CRC Handbook of Marine Mammal Medicine* will be used as a reference for equipment and methods of radiography for marine mammals (Dennison and Saviano 2018). 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.

#### 3.2.3.13 *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, and enhancement activities, including necropsies. For enhancement activities including emergency response, samples may be collected from animals of any species, age, and sex. During baseline health research activities, samples will not be collected from live 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 had not been planned at the time of this opinion; therefore specific numbers and kinds of specimens cannot be predetermined. Because most specimens will be acquired opportunistically, the MMHSRP will have minimal control over the age, size, sex, or reproductive condition of any animals that are sampled. During necropsy of dead animals, any specimens of interest may be collected.

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

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

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

*Biopsy Sampling*
Biopsy sampling would be conducted to collect samples of skin, blubber, muscle, or other tissue (see below for details). Sampling may occur on free ranging animals (live and dead, including healthy, compromised, and entangled animals), animals in rehabilitation, animals in managed

care, and captured animals during research activities. For enhancement activities including emergency response, biopsy samples may be collected from any species, age, and sex animals.

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

Remote biopsy darts may be used to collect skin and blubber biopsy samples from free-swimming cetaceans. This standard technique involves using a blank charge in a modified 0.22 caliber rifle to propel a dart with small cutting head into the side of a small cetacean, below the dorsal fin from a distance of approximately three to six meters away, but may be up to 30 meters, 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 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 approximately within 0.5 meters of the target animal prior to sampling, which would allow a specific area of the animal to be targeted with a high degree of accuracy.

Blubber biopsies may be taken during health assessment studies. Protocols developed as part of other cetacean health assessment projects will be followed (e.g., (Hansen et al. 2004; Hansen and Wells 1996; Schwacke et al. 2002; Wells and Balmer 2005; Wells et al. 2004)). An elliptical wedge biopsy would be obtained from each cetacean. The sampling site would typically 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 typically used for genetic analyses. Additionally, during health assessments, skin scrapings, biopsy samples including muscle samples, or needle aspirates may be collected for clinical diagnoses from sites of suspected lesions. These samples would be processed by various diagnostic laboratories and a subsample would be sent to the National Marine Mammal Tissue Bank when appropriate.

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

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

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

*Blood Sampling*

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

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

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

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

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

*Breath Sampling*

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

For non-restrained animals (e.g., free-swimming whales, hauled out pinnipeds), breath may be collected with a variety of sampling devices positioned as close as possible to the blowholes or nares; positioning may be done with long poles or with remote-controlled vehicles such as UAS. 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 research, health assessments, emergency response activities, during rehabilitation, and during captive research or on any live captured animal including both cetaceans and pinnipeds. Samples may 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 can be conducted using the deposition of growth layer groups in teeth. A tooth will be extracted from an animal in hand by a veterinarian or biologist trained in this procedure.

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

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

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

*Ocular Sampling and Examination*
Samples may be collected from the eye of a cetacean or pinniped. A sterile swab would be inserted at the medial or lateral canthus of the eye, gently swabbed along the conjunctiva or cornea and removed. A complete ocular examination may be performed via visual examination

and through use of an ophthalmoscope and tonometer (an example standard methodology for ophthalmic evaluation is presented in Wright et al. (2015). Additionally, if a corneal ulcer is suspected, fluorescein stain may be administered into the eye via a strip or drops and the cornea examined visually or with an ophthalmoscope to determine if a corneal ulcer is present. Samples are sent to a laboratory for culturing, polymerase chain reaction identification, or further analyses as necessary. Additional types of tests may be performed at the discretion of a veterinary ophthalmologist (e.g., infrared photography, ultrasound, or pachymetry). Pachymetry is the process of measuring the thickness of the cornea using a device called a pachymeter, which may be either ultrasonic (using ultrasonic transducers) or optical (using specialized cameras). General sedation or anesthesia, with or without local anesthesia, may be needed to facilitate safe animal handling and reduce discomfort associated with certain evaluation procedures.

*Urine Sampling*

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

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

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

By definition, a cystocentesis is a procedure during which the bladder is punctured for the purpose of obtaining an uncontaminated urine sample (Ettinger and Feldman 2009). The animal would be placed in dorsal recumbence typically 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 and other stressors or threats.

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

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

#### 3.2.3.14 *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 27 of the *CRC Handbook of Marine Mammal Medicine* will be used as a reference for potential drugs and doses for marine mammal species (Simeone and Stoskopf 2018). Medications would be administered at the discretion of the attending veterinarian or the principal investigator.

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

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

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

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

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

**Administration of Medications: Vaccinations**

The MMHSRP has proposed a pinniped and cetacean vaccination program to address potential infectious disease threats to marine mammals under the NMFS' jurisdiction and to outline a process to address these threats with vaccination. The vaccination of all ESA-listed marine mammals is proposed.

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.

In general, the MMHSRP will use inactivated and recombinant vaccines for the vaccination program. 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 or rehabilitation 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 or rehabilitation (e.g., captive bottlenose dolphins would be a potential surrogate species for false killer whales) and on members of the target species in captivity or rehabilitation (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 or rehabilitated 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 (Appendix XI in NMFS (2022h)) 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.

#### 3.2.3.15 *Auditory Brainstem Response/Auditory Evoked Potential*

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

Procedures on odontocetes are generally minimally invasive and can be conducted in short time frames. An animal may be resting at the surface, on the beach, on a mat on the deck of a boat, or may be physically restrained (held by researchers) in the water 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.

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 animals 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.

#### 3.2.3.16 *Active Acoustic Playbacks*

Active acoustic playbacks would be used to expose cetaceans and pinnipeds to playbacks of pre-recorded natural sounds (e.g., songs, social sounds, and feeding calls) or manmade and synthetic sounds (e.g., ship noise, naval exercises, drilling noise, pile driving, or white noise). Playbacks may be used during research including 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 3.2.3.4).

#### 3.2.3.17 *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 multiple 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 that marine mammals euthanized using drugs shown to cause secondary poisoning of scavengers be disposed 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), 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.

#### 3.2.3.18 *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 including research and enhancement 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 animals in rehabilitation, or 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 (e.g., see Permit No. 18768-01, Appendix 7: Conditions for Research/Enhancement Activities on Permanently Captive Marine Mammals). Research on captive non-releasable marine mammals includes procedures described in this opinion for wild animals and vaccination trials and may include incidental public display to educate the public on the status of the species. Enhancement involving captive marine mammals may include but is not limited to standard husbandry and veterinary care necessary for captive maintenance of non-releasable stranded animals and any incidental public display to educate the public on the status of the species.

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

#### 3.2.3.19 *Import and Export Activities*

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

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

Import of live foreign marine mammals may be necessary for enhancement purposes, as in many cases the best available veterinary care and rehabilitation and holding facilities are available in the United States. Such import would typically occur at the request of a foreign government or stranding network. For example, as previously mentioned in Section 1.1, reinitiation for this consultation was triggered by the possibility that the MMHSRP may import vaquita from captive facilities in Mexico. This import would occur at the request of the Mexican government if, for example, vaquita needed veterinary care that could only be received in the U.S. or if a natural disaster such as a hurricane threatened vaquita at their facilities in Mexico. Situations that may warrant exportation of live animals include: animals that were previously imported, animals that stranded in the U.S. but near a foreign country where better facilities/care exist, and animals that stranded within the U.S. but were clearly extralimital and the best release option is determined to be in a foreign country (e.g., Arctic seals stranding along the U.S. Atlantic coast). As the result of importation and exportation, these marine mammals may experience restraint, handling, transport, temporary holding, and release or euthanasia. These activities would follow those protocols outlined above.

The MMHSRP proposes to import or export an unlimited number of marine mammal (ESA-listed and non-listed) specimens, including cell lines, for baseline health research purposes. The MMHSRP requires exportation authorization to provide specimens to the international scientific community for analyses or as control/standard reference materials and to export animals for release. Importation privileges are necessary for the MMHSRP to acquire legally obtained specimens from outside the U.S. for archival in the National Marine Mammal Tissue Bank or for health-related analyses by U.S. experts and laboratories. Specimen materials may include, but are not necessarily limited to: earplugs, teeth, baleen, bone, cartilage, tympanic bullae, ear ossicles, eyes, muscle, skin, blubber, internal organs and tissues, reproductive organs, fetuses, mammary glands, milk or colostrum, serum or plasma, urine, tears, blood or blood cells, cells for culture, bile, 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.

#### 3.2.3.20 *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.

## 3.3 Potential Stressors

Stressors are any physical, chemical, or biological modification, environmental condition, external stimulus or event, caused directly or indirectly by the action or its activities, that may induce an adverse response. The physical, chemical, or biotic stressors caused by 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 Analysis (Section 0, below). If we identify activities that are not likely to cause stressors; we do not consider these activities further. The categories of potential stressors that we expect to result from the proposed action are those associated with the permitted procedures described in Section 3.2.3 and include:

- Strikes from vehicle or vessel operation;
- Sound from different sources (e.g., water and ground vessels and aircraft, acoustic deterrents, active acoustic playbacks, etc.);
- Visual disturbance from human presence in/near the water, visual deterrents, etc.;
- Entanglement and entrapment (e.g., from various deterrents and during capture, restraint, and handling activities);
- Habitat loss, damage, or alteration from use of deterrents and vessels;
- Mortality from euthanasia;
- Injury from sampling and tagging activities;
- Direct physical contact (e.g., restraint, sampling, tagging, etc.); and
- Introduction of contaminants into the environment (e.g., euthanasia, administration of medications, etc.).

## 3.4 Programmatic Consultation Requirements and Procedures

This section details the PDCs that will be implemented by the MMHSRP to avoid or minimize adverse effects on ESA-listed species and designated critical habitat. In the case of this opinion, the PDCs are equivalent to the MMHSRP's minimization and mitigation measures as outlined in the FPEIS (NMFS 2022h), the cetacean programmatic BA (NMFS 2019c), and the MMHSRP's current Permit No. 18786-06. The measures in the current permit are the same as previously permitted measures and are considered standard mitigation used by all marine mammal researchers. As noted, PDCs, as up-front measures to avoid or minimize adverse effects likely to be caused by program activities, are part of the action for consultation; therefore, their effects are evaluated in this opinion. This section also describes the procedures for streamlined project-specific review and for tiered consultations. Finally, this section details the regular comprehensive review procedures for the program.

The following additional elements of programmatic consultations are covered in later sections of the Opinion:

- Description of the manner in which activities to be implemented under the programmatic consultation may affect listed species and critical habitat, and evaluation of expected level of effects from covered activities (Sections 0 and 7.3).
- Process for the evaluation of the aggregate or net additive effects of all activities expected to be implemented under the programmatic consultation (Section 8).
- Procedures for tracking and monitoring projects and validating effects predictions, in addition to those contained in this section of the opinion related to periodic program review, are also found in the Incidental Take Statement, including its Reasonable and Prudent Measures (RPMs) and associated terms and conditions (Section 11).

The proposed programmatic action includes specific activities that are (1) not likely to adversely affect ESA-listed species or their designated critical habitat with implementation of applicable PDCs, and (2) are likely to adversely affect ESA-listed species and/or their designated critical habitat even with implementation of required PDCs. Although some PDCs and RPMs appear similar, the implementing terms and conditions of the RPMs provide specific requirements that the action agency must follow in order to retain their incidental take authorization under the MMPA.

### 3.4.1 Project Design Criteria

PDCs have been identified to limit potential adverse effects of MMHSRP activities to ESA-listed species and their designated critical habitat. The required PDCs included in this opinion are those that the MMHSRP implements as minimization and mitigation measures and were included in the FPEIS (NMFS 2022h) for this consultation as well as those mitigation measures required by permit. Additional mitigation and minimization measures were included in the BA for the cetacean programmatic (NMFS 2019c). These required PDCs, when applied to activities associated with the MMHSRP, minimize the potential adverse effects to ESA-listed species and their designated critical habitat.

The PDCs described in (NMFS 2022h) and (NMFS 2019c), some of which are described below, are also described in Appendix 15.2 of this opinion.

<u>Required PDCs for Stranding Response</u>

1. When stranding response activities must occur in protected and sensitive areas, response activities will be coordinated with the appropriate authorities to determine the manner in which a response may occur (if it is permitted at all), and to minimize the impacts of a response on biological resources.

2. Activities (e.g., relocation activities and carcass recovery) would be coordinated with federal, state, and/or local agencies to avoid or minimize impacts to non-target species.
3. Anchors would be set by hand in unvegetated areas whenever possible and dragging of anchors or anchor chains would be avoided.
4. Stranding Agreement (SA) holders would make every reasonable effort to conduct and assist in beach clean-up where activities were conducted.
5. Live animals would be approached gradually with minimal noise. Extra care would be taken around nursing mothers and calves/pups.
6. For pinnipeds, responders would carry out activities efficiently, such that the total time they are occupying beach haul-out areas, and the total number of times a site is disturbed, are minimized. Response to stranded pinnipeds in a rookery situation would not be authorized under a SA, as a response would unintentionally harass non-stranded animals. In this situation, a response would only be performed under the authority of the MMPA/ESA permit in coordination with the NMFS Regional Stranding Coordinator (RSC) and Permit Holder/Primary Investigator. Experienced personnel would be used during capture and restraint to complete the activities as quickly as possible.

Required PDCs for Carcass Disposal

1. Beach burial on federal and state lands and disposal in federal or state waters would only occur after federal, state, and/or local authorities have given permission to conduct such activities. If necessary, Stranding Network members would obtain a permit to conduct these disposal activities.
2. If carcasses are known or assumed (based upon test results or prior knowledge of the species) to have contaminant levels that meet or exceed the definition of hazardous waste under EPA, state, and/or local regulations, they would be taken to an EPA-designated hazardous waste landfill for proper disposal.
3. In accordance with the Marine Protection, Research, and Sanctuaries Act (MPRSA) general permit for ocean disposal of marine mammal carcasses[3], permittees must consult with the MMHSRP prior to initiating any disposal activities and consult with and obtain concurrence from the appropriate EPA Regional Office regarding the selection of the ocean disposal site. Unless concurrence specifies otherwise, this site must be seaward of the three mile territorial sea demarcated on nautical charts, and disposal reports must be provided to the EPA.
4. During carcass disposal and removal activities, measures would be taken to avoid protected and sensitive habitats.

Required PDCs for Rehabilitation Activities

[3] *Additional information about the general permit as well as EPA contacts for inquiries about the ocean disposal of marine mammal carcasses are available at: https://www.epa.gov/ocean-dumping/ocean-disposal-marine-mammal-carcasses.*

1. The rehabilitation facility must have sufficient physical and financial resources to maintain appropriate animal care for the duration of rehabilitation, including costs associated with release (e.g., long-term rehabilitation, transport to release site, post-release monitoring) or transport to another facility. Further, the Stranding Network participant would submit a facility operation manual to NMFS for review prior to the issuance of a SA.
2. Per the SA criteria, the rehabilitation facility would have key personnel (e.g., animal handlers, husbandry staff, veterinarian, etc.) with experience or comparable training in all aspects of marine mammal rehabilitation. The rehabilitation facility would have and maintain an attending veterinarian experienced in marine mammal care, or that can consult with experienced marine mammal veterinarians, and that would be willing to assume responsibility for diagnosis, treatment, and medical clearance for release or transport of marine mammals in rehabilitation.
3. Handling and restraint procedures would be performed or directly supervised by qualified personnel.
4. Transportation protocols would be standardized, ensuring the safe, effective, and expeditious transport and transfer of live stranded animals.
5. Pinniped and Cetacean Oil Spill Response Guidelines (Ziccardi et al. 2015) would be followed to ensure that rehabilitation facilities that accept oiled animals are properly equipped to handle their care.

Required PDCs for Release of Rehabilitated Animals

1. For all release activities, the appropriate authorities would be consulted during the site selection and planning process to help coordinate activities, and ensure that release activities avoid protected and sensitive habitats (including submerged aquatic vegetation and coral reefs), or that impacts are minimized.
2. Animals would be medically cleared by the attending veterinarian and their assessment team as part of the release determination process. Behavioral and developmental assessments would also be conducted prior to release.
3. Handling and restraint procedures for release examinations would be performed or directly supervised by qualified personnel and if possible, an experienced marine mammal veterinarian or veterinary technician would be present to carry out or provide direct on-site supervision of all activities involving the use of anesthesia and sedatives.

Required PDCs for Entanglement Response

1. Entanglement response to large whales would be authorized under the MMPA/ESA permit and the MMHSRP would follow all mitigation measures set forth by NMFS OPR Permits and Conservation Division as conditions of the MMPA/ESA permit, and all activities will be conducted in consultation with and with the consent of the permit Principal Investigator.

2. For large whale entanglement response, responders would approach animals gradually, with minimal noise to reduce any reaction. Responders would generally approach at slow speeds, avoid making sudden changes in speed or pitch, and avoid using reverse gear to the extent possible. Extra care would be taken when approaching mothers and calves. Only responders with extensive experience operating vessels near large whales would be involved in vessel approaches.
3. The MMHSRP would follow all mitigation measures set forth by NMFS OPR Permits and Conservation Division as conditions of the MMPA/ESA permit, and all permitted activities will be conducted in consultation with and with the consent of the permit Principal Investigator.
4. If the entanglement response requires net capture, these procedures would be performed or directly supervised by qualified personnel and an experienced marine mammal veterinarian would be present to carry out or provide direct on-site supervision of all activities involving the use of anesthesia and sedatives.
5. To avoid potential damage to protected and sensitive habitats, responders would avoid setting the net on submerged aquatic vegetation, oyster and coral reefs, and other fragile benthic habitats.
6. For entanglement response to pinnipeds on beach sites, responders would carry out activities efficiently, to minimize disturbance and the amount of time responders occupy the haul-out.

PDCs Required for Research Activities

1. The MMHSRP would follow all mitigation measures set forth by the Permits Division as conditions of the MMPA/ESA permit, as well as the MMHSRP's own mitigation measures.
2. Only qualified, experienced personnel would be allowed to perform invasive procedures such as remote biopsy sampling, attachment of intrusive tags, biological sampling of captured animals and administration of drugs.
3. Close approach, vessel and aerial surveys:
    a. To minimize disturbance and ensure adequate opportunities for photo-identification, tagging, and sampling, the researchers would approach animal(s) gradually from behind or alongside, rather than head on.
    b. Researchers would leave the vicinity of an animal(s) or otherwise modify their behavior (slow down, change the angle of approach, etc.) if the animal(s) showed a response to the presence of the research vessel or aircraft.
    c. When UAS is used by NOAA personnel, activities would be conducted pursuant to NOAA UAS Policy 220-1-5[4], including aircraft airworthiness certification

[4] *More information on this policy can be found at: https://www.omao.noaa.gov/find/media/documents/policy-220-1-5-unmanned-aircraft-systems-uas-operations.*

from NOAA, pilot and crewmember training and qualification under the NOAA Operations Manual, aircraft or pilot authorization through the FAA, preflight and operational checklists, and appropriate agency notifications.

   d. Additionally, the UAS would hover over an individual animal only long enough to obtain the needed data or perform the needed action.

4. Capture, restraint, and handling:
   a. Capture, restraint, and handling procedures for pinnipeds and cetaceans would be performed or directly supervised by qualified personnel.
   b. Pinniped research activities would be carried out efficiently, to minimize the total time researchers are occupying the rookery/haul-out and the total number of times a site is disturbed.
   c. Netting activities would cease if a sea turtle or other ESA-listed marine species is sighted in the vicinity of the vessel. If a sea turtle or other non-target protected species is accidentally captured, the vessel would immediately be stopped and either turned off or put in neutral. Tension on the net would be released to allow the animal the opportunity to free itself. Caution would be exercised when attempting to assist the animal in freeing itself. The appropriate Permits Division would be contacted immediately to report any incidents, in addition to other agency reporting requirements when necessary.
5. Attachment of scientific instruments:
   a. Attaching scientific instruments would only be performed by Co-Investigators, trained research biologists, and veterinarians with experience applying the same, or similar, instruments to the target, or similar, species.
   b. Pinniped flipper tags would be placed appropriately, so animals would not walk on or be irritated by them. Care would be taken when attaching scientific instruments to pinnipeds to prevent thermal burns. The correct proportions of epoxy hardener and resin catalyst would be used to prevent a "hot" mix and the minimum practical amount of epoxy would be used to prevent burning the animal. To minimize the risk of infections from implantable tags, appropriate instrument sterilization and sterile surgery techniques would be used.
   c. The MMHSRP would follow the best practices recommendations of a cetacean tagging workshop (Andrews et al. 2019) as well as (Horning et al. 2019; Horning et al. 2017) for pinniped tagging.
   d. 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.
   e. All tagged animals would generally receive follow-up monitoring, including visual observations where feasible, to evaluate any potential effects from tagging activities.
6. Marking:

   a. After freeze or hot branding, the skin would be returned to normal temperature as quickly as possible using water. Pinnipeds would generally be hot branded under sedation or anesthesia, and health-compromised animals would not be hot branded.

7. All sampling procedures:
   a. Procedures would be performed or directly supervised by qualified personnel and an experienced marine mammal veterinarian or research technician would be present to carry out or provide direct on-site supervision of all activities involving the use of anesthesia and sedatives.
   b. Animals that appear severely stressed or ill under manual restraint would not be sedated or anesthetized and would be released. Animals that are physically restrained but continue to struggle or show signs of stress would be released immediately to minimize the risk that continued stress could lead to capture myopathy.
8. Exposure to playbacks and other acoustic research:
   a. A particular playback trial would be suspended if the exposed marine mammals show strong reactions (e.g., sustained breaching for cetaceans or other activities commonly associated with marine mammal stress or agitation). Playbacks may be stopped if non-target protected species approach the study area.
9. Vaccinations:
   a. New vaccine testing would first occur on managed care, surrogate (e.g., non-listed species if possible), or rehabilitating animals, before being tested in wild populations. Additionally, the MMHSRP would use inactivated or recombinant vaccines when possible.
10. Unintentional mortality:
   a. If an unauthorized serious injury or mortality occurs during biomonitoring or research activities, the specific research activity would cease and the Responsible Party or Principal Investigator would notify NMFS OPR Permits and Conservation Division of research-related mortalities by phone as soon as possible after the incident, no later than 72 hours after the incident. The specific biomonitoring and research activity would not resume until written permission is received from the Permits Division.

### 3.4.2 Monitoring the Effects of the Permits for Research and Enhancement Activities

The Permits Division assesses the effects of issuing ESA/MMPA directed take permits issued under the programmatic consultation in several ways that include:

- Permit reporting requirements;
- Monitoring the effects of permitted research and enhancement activities to ESA-listed marine mammals;
- Adaptive management of authorized research and enhancement activities and take levels;

- Monitoring the status of authorized ESA-listed marine mammal species; and
- Internal program reviews.

Permit holders are required to notify the Permits Division if their activities result in exceeding authorized take, serious injury, or mortality of a protected species within 72 hours of the incident. In this case of reaching or exceeding take (in terms of species, annual numbers or activities), the permit holder is required to suspend research and enhancement activities, notify the Permits Division, and submit an incident report. Review of the report and the authorized methods and protocols allow the Permits Division to proactively modify (i.e., adaptively manage) the protocols and permit as needed to minimize further impacts to the species before allowing activities to resume. On a case-by-case basis, the Permits Division will consider whether the standard mitigation measures for the authorized research and enhancement activities relevant to the incident need revision in other active permits or future permits. The incident report information must also be briefly summarized and included in that year's annual report.

In addition to discussing the above incidents when submitting annual reports, permit holders must provide information to enable us to assess the impact of authorized research and enhancement activities and monitor the effectiveness of permit mitigation measures to confirm that the Permits Division's initial assessment of anticipated impacts to the species and the environment remains valid. This includes discussion of efforts taken to monitor the effects of their research and enhancement activities and reporting on observed effects, such as the species' reaction rate to invasive procedures or an animal's physical condition upon resighting or recapture. The annual report format and questions are in Section 15.3.

If any report indicates that the research and enhancement activities are exceeding the original assessment of impacts, the Permits Division will take measures to modify the activities and protocols authorized and/or conduct a new environmental assessment of the action, if needed. The last year's annual report for the life of the permit (i.e., final report) must also include discussion of how the research and enhancement activities benefited the species or promoted recovery or conservation of the target ESA-listed species including how the work contributed to fulfilling research needs or objectives in a species' recovery or conservation plan. This informs the Permits Division's review of future requests for work of a similar nature in terms of whether specific methods, protocols, and study designs will benefit the species and aid recovery. Submission of annual reports also allows the Permits Division to review how the permit holder has used the number of takes authorized each year. To facilitate the Permits Division's ability to monitor the reported use of takes by permit holders across the program, they are establishing a fixed reporting schedule.

The MMHSRP describes their current mitigation measures to minimize the risk of mortalities and serious injuries for non-target marine mammals in their application, No. 24359, and in the draft PEIS (NMFS 2022). These include:

- Ensuring all authorized personnel have qualifications commensurate with their duties, only using trained and experienced personnel to conduct permitted activities, and using veterinarians to conduct or oversee activities when possible;
- Using experienced and trained individuals who are able to modify their activities in response to signs of animal stress;
- Closely monitoring the target and non-target animals and modifying activities as possible and appropriate;
- Surveying areas for non-target species prior to conducting permitted activities, and avoiding non-target species whenever possible;
- Reducing the number and duration of close approaches, including modifying activities if animals show signs of stress;
- Taking extra care when approaching or conducting activities with sensitive groups such as pregnant females and mothers and calves/pups;
- Use of careful decision-making to decide only to use methods when they can be done safely and effectively, and any potential harm is outweighed by the benefits to the animal of avoiding the danger; and
- Following approved IACUC protocols.
- In addition, for stampedes:
    - Only conducting activities when there are few other animals nearby, or the risk of a reaction from any other animals is deemed likely to be minimal;
    - Approaching animals gradually, with minimal noise to reduce any reaction;
    - Selecting times, approach angles, approach speed, and other factors to minimize disruptions of other animals; and
    - Stalking carefully, wearing camouflaging clothes and using natural cover, to within close proximity of the subject animal.
- For captures:
    - Using adequate numbers of experienced individuals to be able to monitor the capture net from a close enough distance to intervene quickly and prevent drowning or injuries;
    - Stopping netting activities if non-target protected species are observed;
    - Choosing appropriate equipment (e.g., net mesh size) and ensuring nets are specifically designed to prevent animals from drowning (light lead lines allow for entangled animals to reach the surface);
    - Deploying nets only when the target animal is alone and if that could not be avoided (e.g., mom/calf pairs) to have response personnel dedicated for the non-target animal; and
    - Actively monitoring the net to help ensure that non-target animals are not caught in the net and responding to and releasing non-target animals as quickly as possible.

### 3.4.3 Monitoring the Status of Endangered Species Act-Listed Species

The Permits Division recognizes that a species' abundance, population trend, habitat use, or range can change in the future for a host of reasons (e.g., climate change, fishery changes, prey availability, habitat degradation, water quality, other human impacts, etc.). Therefore, the Permits Division will remain apprised of species status reviews and stock assessment reports in coordination with the Marine Mammal Division and NMFS, Office of Protected Resources, Endangered Species Division, of the target species on an annual basis to ensure that the Permits Division does not authorize take to a degree that will result in greater impacts to any cetacean species. The Permits Division will also consider whether new information indicates that they should request reinitiation of the programmatic consultation. This can be information such as a new or revised ESA-listing, an expansion or shift in species range bringing a species into the action area that was not considered in this opinion, or evidence that effects of the action are occurring as a result of the research methods that were not anticipated based on the best available scientific data to date. Changes to the population abundance of ESA-listed cetaceans authorized for deep-implantable tags may result in changes (increases or decreases) to the number of deep-implantable tags authorized annually.

### 3.4.4 Standard Reporting Schedule

Similar to the annual permit cycle for reviewing applications and allocating takes, the Permits Division will have a fixed reporting schedule so that all permit reports are due at the same time of year. Permit holders will have 90 days to submit their report after the end of each permit year. The Permits Division will then have 30 days to review the reports and ask permit holders for additional information if needed. The Permits Division will also use this time to send reminders to any permit holders who have not sent in their report to do so within 30 days. After the additional 30-day grace period, if the report is not received the permit may be suspended until the report is received and approved by the Permits Division. After the reports have been reviewed, the Permits Division will have another 30 days to compile all data for annual reporting to us.

To better illustrate the timing of reporting, an example is provided below assuming that permits are issued with a calendar year reporting period (January through December each year).

**Table 3. Example of the timeline and actions during the standard reporting schedule for cetacean research and enhancement permits under the cetacean programmatic consultation (NMFS 2019b).**

| Timeline | Action |
|---|---|
| January through December | Effective permit year. |
| February 28 | Permit reports due approximately 60 days after permit year. |
| March | Permits Division reviews reports received and requests any additional information. Permits Division sends reminders to any delinquent permit holders. |
| March 31 | Deadline for overdue reports. |
| April | Permits Division will suspend any active permit that has not reported. Permits Division compiles annual report to us. |

| | |
|---|---|
| May | Permits Division submits annual report to us. |

Because reporting is vital to effectively monitor the takes used by permit holders and ultimately, monitoring of impacts to the species, the Permits Division may take additional measures to ensure that reports are received in a timely manner. This may include any of the following:

- Suspending the permit until the report is received and approved by the Permits Division.
- Deferring or returning modification requests for an active permit until the report is received.
- Deferring or returning an application for a new permit until the report is received.
- Notifying the Office of Law Enforcement of a permit violation due to failure to report.

### 3.4.5 Programmatic Review

Continued close collaboration and an on-going dialogue between the Marine Mammal Division, the Permits Division, and the ESA Interagency Cooperation Division will be an important component of the adaptive approach to managing the activities of the MMHSRP. The Marine Mammal Division will review, summarize, and compile information from the annual reports submitted by Co-Investigators including stranding agreement holders for the prior year into an annual report provided to us. As in annual reviews outlined in (NMFS 2019b), the annual report will synthesize data such as the number and percentage of takes used out of those allocated in ESA permits, the frequency of observed effects during enhancement and research activities, and the number and kinds of unauthorized non-target species unintentionally or incidentally taken. The Permits Division will provide the ESA Interagency Cooperation Division with cover letters to the Marine Mammal Division's annual reports that will also provide this information.

Annual reports will also notify us if new information becomes available indicating that the adverse effects of authorized research methods, such as tagging, have changed. This information will be conveyed and discussed in the report, including references to literature and other reports that were the basis for this determination. If new information indicates that a procedure has greater impacts than those analyzed in this programmatic consultation, the Permits Division and the Marine Mammal Division will request reinitiation of consultation and use the additional documentation to modify individual permits as needed; permits may be modified to authorize or remove procedures or add or revise mitigation measures to limit the potential impacts of authorized activities. The timing of the annual reporting will allow for the Permits Division and the Marine Mammal Division to discuss such matters with us before the next year's permit cycle begins. The Permits Division will also continue to work closely with us during the life of the programmatic consultation to routinely check-in (e.g., every five years or more frequently as needed) on how the issuance of permits for the MMHSRP and programmatic consultation is functioning overall, and to determine whether new information indicates that the Marine Mammal Division and Permits Division should request reinitiation of this programmatic consultation.

# 4 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 programmatic consultation includes all areas where MMHSRP activities may occur, which encompasses the coastal waters, estuarine and adjacent inland waters, and the Exclusive Economic Zone (EEZ) of the U.S., its territories, and possessions, and adjacent marine waters (Figure 2). The coastal zone includes coastal waters, adjacent shores, intertidal areas, salt marshes, wetlands, and beaches. The action area also includes the marine mammal rehabilitation facilities of the stranding network. The MMHSRP may also piggyback on Researchers working in international waters and on the high seas. Marine mammal parts may be imported, exported, and received from any location worldwide.

The MMHSRP may also import or export live marine mammals for the purposes of emergency response and rehabilitation from any location world-wide. Marine mammals may strand very far from their typical range, especially if they are debilitated. This means the MMHSRP may find ESA-listed marine mammals in different countries, even if their typical range is only within the United States; or, animals may strand within the United States, even though their typical range is not in U.S. waters. There are also some species that are routinely found across national boundaries. In many cases, the best opportunities for rehabilitation are found within the United States, and it is in the best interest of the animal to import it to a U.S. rehabilitation facility. Once an animal has completed rehabilitation in the United States (or in a foreign facility), it may be in the best interest of the animal to export/import it back to the original stranding location for release.

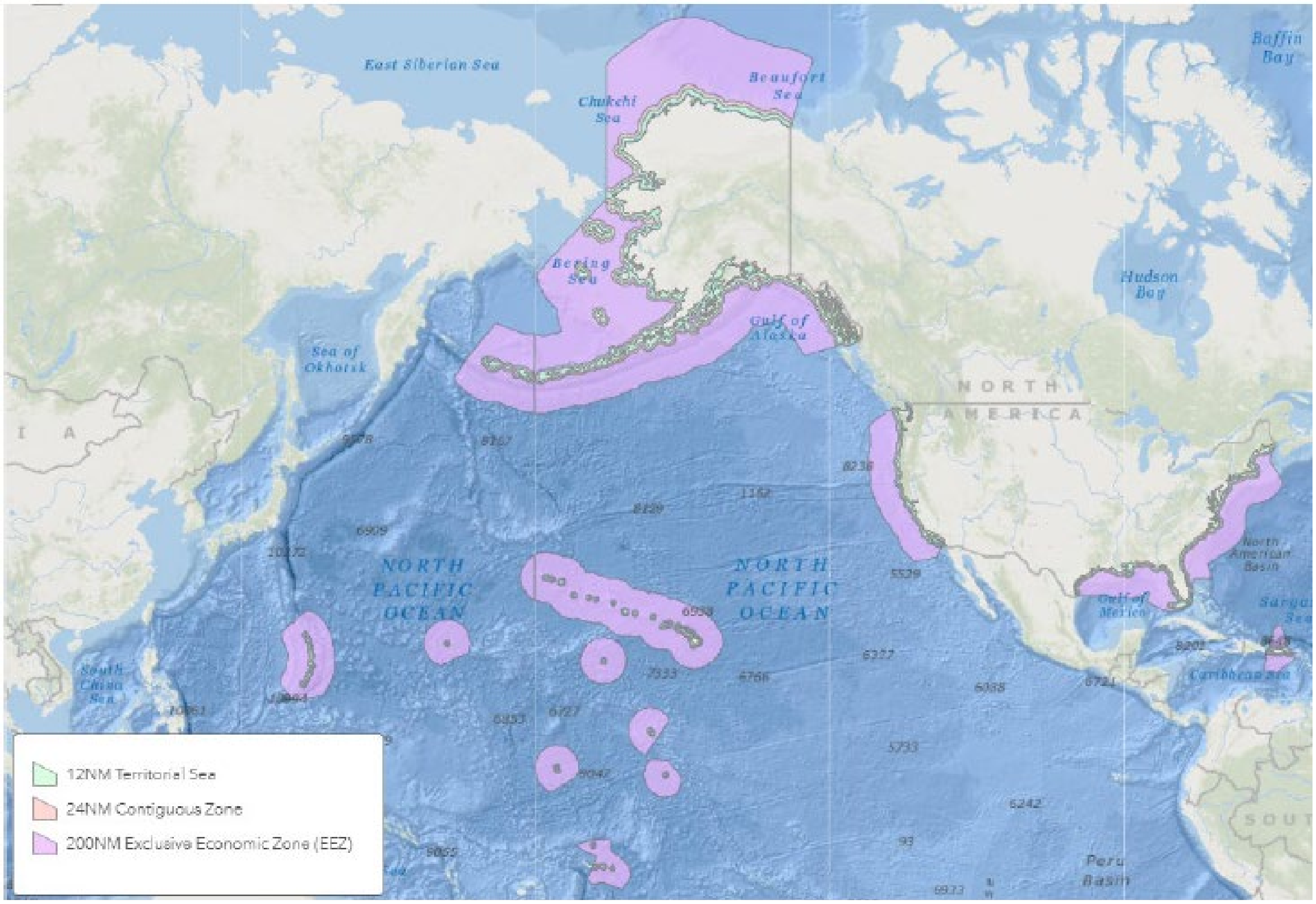

**Figure 2. Map of the MMHSRP's activities.**

# 5 Status of Endangered Species Act Protected Resources

This section identifies the ESA-listed species and designated critical habitat that potentially occur within the action area that may be affected by the proposed action along with their regulatory status (Table 4). Section 5.1 identifies those species and critical habitats that may be affected but are not likely to be adversely affected by the proposed action.

In Section 5.2, we provide a summary of the biology, ecology, and population status of those species that are likely to be adversely affected by one or more stressors created by the proposed action and detail information on their life histories in the action area, if known. These species are carried forward in our effects analysis (Section 6.7.13).

**Table 4: ESA-listed species and designated critical habitat that may be affected by the proposed action of permitting and carrying out the marine mammal health and stranding response program.**

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| **Marine Mammals – Cetaceans** | | | |
| Beluga Whale (*Delphinapterus leucas*) – Cook Inlet DPS | E – 73 FR 62919 | 76 FR 20179 | 82 FR 1325 |
| Blue Whale (*Balaenoptera musculus)* | E – 35 FR 18319 | -- -- | 07/1998 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| | | | 11/2020 |
| Bowhead Whale (*Balaena mysticetes*) | E – 35 FR 18319 | -- -- | -- -- |
| Chinese River/Baiji Dolphin (*Lipotes vexillifer*) | E – 54 FR 22906 | -- -- | -- -- |
| False Killer Whale (*Pseudorca crassidens*) – Main Hawaiian Islands Insular DPS | E – 77 FR 70915 | 83 FR 35062 | 86 FR 60615 |
| Fin Whale (*Balaenoptera physalus)* | E – 35 FR 18319 | -- -- | 75 FR 47538<br>07/2010 |
| Gray Whale (*Eschrichtius robustus*) Western North Pacific | E – 35 FR 18319 | -- -- | -- -- |
| Gulf of California Harbor Porpoise/Vaquita (*Phocoena sinus*) | E – 50 FR 1056 | -- -- | -- -- |
| Humpback Whale (*Megaptera novaeangliae*) – Arabian Sea DPS | E – 81 FR 62259 | -- -- | 11/1991 |
| Humpback Whale (*Megaptera novaeangliae*) – Cape Verde Islands/Northwest Africa DPS | E – 81 FR 62259 | -- -- | 11/1991 |
| Humpback Whale (*Megaptera novaeangliae*) – Central America DPS | E – 81 FR 62259 | 86 FR 21082 | 06/2022 (outline) |
| Humpback Whale (*Megaptera novaeangliae*) – Mexico DPS | T – 81 FR 62259 | 86 FR 21082 | 06/2022 (outline) |
| Humpback Whale (*Megaptera novaeangliae*) – Western North Pacific DPS | E – 81 FR 62259 | 86 FR 21082 | 06/2022 (outline) |
| Indus River Dolphin (*Platanista minor*) | E – 56 FR 1463 | -- -- | -- -- |
| Killer Whale (*Orcinus orca*) – Southern Resident DPS | E – 70 FR 69903<br>Amendment 80 FR 7380 | 86 FR 41668<br>71 FR 69054 | 73 FR 4176<br>01/2008 |
| Maui's Dolphin (*Cephalorhynchus hectori maui*) | E – 82 FR 43701 | -- -- | -- -- |
| North Atlantic Right Whale (*Eubalaena glacialis*) | E – 73 FR 12024 | 59 FR 28805 and 81 FR 4837 | 70 FR 32293<br>05/2005 |
| North Pacific Right Whale (*Eubalaena japonica*) | E – 73 FR 12024 | 59 FR 28805 and 73 FR 19000 | 78 FR 34347<br>06/2013 |
| Rice's Whale (*Balaenoptera ricei*) – formerly Gulf of Mexico Bryde's Whale (*Balaenoptera edeni*) | E – 84 FR 15446<br>86 FR 47022 (Taxonomy Revision) | -- -- | 09/2020 (outline) |
| Sei Whale (*Balaenoptera borealis*) | E – 35 FR 18319 | -- -- | 12/2011 |
| South Island Hector's Dolphin (*Cephalorhynchus hectori hectori*) | T – 82 FR 43701 | -- -- | -- -- |
| Southern Right Whale (*Eubalaena australis*) | E – FR Not Available | -- -- | 85 FR 49640<br>03/2021 |
| Sperm Whale (*Physeter macrocephalus*) | E – 35 FR 18319 | -- -- | 75 FR 81584<br>12/2010 |
| Taiwanese Humpback Dolphin (*Sousa chinensis taiwanensis*) | E – 83 FR 21182 | -- -- | -- -- |
| **Marine Mammals – Pinnipeds** | | | |
| Bearded Seal (*Erignathus barbatus*) – Beringia DPS | T – 77 FR 76739 | 86 FR 1433 (Proposed)<br>87 FR 19180 (Final) | -- -- |
| Bearded Seal (*Erignathus barbatus*) –Okhotsk DPS | T – 77 FR 76739 | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Guadalupe Fur Seal (*Arctocephalus townsendi*) | T – 50 FR 51252 | -- -- | -- -- |
| Hawaiian Monk Seal (*Neomonachus schauinslandi*) | E – 41 FR 51611 | 80 FR 50925, 53 FR 18988, and 51 FR 16047 | 72 FR 46966<br>2007 |
| Mediterranean Monk Seal, (*Monachus monachus*) | T – 35 FR 8491 | -- -- | -- -- |
| Ringed Seal (*Phoca hispida hispida*) –Arctic DPS | T – 77 FR 76706 | 86 FR 1452 (Proposed)<br>87 FR 19232 (Final) | -- -- |
| Ringed Seal (*Phoca hispida botnica*) –Baltic DPS | T – 77 FR 76706 | -- -- | -- -- |
| Ringed Seal (*Phoca hispida ladogensis*) – Ladoga DPS | E – 77 FR 76706 | -- -- | -- -- |
| Ringed Seal (*Phoca hispida ochotensis*) – Okhotsk DPS | T – 77 FR 76706 | -- -- | -- -- |
| Ringed Seal, (*Phoca hispida saimensis*) Saimaa | E – 58 FR 26920 | -- -- | -- -- |
| Spotted Seal (*Phoca largha*) – Southern DPS | T – 75 FR 65239 | -- -- | -- -- |
| Steller Sea Lion (*Eumetopias jubatus*) – Western DPS | E – 55 FR 49204 and T – 62 FR 24345 | 58 FR 45269 | 73 FR 11872<br>2008 |
| **Marine Reptiles** | | | |
| Green Turtle (*Chelonia mydas*) – Central North Pacific DPS | T – 81 FR 20057 | -- -- | 63 FR 28359<br>01/1998 |
| Green Turtle (*Chelonia mydas*) – Central South Pacific DPS | E – 81 FR 20057 | -- -- | 63 FR 28359<br>01/1998 |
| Green Turtle (*Chelonia mydas*) – Central West Pacific DPS | E – 81 FR 20057 | -- -- | 63 FR 28359<br>01/1998 |
| Green Turtle (*Chelonia mydas*) – East Indian-West Pacific DPS | T – 81 FR 20057 | -- -- | -- -- |
| Green Turtle (*Chelonia mydas*) – East Pacific DPS | T – 81 FR 20057 | -- -- | 63 FR 28359<br>01/1998 |
| Green Turtle (*Chelonia mydas*) – Mediterranean DPS | E – 81 FR 20057 | -- -- | -- -- |
| Green Turtle (*Chelonia mydas*) – North Atlantic DPS | T – 81 FR 20057 | 63 FR 46693 | 10/1991 |
| Green Turtle (*Chelonia mydas*) – North Indian DPS | T – 81 FR 20057 | -- -- | -- -- |
| Green Turtle (*Chelonia mydas*) – South Atlantic DPS | T – 81 FR 20057 | -- -- | -- -- |
| Green Turtle (*Chelonia mydas*) – Southwest Indian DPA | T – 81 FR 20057 | -- -- | -- -- |
| Green Turtle (*Chelonia mydas*) – Southwest Pacific DPS | T – 81 FR 20057 | -- -- | -- -- |
| Hawksbill Turtle (*Eretmochelys imbricata)* | E – 35 FR 8491 | 63 FR 46693 | 63 FR 28359 and 57 FR 38818 |
| Kemp's Ridley Turtle (*Lepidochelys kempii*) | E – 35 FR 18319 | -- -- | 9/2011 |
| Leatherback Turtle (*Dermochelys coriacea*) | E – 35 FR 8491 | 44 FR 17710 and 77 FR 4170 | 63 FR 28359 and 10/1991 |
| Loggerhead Turtle (*Caretta caretta*) – Mediterranean DPS | E – 76 FR 58868 | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Loggerhead Turtle (*Caretta caretta*) – North Indian Ocean DPS | E – 76 FR 58868 | -- -- | -- -- |
| Loggerhead Turtle (*Caretta caretta*) – North Pacific Ocean DPS | E – 76 FR 58868 | -- -- | 63 FR 28359 |
| Loggerhead Turtle (*Caretta caretta*) – Northeast Atlantic Ocean DPS | E – 76 FR 58868 | -- -- | -- -- |
| Loggerhead Turtle (*Caretta caretta*) – Northwest Atlantic Ocean DPS | T – 76 FR 58868 | 79 FR 39856 | 74 FR 2995 |
| Loggerhead Turtle (*Caretta caretta*) – South Atlantic Ocean DPS | T – 76 FR 58868 | -- -- | -- -- |
| Loggerhead Turtle (*Caretta caretta*) – South Pacific Ocean DPS | E – 76 FR 58868 | -- -- | -- -- |
| Loggerhead Turtle (*Caretta caretta*) – Southeast Indo-Pacific Ocean DPS | T – 76 FR 58868 | -- -- | -- -- |
| Loggerhead Turtle (*Caretta caretta*) – Southwest Indian Ocean DPS | T – 76 FR 58868 | -- -- | -- -- |
| Olive Ridley Turtle (*Lepidochelys olivacea*) All Other Areas | T – 43 FR 32800 | -- -- | -- -- |
| Olive Ridley Turtle (*Lepidochelys olivacea*) Mexico's Pacific Coast Breeding Colonies | E – 43 FR 32800 | -- -- | 63 FR 28359 |
| **Fishes** | | | |
| African coelacanth (*Latimaria chalumnae*) – Tanzanian DPS | T – 81 FR 17398 | -- -- | -- -- |
| Atlantic Salmon (*Salmo salar*) – Gulf of Maine DPS | E – 74 FR 29344 and 65 FR 69459 | 74 FR 29300 | 02/2019 |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Carolina DPS | E – 77 FR 5913 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Chesapeake DPS | E – 77 FR 5879 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – Gulf of Maine DPS | T – 77 FR 5879 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – New York Bight DPS | E – 77 FR 5879 | 82 FR 39160 | -- -- |
| Atlantic Sturgeon (*Acipenser oxyrinchus oxyrinchus*) – South Atlantic DPS | E – 77 FR 5913 | 82 FR 39160 | -- -- |
| Blackchin guitarfish (*Rhinobatos cemiculus*) | T – 82 FR 6309 | -- -- | -- -- |
| Bocaccio (*Sebastes paucispinis*) – Puget Sound/Georgia Basin DPS | E – 75 FR 22276 and 82 FR 7711 | 79 FR 68041 | 81 FR 54556 (Draft) |
| Brazilian guitarfish (*Rhinobatos horkelii*) | E – 82 FR 21722 | -- -- | -- -- |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – California Coastal ESU | T – 70 FR 37160 | 70 FR 52488 | 81 FR 70666 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Central Valley Spring-Run ESU | T – 70 FR 37160 | 70 FR 52488 | 79 FR 42504 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Lower Columbia River ESU | T – 70 FR 37160 | 70 FR 52629 | 78 FR 41911 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Puget Sound ESU | T – 70 FR 37160 | 70 FR 52629 | 72 FR 2493 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Sacramento River Winter-Run ESU | E – 70 FR 37160 | 58 FR 33212 | 79 FR 42504 |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Fall-Run ESU | T – 70 FR 37160 | 58 FR 68543 | 80 FR 67386 (Draft) |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Snake River Spring/Summer Run ESU | T – 70 FR 37160 | 64 FR 57399 | 81 FR 74770 (Draft) 11-2017-Final |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Columbia River Spring-Run ESU | E – 70 FR 37160 | 70 FR 52629 | 72 FR 57303 |
| Chinook Salmon (*Oncorhynchus tshawytscha)* – Upper Willamette River ESU | T – 70 FR 37160 | 70 FR 52629 | 76 FR 52317 |
| Chum Salmon (*Oncorhynchus keta*) –Columbia River ESU | T – 70 FR 37160 | 70 FR 52629 | 78 FR 41911 |
| Chum Salmon (*Oncorhynchus keta*) –Hood Canal Summer-Run ESU | T – 70 FR 37160 | 70 FR 52629 | 72 FR 29121 |
| Coho Salmon (*Oncorhynchus kisutch*) – Central California Coast ESU | E – 70 FR 37160 | 64 FR 24049 | 77 FR 54565 |
| Coho Salmon (*Oncorhynchus kisutch*) –Lower Columbia River ESU | T – 70 FR 37160 | 81 FR 9251 | 78 FR 41911 |
| Coho Salmon (*Oncorhynchus kisutch*) – Oregon Coast ESU | T – 73 FR 7816 | 73 FR 7816 | 81 FR 90780 |
| Coho Salmon (*Oncorhynchus kisutch*) – Southern Oregon and Northern California Coasts ESU | T – 70 FR 37160 | 64 FR 24049 | 79 FR 58750 |
| Common angelshark (*Squatina squatina*) | E – 81 FR 50394 | -- -- | -- -- |
| Common guitarfish (*Rhinobatos rhinobatos*) | T – 82 FR 6309 | -- -- | -- -- |
| Daggernose shark (*Isogomphodon oxyrhynchus*) | E – 82 FR 21722 | -- -- | -- -- |
| Dwarf sawfish (*Pristis clavata*) | E – 79 FR 73977 | -- -- | -- -- |
| Eulachon (*Thaleichthys pacificus*) –Southern DPS | T – 75 FR 13012 | 76 FR 65323 | 9/2017 |
| Giant Manta Ray (*Manta birostris*) | T – 83 FR 2916 | -- -- | -- -- |
| Green sawfish (*Pristis zijsron*) | E – 79 FR 73977 | -- -- | -- -- |
| Green Sturgeon (*Acipenser medirostris*) – Southern DPS | T – 71 FR 17757 | 74 FR 52300 | 8/2018- Final |
| Gulf Grouper (*Mycteroperca jordani*) | E – 81 FR 72545 | -- -- | -- -- |
| Gulf Sturgeon (*Acipenser oxyrinchus desotoi*) | T – 56 FR 49653 | 68 FR 13370 | 09/1995 |
| Island grouper (*Mycteroperca fusca*) | T – 81 FR 72545 | -- -- | -- -- |
| Kaluga sturgeon (*Huso dauricus*) | E – 79 FR 31222 | -- -- | -- -- |
| Largetooth sawfish (*Pristis pristis*) | E – 76 FR 40822 and E - 79 FR 73977 | -- -- | -- -- |
| Narrow sawfish (*Anoxypristis cuspidata*) | E – 79 FR 73977 | -- -- | -- -- |
| Narrownose smoothhound shark (*Mustelus schmitti*) | T – 82 FR 21722 | -- -- | -- -- |
| Nassau Grouper (*Epinephelus striatus*) | T – 81 FR 42268 | 87 FR 62930 (Proposed) | 8/2018- Outline |
| Oceanic Whitetip Shark (*Carcharhinus longimanus*) | T – 83 FR 4153 | -- -- | 9/2018- Outline |
| Sakhalin sturgeon (*Acipenser mikadoi*) | E – 79 FR 31222 | -- -- | -- -- |
| Sawback angelshark (*Squatina aculeata*) | E – 81 FR 50394 | -- -- | -- -- |
| Scalloped Hammerhead Shark (*Sphyrna lewini*) – Central and Southwest Atlantic DPS | T – 79 FR 38213 | -- -- | -- -- |
| Scalloped Hammerhead Shark (*Sphyrna lewini*) – Eastern Atlantic DPS | E – 79 FR 38213 | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| Scalloped Hammerhead Shark (*Sphyrna lewini*) – Eastern Pacific DPS | E – 79 FR 38213 | -- -- | -- -- |
| Scalloped Hammerhead Shark (*Sphyrna lewini*) – Indo-West Pacific DPS | T – 79 FR 38213 | -- -- | -- -- |
| Shortnose Sturgeon (*Acipenser brevirostrum*) | E – 32 FR 4001 | -- -- | 63 FR 69613 |
| Smalltooth Sawfish (*Pristis pectinata*) – Non-U.S. portion of range DPS | E - 79 FR 73977 | -- -- | -- -- |
| Smalltooth Sawfish (*Pristis pectinata*) – U.S. portion of range DPS | E – 68 FR 15674 | 74 FR 45353 | 74 FR 3566 |
| Smoothback angelshark (*Squatina oculata*) | E – 81 FR 50394 | -- -- | -- -- |
| Sockeye Salmon (*Oncorhynchus nerka*) – Ozette Lake ESU | T – 70 FR 37160 | 70 FR 52630 | 74 FR 25706 |
| Sockeye Salmon (*Oncorhynchus nerka*) – Snake River ESU | E – 70 FR 37160 | 58 FR 68543 | 80 FR 32365 |
| Spiny angelshark (*Squatina guggenheim*) | E – 82 FR 21722 | -- -- | -- -- |
| Steelhead Trout (*Oncorhynchus mykiss*) – California Central Valley DPS | T – 71 FR 834 | 70 FR 52487 | 79 FR 42504 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Central California Coast DPS | T – 71 FR 834 | 70 FR 52487 | 81 FR 70666 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Lower Columbia River DPS | T – 71 FR 834 | 70 FR 52629 | 78 FR 41911 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Middle Columbia River DPS | T – 71 FR 834 | 70 FR 52629 | 74 FR 50165 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Northern California DPS | T – 71 FR 834 | 70 FR 52487 | 81 FR 70666 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Puget Sound DPS | T – 72 FR 26722 | 81 FR 9251 | 84 FR 71379 |
| Steelhead Trout, (*Oncorhynchus mykiss*) – Snake River Basin DPS | T – 71 FR 834 | 70 FR 52629 | 11-2017-Final |
| Steelhead Trout (*Oncorhynchus mykiss*) – South-Central California Coast DPS | T – 71 FR 834 | 70 FR 52487 | 78 FR 77430 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Southern California DPS | E – 71 FR 834 | 70 FR 52487 | 77 FR 1669 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Upper Columbia River DPS | T – 71 FR 834 | 70 FR 52629 | 72 FR 57303 |
| Steelhead Trout (*Oncorhynchus mykiss*) – Upper Willamette River DPS | T – 71 FR 834 | 70 FR 52629 | 76 FR 52317 |
| Striped smoothhound shark (*Mustelus fasciatus*) | E – 82 FR 21722 | -- -- | -- -- |
| Yelloweye Rockfish (*Sebastes rubberimus*) – Puget Sound/Georgia Basin DPS | T – 75 FR 22276 and 82 FR 7711 | 79 FR 68041 | 81 FR 54556 (Draft) 10/2017 |
| **Marine Invertebrates** | | | |
| *Acropora globiceps* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| *Acropora jacquelineae* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| *Acropora lokani* coral | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora pharaonis* coral | T – 79 FR 53851 | -- -- | -- -- |

| Species | ESA Status | Critical Habitat | Recovery Plan |
|---|---|---|---|
| *Acropora retusa* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| *Acropora rudis* coral | T – 79 FR 53851 | -- -- | -- -- |
| *Acropora speciosa* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| *Acropora tenella* coral | T – 79 FR 53851 | -- -- | -- -- |
| *Anacropora spinosa* coral | T – 79 FR 53851 | -- -- | -- -- |
| Black abalone (*Haliotis cracherodii*) | E – 74 FR 1937 | 76 FR 66805 | 85 FR 5396 |
| Boulder star coral (*Orbicella franksi*) | T – 79 FR 53851 | 85 FR 76302 (Proposed) | -- -- |
| *Cantharellus noumeae* coral | E – 80 FR 60560 | -- -- | -- -- |
| Chambered nautilus (*Nautilus pompilius*) | T – 83 FR 48976 | -- -- | -- -- |
| Elkhorn coral (*Acropora palmata*) | T – 79 FR 53851 | 73 FR 72210 | 80 FR 12146 |
| *Euphyllia paradivisa* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| *Isopora crateriformis* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| Lobed star coral (*Orbicella annularis*) | T – 79 FR 53851 | 85 FR 76302 (Proposed) | -- -- |
| *Montipora australiensis* coral | T – 79 FR 53851 | -- -- | -- -- |
| Mountainous star coral (*Orbicella faveolata*) | T – 79 FR 53851 | 85 FR 76302 (Proposed) | -- -- |
| *Pavona diffluens* coral | T – 79 FR 53851 | -- -- | -- -- |
| Pillar coral (*Dendrogyra cylindrus*) | T – 79 FR 53851 | 85 FR 76302 (Proposed) | -- -- |
| *Porites napopora* coral | T – 79 FR 53851 | -- -- | -- -- |
| Queen conch (*Alger gigas*) | T – 87 FR 55200 (Proposed) | -- -- | -- -- |
| Rough cactus coral (*Mycetophyllia ferox*) | T – 79 FR 53851 | 85 FR 76302 (Proposed) | -- -- |
| *Seriatopora aculeata* coral | T – 79 FR 53851 | 85 FR 76262 (Proposed) | -- -- |
| Staghorn coral (*Acropora cervicornis*) | T – 79 FR 53851 | 73 FR 72210 | 80 FR 12146 |
| White abalone (*Haliotis sorenseni*) | E – 66 FR 29046 | 66 FR 29046 (Not Prudent) | 73 FR 62257 |

## 5.1 Species and Critical Habitat Not Likely to be Adversely Affected

NMFS uses two criteria to identify the ESA-listed species and designated critical habitat that are not likely to be adversely affected by the proposed action. The first criterion is exposure, or some reasonable expectation of a co-occurrence, between one or more potential stressors associated with the proposed activities and ESA-listed species or designated critical habitat. If we conclude that an ESA-listed species or designated critical habitat is not likely to be exposed to the proposed activities, we must also conclude that the species or designated critical habitat is not likely to be adversely affected by those activities.

The second criterion is the probability of a response given exposure. An ESA-listed species or designated critical habitat that co-occurs with a stressor of the action but is not likely to respond to the stressor is also not likely to be adversely affected by the proposed action.

The probability of an effect on a species or designated critical habitat is a function of exposure intensity and susceptibility of a species to a stressor's effects (i.e., probability of response). An action warrants a "may affect, not likely to be adversely affected" finding when its effects are wholly *beneficial, insignificant* or *discountable*.

*Beneficial* effects have an immediate positive effect without any adverse effects to the species or habitat. *Insignificant* effects relate to the size or severity of the impact and include those effects that are undetectable, not measurable, or so minor that they cannot be meaningfully evaluated. *Discountable* effects are those that are extremely unlikely to occur.

We applied these criteria to the ESA-listed species in Table 4 above. We summarize our results below for ESA-listed species and critical habitat that are not likely to be adversely affected by any stressor created by the proposed action.

### 5.1.1 Endangered Species Act-Listed Sea Turtles

The proposed action overlaps spatially and temporally with the ranges of several ESA-listed sea turtles that may be affected by the proposed action, but are not likely to be adversely affected. These include: green turtles (East Indian-West Pacific, Mediterranean, North Indian, Southwest Indian, and Southwest Pacific DPSs) and loggerhead turtles (Northeast Atlantic Ocean, Mediterranean Sea, North Indian Ocean, South Atlantic Ocean, Southeast Indo-Pacific Ocean, and Southwest Indian Ocean DPSs). Under the MMHSRP, non-target ESA-listed marine sea turtles may occasionally be present in areas with targeted cetaceans. Research and enhancement activities that have the potential to affect sea turtles include aerial (manned and unmanned) surveys, vessel surveys, underwater photography and videography, passive acoustic monitoring, active acoustics, biological sampling, and tagging. Researchers will not purposely approach or pursue ESA-listed sea turtles, if encountered, and will stop research and enhancement activities and move to another area or wait until the animals have left the area if ESA-listed sea turtles are observed. Researchers will constantly be on the lookout for cetaceans and thus be able to spot sea turtles at a distance (approximately 100 to 200 meters (328.1 to 656.2 feet), Epperly et al. 2002), well before they are be expected to respond to aircraft and research vessels (Hazel et al. 2007). Furthermore, if a sea turtle is spotted, normally the researchers will exercise caution and remain a safe distance from the animal(s), as described in the permit applications and conditioned by the permit. Precautionary steps may include stopping research activities, moving to another area (or higher latitude), or waiting until the sea turtle has left the area. In the event a sea turtle is exposed to aerial or vessel surveys, exposure will likely be brief and temporary and result in short-term behavioral reactions, such as swimming away from the aircraft or research vessel, which are not expected to have fitness consequences. However, given the limited overlap between the distribution of the aforementioned ESA-listed turtles and the action area, we believe exposures of these turtles to the above stressors are extrememly unlikely to occur. We therefore believe the effects resulting from the above stressors on the aforementioned ESA-listed sea turtles to be discountable. We conclude that the program and issuance of Permit No. 24359 under the mixed programmatic action are not likely to adversely affect the above ESA-listed sea turtle species.

### 5.1.2 Endangered Species Act-Listed Fishes

The proposed action overlaps spatially and temporally with the ranges of several ESA-listed marine fishes that may be affected by the proposed action, but are not likely to be adversely affected. These include: African coelacanth, Atlantic salmon (Gulf of Maine DPS), bocaccio, blackchin guitarfish, bocaccio (Puget Sound/Georgia Basin DPS), Brazilian guitarfish, Chinook salmon (all ESUs), chum salmon (all ESUs), coho salmon (all ESUs), common angelshark, common guitarfish, daggernose shark, dwarf sawfish, eulachon (Southern DPS), giant manta ray, green sawfish, Gulf grouper, island grouper, Kaluga sturgeon, largetooth sawfish, narrow sawfish, narrownose smoothhound shark, Nassau grouper, oceanic whitetip shark, Sakhalin sturgeon, sawback angelshark, scalloped hammer head shark (Eastern Pacific, Central and Southwest Atlantic, and Indo-West Pacific DPSs), smalltooth sawfish (non-U.S. potion of range DPS), smoothback angelshark, sockeye salmon (all ESUs), spiny angelshark, steelhead trout (all DPSs), striped smoothhound shark, and yelloweye rockfish (Puget Sound/Georgia Basin DPS). Interactions with these fish species during an enhancement activity is not expected to occur because MMHSRP enhancement activities are in response to marine mammals in distress that would not involve fishes (i.e., response would be to a stranded, entangled, sick marine mammal). Baseline health research activities that have potential to interact with these species would include netting of marine mammals. The coastal and marine habitat use of these fishes is expected to be offshore and deeper than where netting activities would occur. If one of these ESA-listed fish species were near a netting activity, we would expect them to evade interactions with MMHSRP personnel and equipment. Therefore, we find that effects on these ESA-listed fishes are extremely unlikely to occur, and thus discountable. We conclude that the issuance of Permit No. 24359 and the implementation of the MMHSRP are not likely to adversely affect the above ESA-listed fish species.

### 5.1.3 Endangered Species Act-Listed Marine Invertebrates

The proposed action overlaps spatially and temporally with the ranges of several ESA-listed invertebrates and one proposed species that may be affected by the proposed action, but are not likely to be adversely affected. These include: *Acropora globiceps* coral, *A. jacquelineae* coral, *A. lokani* coral, *A. pharaonis* coral, *A. retusa* coral, *A. rudis* coral, *A. speciosa* coral, *A. tenella* coral, *Anacropora spinosa* coral, black abalone, boulder star coral, *Cantharellus noumeae* coral, chambered nautilus, elkhorn coral, *Euphyllia paradivisa* coral, *Isopora crateriformis* coral, lobed star coral, *Montipora australiensis* coral, mountainous star coral, *Pavona diffluens* coral, pillar coral, *Porites napopora* coral, queen conch (proposed), rough cactus coral, *Seriatopora aculeata* coral, staghorn coral, and white abalone. Under the MMHSRP, non-target ESA-listed marine invertebrates may occasionally be present with targeted marine mammals. Research and enhancement activities that have the potential to disturb marine invertebrates include vessel surveys, passive acoustic monitoring, and active acoustics. The possibility of these interactions is considered extremely unlikely to occur because the proposed research and enhancement activities are directed at marine mammals at or above the water surface, thus the effects of the proposed action on the benthic habitat where ESA-listed corals may occur, or area of the water column and benthic habitat where mobile species generally occur will be discountable. Researchers will not purposely approach or pursue these ESA-listed and proposed marine invertebrates and, if encountered, will stop research activities and move to another area or wait until the animal(s) have left the area (in the case of mobile species) if any of these ESA-listed or proposed marine invertebrates are observed. In the event a mobile marine invertebrate (i.e., chambered nautilus) is exposed to vessel surveys, passive acoustic monitoring, and active acoustics, exposure will likely be brief and temporary and it is not clear that stressors such as noise affect invertebrate species in a way that would elicit a response. We expect the effects of these stressors will be insignificant.

We believe the potential impacts to ESA-listed and proposed marine invertebrates as a result of the proposed action will be insignificant or discountable. We conclude that the issuance of Permit No. 24359 and the implementation of the MMHSRP are not likely to adversely affect the above ESA-listed marine invertebrate species.

### 5.1.4 Designated and Proposed Critical Habitat

The action area for MMHSRP activities includes proposed or designated critical habitats for multiple species. These include the beluga (Cook Inlet DPS), false killer whale (Main Hawaiian Islands Insular DPS), humpback whale (Central America, Mexico, and Western North Pacific DPSs), North Atlantic right whale, North Pacific right whale, killer whale (Southern Resident DPS), bearded seal (Beringia DPS), Arctic subspecies of ringed seal, Hawaiian monk seal, Steller sea lion (Western DPS), green turtle (North Atlantic DPS), hawksbill turtle, leatherback turtle, loggerhead turtle (Northwest Atlantic Ocean DPS), Atlantic salmon (Gulf of Maine DPS), Atlantic sturgeon (Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic DPSs), bocaccio (Puget Sound/Georgia Basin DPS), eulachon (Southern DPS), green sturgeon (Southern DPS), gulf sturgeon, Nassau grouper, Pacific salmonids and steelhead (all DPSs), smalltooth sawfish (U.S. portion of range), yelloweye rockfish (Puget Sound/Georgia Basin DPS), staghorn coral, elkhorn coral, black abalone, boulder star coral, *Acropora globiceps* coral, *A. jacquelineae* coral, *A. retusa* coral, *A. speciosa* coral, *Euphyllia paradivisa* coral, *Isopora crateriformis* coral, lobed star coral, mountainous star coral, pillar coral, rough cactus coral, and *Seriatopora aculeata* coral. Each critical habitat designation along with the physical and biological features of the species are addressed below and an analysis of the program on those physical and biological features (many overlap or protect similar features) can be found in section 5.1.5.

#### 5.1.4.1 *Beluga Whale – Cook Inlet Distinct Population Segment Critical Habitat*

In 2011, NMFS designated critical habitat for the Cook Inlet DPS of beluga whale (76 FR 20180). Two specific areas were designated comprising 7,809 square kilometers (2,276.7 square nautical miles) of marine habitat. Area 1 encompasses 1,918 square kilometers (559.2 square nautical miles) of Cook Inlet northeast of a line from the mouth of Threemile Creek to Point Possession. This area contains shallow tidal flats, river mouths or estuarine areas and is important as foraging and calving habitats. Area 1 has the highest concentrations of beluga whales in the spring through fall as well as the greatest potential for adverse impact from anthropogenic threats. Area 2 includes near and offshore areas of the mid and upper part of Cook Inlet, and nearshore areas of the lower part of Cook Inlet. Area 2 includes Tuxedni, Chinitna, and Kamishak Bays on the west coast and a portion of Kachemak Bay of the east coast. Dive studies indicate that beluga whales in this area dive to deeper depths and are at the surface less frequently than they are when they inhabit Area 1.

The physical and biological features (formerly called primary constituent elements) essential to the conservation of Cook Inlet DPS of beluga whales found in these areas include: (1) intertidal and subtidal waters of Cook Inlet with depths less than 9.1 meters (30 feet) (mean lower low water) and within 8 kilometers (five miles) of high and medium flow accumulation anadromous fish streams; (2) primary prey species consisting of four species of Pacific salmon (Chinook, coho, sockeye, and chum salmon), Pacific eulachon, Pacific cod, walleye pollock, saffron cod, and yellowfin sole; (3) the absence of toxins or other agents of a type or amount harmful to beluga whales; (4) unrestricted passage within or between the critical habitat areas; and (5) absence of in-water noise at levels resulting in the abandonment of habitat by Cook Inlet DPS of beluga whales (76 FR 20180).

#### 5.1.4.2 *False Killer Whale – Main Hawaiian Islands Insular Distinct Population Segment Critical Habitat*

In 2018 (83 FR 35062), NMFS designated critical habitat for the Main Hawaiian Islands insular DPS of false killer whale, which includes waters from the 45 meter (147.6 feet) to the 3,200 meter (10,498.7 feet) depth contour around the Main Hawaiian Islands from Niihau east to the island of Hawaii. This area designated for critical habitat includes approximately 45,504 square kilometers (13,266.8 square nautical miles) surrounding the Main Hawaiian Islands within the geographical area presently occupied by Main Hawaiian Islands insular DPS of false killer whales. Due to the unique ecology of this island associated population, habitat use is largely driven by depth. Thus, the features essential to the species' conservation are found in those depths that allow the false killer whales to travel throughout a majority of their range seeking food and opportunities to socialize and reproduce. The final rule excludes from the designation particular areas where they overlap with 45 meter (147.6 feet) to the 3,200 meter (10,498.7 feet) depth contour around the Main Hawaiian Islands from Niihau east to the island of Hawaii which include (1) the Bureau of Ocean Energy Management's Call Area offshore of the Island of Oahu (which includes two sites, one off Kaena Point and one off the south shore); (2) the U.S. Navy

Pacific Missile Range Facilities Offshore ranges (including the Shallow Water Training Range, the Barking Sands Tactical Underwater Range, and the Barking Sands Underwater Range Extension (west of Kauai); (3) the U.S. Navy Kingfisher Range (northeast of Niihau); (4) Warning Area 188 (west of Kauai); (5) Kaula Island and Warning Area 187 (surrounding Kaula Island); (6) the U.S. Navy Fleet Operational Readiness Accuracy Check Site (west of Oahu); (7) the U.S. Navy Shipboard Electronic Systems Evaluation Facility (west of Oahu); (8) Warning Areas 196 and 191 (south of Oahu); (9) Warning Areas 193 and 194 (south of Oahu); (10) the Kaulakahi Channel portion of Warning Area 186 (the channel between Niihau and Kauai and extending east); (11) the area north of Molokai; (12) the Alenuihaha Channel; (13) Hawaii Area Tracking System; and (14) the Kahoolawe Training Minefield. In addition, the Ewa Training Minefield and the Naval Defensive Sea Area are precluded from designation under section 4(a)(3) of the ESA because they are managed under the Joint Base Pearl Harbor-Hickam Integrated Natural Resource Management Plan and we find provides a benefit to the Main Hawaiian Islands insular DPS of false killer whale.

The physical and biological features essential for the conservation of the Main Hawaiian Islands insular DPS of false killer whales includes island-associated marine habitat for the Main Hawaiian Islands insular DPS of false killer whales. The following characteristics of this habitat support the Main Hawaiian Islands insular DPS of false killer whales ability to travel, forage, communicate, and move freely around and among the water surrounding the Main Hawaiian Islands: (1) adequate space for movement and use within shelf and slope habitat; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; (3) waters free of pollutants of a type and amount harmful of Main Hawaiian Islands insular DPS of false killer whales; and (4) sound levels that will not significantly impair false killer whales' use or occupancy.

#### 5.1.4.3 *Humpback Whale – Central America, Mexico, and Western North Pacific Distinct Population Segments Critical Habitat*

On April 21, 2021, NMFS designated critical habitat for Central America, Mexico, and Western North Pacific DPS humpback whales (86 FR 21082). These critical habitat designations include the PBF of prey species, defined as "primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth" (84 FR 54354). For the Central America DPS, this designation includes approximately 166,422.4 square kilometers (48,521 square nautical miles) of marine seasonal habitat off the coasts of Washington, Oregon, and California. Mexico DPS critical habitat designation includes 398205 square kilometers (116,098 square nautical miles) of marine seasonal feeding habitat off the coasts of Alaska, Washington, Oregon, and California. Western North Pacific DPS critical habitat designation includes approximately 203,774 square kilometers (59,411 square nautical miles) of marine seasonal feeding habitat off the coast of Alaska.

#### 5.1.4.4 *North Atlantic Right Whale Critical Habitat*

In 1994, NMFS designated critical habitat for the Northern right whale population in the North Atlantic Ocean (59 FR 28805). This critical habitat designation included portions of Cape Cod Bay and Stellwagen Bank, the Great South Channel (each off the coast of Massachusetts), and waters adjacent to the coasts of Georgia and the east coast of Florida. These areas were determined to provide critical feeding, nursery, and calving habitat for the North Atlantic population of northern right whales.

In 2016, NMFS revised designated critical habitat for the North Atlantic right whale with two new expanded areas. The areas designated as critical habitat contains approximately 102,084.2 square kilometers (29,763 square nautical miles) of marine habitat in the Gulf of Maine and Georges Bank region (Unit 1) and off the Southeast U.S. coast (Unit 2).

The physical and biological features essential to the conservation of the North Atlantic right whale, which provide foraging area functions in Unit 1 are a combination of: (1) the physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *Calanus finmarchicus* for North Atlantic right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; (2) low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *Calanus finmarchicus* to aggregate passively below the convective layer so that the copepods are retained in the basins; (3) late stage *Calanus finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and (4) Diapausing *Calanus finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region. The physical and biological features essential to the conservation of North Atlantic right whale calving habitat that are essential to the conservation of the North Atlantic right whale, which provide calving area functions in Unit 2 are: (1) calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface temperatures from a minimum of seven degrees Celsius, and never more than 17 degrees Celsius; and (3) water depths of 6 to 28 meters (19.7 to 91.9 feet) where these features simultaneously co-occur over contiguous areas of at least 792.3 square kilometers (231 square nautical miles) of ocean waters during the months of November through April. When these features are available, they are selected by North Atlantic right whale cows and calves in dynamic combinations that are suitable for calving nursing, and rearing, and which vary, within the ranges specified, depending on factors such as weather and age of the calves (81 FR 4838).

#### 5.1.4.5 *North Pacific Right Whale Critical Habitat*

In 2008, NMFS designated critical habitat for the North Pacific right whale, which includes an area in the Southeast Bering Sea and an area south of Kodiak Island in the Gulf of Alaska. Designated critical habitat for the North Pacific right whale is influenced by large eddies, submarine canyons, or frontal zones which enhance nutrient exchange and act to concentrate prey. North Pacific right whale designated critical habitat is adjacent to major ocean currents and characterized by relatively low circulation and water movement.

The designated critical habitat supports feeding by North Pacific right whales because they contain specific physical and biological features that include: nutrients, physical oceanography processes, certain species of zooplankton (copepods), and a long photoperiod due to the high latitude (73 FR 19000).

### 5.1.4.6 *Killer Whale – Southern Resident Distinct Population Segment Critical Habitat*

In 2006, NMFS designated critical habitat for the Southern Resident DPS of killer whale (71 FR 69054). This includes three specific areas in Washington: (1) the Summer Core Area in Haro Strait and waters around the San Juan Islands; (2) Puget Sound; and (3) the Strait of Juan de Fuca, which comprise approximately 6,630 square kilometers (1,933 square nautical miles) of marine habitat.

On August 2, 2021, NMFS revised the critical habitat designation for Southern Resident killer whales by expanding it to include six new areas along the U.S. West Coast (86 FR 41668), while keeping the current designated critical habitat area in Washington. The proposed new areas along the U.S. West Coast include roughly 16,167 square miles (41,873.8 square kilometers) of marine waters between the 20 foot (6.1 meter) depth contour and the 652.2 feet (200 meter) depth contour from the U.S. international border with Canada south to Point Sur, California.

The physical and biological features essential to the conservation of Southern Resident DPS of killer whales includes: (1) water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) inter-area passage conditions to allow for migration, resting, and foraging.

### 5.1.4.7 *Bearded Seal – Beringia Distinct Population Segment Designated Critical Habitat*

NMFS designated critical habitat for the Beringia DPS of bearded seal in 2022 (87 FR 19180). This includes marine waters in the Bering, Chukchi, and Beaufort Seas extending from the Alaskan shoreward boundary to a maximum water depth of 200 meters (656 feet) within the U.S. EEZ. This shoreward boundary follows the 20-meter (65.6 feet) isobath westward from the eastern limit of the U.S. EEZ in the Beaufort Sea and continuing into the northeastern Chukchi Sea to its intersection with latitude 70°36′ N south of Wainwright; then follows the 10-meter (32.8 feet) isobath to its intersection with latitude 65°35′ N near Cape Prince of Wales; then follows the 5-meter (16.4 feet) isobath to its intersection with longitude 164°46′ W near the mouth of the Kolovinerak River in the Bering Sea, except at Port Clarence Bay where the shoreward boundary is defined as a continuous line across the entrance. The eastern boundary in the Beaufort Sea follows the eastern limit of the U.S. EEZ beginning at the nearshore boundary defined by the 20-meter (65.6 feet) isobath, extends offshore to the 200-meter (656 feet) isobath, and then follows this isobath generally westward and northwestward to its intersection with the seaward limit of the U.S EEZ in the Chukchi Sea. The boundary then follows the limit of the U.S. EEZ southwestward and south to the intersection of the southern boundary of the critical habitat in the Bering Sea at 60°32′26″ N/179°9′53″ W. The southern boundary extends southeastward from this intersection point to 57°58′ N/170°25′ W, then eastward to 58°29′ N/164°46′ W, then follows longitude 164°46′ W to its intersection with the nearshore boundary defined by the 5-meter (16.4 feet) isobath near the mouth of the Kolovinerak River. This includes waters off the coasts of the Bethel, Kusilvak, and Nome Census Areas, and the Northwest Arctic and North Slope Boroughs, Alaska.

The essential features of bearded seal Beringia DPS critical habitat include: 1) sea ice habitat suitable for whelping and nursing, defined as areas with waters 200 meters or less in depth containing pack ice of at least 25 percent concentration and providing bearded seals access to those waters from the ice; 2) sea ice habitat suitable as a platform for molting, defined as areas with waters 200 meters or less in depth containing pack ice of at least 15 percent concentration and providing bearded seals access to those waters from the ice; and 3) primary prey resources to support bearded seals: waters 200 meters or less in depth containing benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes.

#### 5.1.4.8 *Ringed Seal – Arctic Subspecies Designated Critical Habitat*

NMFS designated critical habitat for the Arctic subspecies of ringed seal in 2022 (87 FR 19232). This includes one specific area in the Bering, Chukchi, and Beaufort seas, extending from the nearshore boundary, defined by the 3-meter (9.8 feet) isobath, to an offshore limit within the U.S. EEZ. The boundary extends offshore from the northern limit of the United States-Canada border approximately 90 kilometers (55.9 miles) to 70°26′19″ N/ 140°11′21″ W, and from this point runs generally westward along the line connecting the following points: 70°55′35″ N/142°33′51″ W, 70°53′25″ N/ 144°37′19″ W, 71°1′22″ N/146°36′55″ W, 71°17′21″ N/148°34′58″ W, and 71°20′8″ N/150° W. From this point (71°20′8″ N/ 150° W) the boundary follows longitude 150° W northward to 72°20′4″ N/150° W, then extends westward to 72°20′4″ N/153° W, then follows longitude 153° W northward to the seaward limit of the U.S. EEZ, and then follows the limit of the U.S. EEZ northwestward; then southwestward and south to the intersection of the southern boundary of the critical habitat in the Bering Sea at 61°18′15″ N/177°45′56″ W. The southern boundary extends southeastward from this intersection point to 60°7″ N/172°1″ W, then northeastward along a line extending to near Cape Romanzof at 61°48′42″ N/ 166°6′5″ W, with the nearshore boundary defined by the 3-meter (9.8 feet) isobath. This includes waters off the coasts of the Kusilvak, and Nome Census Areas, and the Northwest Arctic and North Slope Boroughs, Alaska.

Essential features of this critical habitat include: 1) snow-covered sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing, which is defined as waters 3 meters (9.8 feet) or more in depth containing areas of seasonal landfast (shorefast) ice or dense, stable pack ice, that have undergone deformation and contain snowdrifts of sufficient depth to form and maintain birth lairs (typically at least 54 centimeters (21.3 inches) deep); 2) sea ice habitat suitable as a platform for basking and molting, which is defined as areas containing sea ice of 15 percent or more concentration in waters 3 meters (9.8 feet) or more in depth; and 3) primary prey resources to support Arctic ringed seals, which are defined to be small, often schooling, fishes, in particular, Arctic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), and rainbow smelt (*Osmerus dentex*); and small crustaceans, in particular, shrimps and amphipods.

#### 5.1.4.9 *Hawaiian Monk Seal Designated Critical Habitat*

In 1986, NMFS originally designated critical habitat for the Hawaiian monk seal (51 FR 16047) and was extended on May 26, 1988. It includes all beach areas, sand spits, and islets (including all beach crest vegetation to its deepest extent inland), lagoon waters, inner reef waters, and ocean waters out to a depth of 37 meters (121.4 feet) around the northwestern Hawaiian Islands breeding atolls and islands. The marine component of this habitat serves as foraging areas, while terrestrial habitat provides resting, pupping, and nursing habitat.

In 2015, NMFS published a final rule to revise designated critical habitat for Hawaiian monk seals (80 FR 50925), extending the current designation in the northwestern Hawaiian Islands out to the 200 meter (656.2 feet) depth contour (including Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, Maro Reef, Gardner Pinnacles, French Frigate Shoals, Necker Island, and Nihoa Island). It also designated six new areas in the Main Hawaiian Islands (i.e., terrestrial and marine habitat from 5 meters [15.4 feet] inland from the shoreline extending seaward to the 200 meter [656.2 feet] depth contour around Kaula, Niihau, Kauai, Oahu, Maui, Nui, and Hawaii).

The physical and biological features identified for this area include adequate prey quality and quantity for juvenile and adult Hawaiian monk seal foraging (80 FR 50925).

#### 5.1.4.10 *Steller Sea Lion – Western Distinct Population Segment Designated Critical Habitat*

In 1997, NMFS designated critical habitat for the Steller sea lion (58 FR 45269), which remains in effect for the Western DPS despite the Eastern DPS being delisted in 2013 (78 FR 66139). The designated critical habitat includes specific rookeries, haul-outs, and associated areas, as well as three marine foraging areas that are considered to be essential for health, continued survival, and recovery of the species. In Alaska, areas include major Steller sea lion rookeries, haul-outs and associated terrestrial, air, and aquatic zones. The aquatic zones extend 0.9 kilometers (0.5 nautical miles) seaward from the major rookeries and haul-outs east of 144° West. In addition, NMFS designated special aquatic foraging areas as critical habitat for the Steller sea lion. These areas include the Shelikoff Strait (in the Gulf of Alaska), Bogoslof Island, and Seaguam Pass (the latter two are in the Aleutian Islands). These sites are located near Steller sea lion abundance centers and include important foraging areas, large concentrations of prey, and host large commercial fisheries that often interact with the species.

The physical and biological features identified for the aquatic areas of Steller sea lion designated critical habitat that occur within the action area are those that support foraging, such as adequate prey resources and available foraging habitat (58 FR 45269). While Steller sea lions do rest in aquatic habitat, there was insufficient information available at the time critical habitat was designated to include aquatic resting sites as part of the critical habitat designation (58 FR 45269).

#### 5.1.4.11 *Green Turtle – North Atlantic Distinct Population Segment Designated Critical Habitat*

In 1998, NMFS designated critical habitat for green turtles, which include coastal waters surrounding Culebra Island, Puerto Rico. Seagrass beds surrounding Culebra provide important foraging resources for juvenile, sub-adult, and adult green turtles. Additionally, coral reefs surrounding the island provide resting shelter and protection from predators. This area provides important developmental habitat for the species. Activities that may affect the critical habitat include beach renourishment, dredge and fill activities, coastal construction, and freshwater discharge. Due to its location, this critical habitat would be accessible by individuals of the North Atlantic DPS.

#### 5.1.4.12 *Hawksbill Turtle Designated Critical Habitat*

In 1998, NMFS established critical habitat for hawksbill turtles around Mona and Monito Islands, Puerto Rico. Aspects of these areas that are important for hawksbill turtle survival and recovery include important natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill turtle prey.

#### 5.1.4.13 *Leatherback Turtle Designated Critical Habitat*

In 1979, leatherback critical habitat was identified adjacent to Sandy Point, St. Croix, Virgin Islands from the 183 meter (600 feet) isobath to mean high tide level between 17° 42’ 12” North and 65° 50’ 00” West. This habitat is essential for nesting, which has been increasingly threatened since 1979, when tourism increased significantly, bringing nesting habitat and people into close and frequent proximity. The designated critical habitat is within the Sandy Point National Wildlife Refuge. Leatherback turtle nesting increased at an annual rate of thirteen percent from 1994 through 2001; this rate has slowed according to nesting data from 2001 through 2010 (NMFS 2013h).

In 2012, NMFS revised designated critical habitat for the leatherback turtle by designating additional areas within the Pacific Ocean. This designation includes approximately 43,798 square kilometers (16,910 square miles) stretching along the California coast from Point Arena to Point Arguello east of the 3,000 meter (9,842.4 feet) depth contour; and 64,760 square kilometers (25,004 square miles) stretching from Cape Flattery, Washington to Cape Blanco, Oregon east of the 2,000 meter (6,561.7 feet) depth contour. The designated areas comprise approximately 108,558 square kilometers (41,914 square miles) of marine habitat and include waters from the ocean surface down to a maximum depth of 80 meters (262 feet).

NMFS has identified one physical and biological feature for the conservation of leatherback turtles in marine waters off the U.S. West Coast that includes the occurrence of prey species, primarily scyphomedusae (i.e., jellyfish) of the order Semaeostomeae (e.g., *Chrysaora*, *Aurelia*, *Phacellophora*, and *Cyanea*), of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development of leatherback turtles (77 FR 4170).

#### 5.1.4.14 *Loggerhead Turtle – Northwest Atlantic Ocean Distinct Population Segment Designated Critical Habitat*

In 2014, NMFS and the U.S. Fish and Wildlife Service designated critical habitat for the Northwest Atlantic Ocean DPS of loggerhead turtle along the U.S. Atlantic and Gulf of Mexico coasts, from North Carolina to Mississippi (79 FR 39856). The final rule designated five different units of critical habitat, each supporting an essential biological function of loggerhead turtles. These units include nearshore reproductive habitat, winter area, *Sargassum*, breeding areas, and migratory corridors. In total, the critical habitat is composed of 38 occupied marine areas and 1,102.4 kilometers (685 miles) of nesting beaches. Loggerhead designated critical habitat occurs within the action area and the potential effects to each unit and its physical and biological features are discussed below (Table 5).

**Table 5. Essential physical and biological features for loggerhead turtle designated critical habitat units.**

| Loggerhead Turtle Designated Critical Habitat Unit | Essential Physical or Biological Features |
|---|---|
| Nearshore Reproductive Habitat | 1. Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 C.F.R. 17.95(c) to 1.6 kilometers (0.9 nautical miles) offshore.<br>2. Waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water.<br>3. Waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emergent offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents. |
| Winter Habitat | 1. Water temperatures above 10° Celsius from November through April.<br>2. Continental shelf waters in proximity to the western boundary of the Gulf Stream.<br>3. Water depths between 20 and 100 meters (65.6 to 328.1 feet). |
| Breeding Habitat | 1. High densities of reproductive male and female loggerheads.<br>2. Proximity to primary Florida migratory corridor. |

| | |
|---|---|
| | 3. Proximity to Florida nesting grounds. |
| Migratory Habitat | 1. Constricted continental shelf area relative to nearby continental shelf waters but concentrate migratory pathways.<br>2. Passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas. |
| *Sargassum* Habitat | 1. Convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerhead turtles.<br>2. *Sargassum* in concentrations that support adequate prey abundance and cover.<br>3. Available prey and other material associated with *Sargassum* habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods.<br>4. Sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatchling loggerhead turtles, i.e., greater than 10 meters (32.8 feet) depth. |

### *Nearshore Reproductive Habitat*

Nearshore reproductive habitat is a portion of the nearshore waters adjacent to nesting beaches that are used by hatchlings to egress to the open-water environment as well as by nesting females to transit between beach and open water during nesting season. Nearshore reproductive habitat units occur in 35 areas from North Carolina to Mississippi. These units extend from the shore to 1.6 kilometer (0.9 nautical mile) seaward. The physical and biological features for nearshore reproductive habitat are shown in Table 5.

### *Winter Habitat*

Winter habitat is designated off North Carolina from the 20 to 100 meter (65.6 to 328.1 feet) depth contour. Winter habitat is warm water habitat south of Cape Hatteras near the western edge of the Gulf Stream used by a high concentration of juveniles and adults during the winter months. The purpose in the designated winter habitat was to maintain habitat with suitable water temperatures and depths, and continental shelf waters in proximity to the Gulf Stream to support a loggerhead turtle foraging area (Table 5). The physical and biological features for winter habitat are shown in Table 5.

***Constricted Migratory Habitat***

Constricted migratory habitat is high use migratory corridors that are constricted (limited in width) by land on one side and the edge of the continental shelf and Gulf Stream on the other side. Loggerhead turtles migrate through this area northward in the spring (to foraging areas in the Mid-Atlantic Bight) and southward in the fall (south of Cape Hatteras) to be in warmer waters (78 FR 43005). The physical and biological features for constricted migratory habitat are shown in Table 5.

***Breeding Habitat***

Breeding habitat is sites with high densities of both male and female adult individuals during the breeding season. Loggerhead turtle breeding critical habitat includes two areas along the Atlantic Ocean coast of Florida, and into the Florida Keys. The southern unit starts at the Martin County/Palm Beach County line and extends south to the Marquesas Keys. The northern portion of the breeding habitat unit is located from near Titusville, Florida, south to Floridana Beach, from the shoreline to depths less than 60 meters (196.9 feet). The physical and biological features for breeding habitat are shown in Table 5.

***Sargassum Habitat***

*Sargassum* habitat is developmental and foraging habitat for young loggerhead turtles where surface waters form accumulations of floating material, especially Sargassum. The physical and biological features for *Sargassum* habitat are shown in Table 5.

#### 5.1.4.15 *Atlantic Salmon – Gulf of Maine Distinct Population Segment Designated Critical Habitat*

In 2009, NMFS and the U.S. Fish and Wildlife Service designated critical habitat for Atlantic salmon (74 FR 29300). The critical habitat includes all anadromous Atlantic salmon streams whose freshwater range occurs in watersheds from the Androscoggin River northward along the Maine coast northeastward to the Denny River, and wherever these fish occur in the estuarine and marine environment.

Essential physical and biological features were identified within freshwater and estuarine habitats of the occupied range of the Gulf of Maine DPS of Atlantic salmon and include sites for spawning and incubation, juvenile rearing, and migration. The final rule also identified three salmon habitat recovery units to identify geographic and population-level factors to aid in managing the habitat: Merrymeeting Bay, Penobscot, and Downeast. Critical habitat and essential physical and biological features were not designated within marine environments because of the limited knowledge of these elements that the species uses during the marine phase of its life.

#### 5.1.4.16 *Atlantic Sturgeon - Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic Distinct Population Segments Designated Critical Habitat*

In 2017, NMFS designated critical habitat for all five DPSs (Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic) of Atlantic sturgeon in 31 rivers from Maine through Florida. The essential physical or biological features identified for Atlantic sturgeon critical habitat pertain to the features that promote larval, juvenile, and sub-adult growth and development, foraging habitat, water conditions suitable for adult spawning, and an absence of physical barriers (e.g., dams) (Table 6).

**Table 6. Essential physical and biological features from Maine to Florida for five distinct population segments of Atlantic sturgeon.**

| Atlantic Sturgeon Distinct Population Segment | Physical or Biological Features |
|---|---|
| Gulf of Maine<br>New York Bight<br>Chesapeake Bay | Hard bottom substrate (e.g. rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 parts per thousand range) for settlement of fertilized eggs, refuge, growth, and development of early life stages. |
| Gulf of Maine<br>New York Bight<br>Chesapeake Bay | Aquatic habitat with a gradual downstream salinity gradient of 0.5 to 30 parts per thousand and soft substrate (e.g., sand, mud) downstream of spawning sites for juvenile foraging and physiological development. |
| Gulf of Maine<br>New York Bight<br>Chesapeake Bay | Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:<br>1. Unimpeded movement of adults to and from spawning sites;<br>2. Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and<br>3. Staging, resting, or holding of subadults or spawning condition adults<br>Water depths in main river channels must also be deep enough (e.g., greater than or equal to 1.2 meters [3.94 feet]) to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river. |
| Gulf of Maine<br>New York Bight<br>Chesapeake Bay | Water, especially in the bottom meter of the water column, with the temperature, salinity, and oxygen values that, combined, support:<br>1. Spawning;<br>2. Annual and interannual adult, subadult, larval, and juvenile survival; and<br>3. Larval, juvenile, and subadult growth, development, and recruitment (e.g., 13º Celsius to 26º Celsius for spawning habitat and no more than 30º Celsius for juvenile rearing habitat, and 6 mg/L dissolved oxygen for juvenile rearing habitat). |
| Carolina<br>South Atlantic | Suitable hard bottom substrate (e.g., rock, cobble, gravel, limestone, boulder, etc.) in low salinity waters (i.e., 0.0 to 0.5 ppt range) for settlement of fertilized eggs and refuge, growth, and development of early life stages. |
| Carolina<br>South Atlantic | Transitional salinity zones inclusive of waters with a gradual downstream gradient of 0.5 to 30 ppt and soft substrate (e.g., sand, mud) downstream of spawning sites for juvenile foraging and physiological development. |

| | |
|---|---|
| Carolina<br>South Atlantic | Water of appropriate depth and absent physical barriers to passage (e.g., locks, dams, reservoirs, gear, etc.) between the river mouth and spawning sites necessary to support:<br>1. Unimpeded movement of adults to and from spawning sites;<br>2. Seasonal and physiologically dependent movement of juvenile Atlantic sturgeon to appropriate salinity zones within the river estuary; and<br>3. Staging, resting, or holding of subadults and spawning condition adults.<br>Water depths in main river channels must be deep enough to ensure continuous flow in the main channel at all times when any sturgeon life stage would be in the river. Water depths of at least 1.2 meters (3.94 feet) are generally deep enough to facilitate effective adult migration and spawning behavior. |
| Carolina<br>South Atlantic | Water quality conditions, especially in the bottom meter of the water column, with temperature and oxygen values that support:<br>1. Spawning;<br>2. Annual and inter-annual adult, subadult, larval, and juvenile survival; and<br>3. Larval, juvenile, and subadult growth, development, and recruitment.<br>Appropriate temperature and oxygen values will vary interdependently, and depending on salinity in a particular habitat. For example, 6.0 mg/L D.O. for juvenile rearing habitat is considered optimal, whereas D.O. less than 5.0 mg/L for longer than 30 days is considered suboptimal when water temperature is greater than 25º Celsius. In temperatures greater than 26º Celsius, D.O. greater than 4.3 mg/L is needed to protect survival and growth. Temperatures of 13º Celsius to 26º Celsius for spawning habitat are considered optimal. |

ppt=parts per thousand
mg=milligram
L=liter

#### 5.1.4.17 *Rockfish – Bocaccio and Yelloweye Rockfish – Puget Sound/Georgia Basin Distinct Population Segment Designated Critical Habitat*

In 2014, NMFS designated critical habitat for the Puget Sound/Georgia Basin DPS of bocaccio, canary rockfish, and yelloweye rockfish (79 FR 68041). The critical habitat designation was updated in 2017 when canary rockfish were delisted (82 FR 7711). The specific areas designated for bocaccio include approximately 3,068.5 square kilometers (1,184.75 square miles) of marine habitat in Puget Sound, Washington. Designated habitat was divided into two units – nearshore, to support juveniles, and deeper, rocky habitat for adults.

Physical and biological features essential for adult boccacio and yelloweye rockfish (greater than 30 meters (98.4 feet) deep) include sufficient prey resources, water quality, and rocks or highly rugose habitat. For juvenile boccacio and yelloweye rockfish, physical and biological features essential for their conservation include sufficient prey resources and water quality.

#### 5.1.4.18 *Eulachon – Southern Distinct Population Segment Designated Critical Habitat*

In 2011, NMFS designated critical habitat (76 FR 65324). Sixteen areas were designated in the states of Washington, Oregon, and California. These areas include: the Mad River, California;

Redwood Creek, California, Klamath River, California; Umpqua River/Winchester Bay, Oregon; Tenmile Creek, Oregon; Sandy River, Oregon; Lower Columba River, Oregon and Washington; Grays River, Washington; Skamokawa Creek, Washington; Elochoman River, Washington; Cowlitz River, Washington; Toutle River, Washington; Kalama River, Washington; Lewis River, Washington; Quinault River, Washington; and the Elwha River, Washington. The designated areas are a combination of freshwater creeks and rivers and their associated estuaries, comprising approximately 539 kilometers (335 miles) of habitat.

The physical or biological features essential to the conservation of the DPS include:

- Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles.
- Freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and with abundant prey items supporting larval feeding after the yok sac is depleted.

Nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival.

#### 5.1.4.19 *Green Sturgeon – Southern Distinct Population Segment Designated Critical Habitat*

In 2009, NMFS designated critical habitat for the Southern DPS of green sturgeon. Specific areas include coastal U.S. marine waters within 109.7 meters (359.9 feet) depth from Monterey Bay, California (including Monterey Bay), north to Cape Flattery, Washington, including the Strait of Juan de Fuca, Washington, to its U.S. boundary; the Sacramento River, lower Feather River, and lower Yuba River in California; the Sacramento-San Joaquin Delta and Suisun, San Pablo, and San Francisco bays in California; the lower Columbia River estuary; and certain coastal bays and estuaries in California (Humboldt Bay), Oregon (Coos Bay, Winchester Bay, Yaquina Bay, and Nehalem Bay), and Washington (Willapa Bay and Grays Harbor). NMFS designated approximately 515 kilometers (320 miles) of freshwater river habitat, 2,323 square kilometers (11,421 square miles) of marine habitat, 784 kilometers (487 miles) of habitat within the Yolo and Sutter bypasses (Sacramento River, California) as critical habitat for Southern DPS of green sturgeon.

The physical and biological features essential for Southern DPS of green sturgeon include freshwater riverine systems, estuarine habitats, and nearshore coastal marine areas that provide sufficient food resources, substrate type suitable for egg deposition, and development, water flow, water quality, migratory corridors, depth (greater than or equal to 5 meters [16.4 feet]), and sediment quality.

#### 5.1.4.20 *Gulf Sturgeon Designated Critical Habitat*

In 2003, NMFS designated critical habitat for Gulf sturgeon (68 FR 13370) and consists of 14 geographic units encompassing 2,783 river kilometers (1,502.7 nautical miles) as well as 6,042 square kilometers (3,262.4 nautical miles) of estuarine and marine habitat.

Potential biological features considered essential for the conservation of Gulf sturgeon are abundant food items, riverine spawning sites with substrates suitable for egg deposition and development, riverine aggregation areas, a flow regime necessary for normal behavior, growth, and survival, water and sediment quality necessary for normal behavior, growth, and viability of all life stages, and safe and unobstructed migratory pathways.

#### 5.1.4.21 *Nassau Grouper Proposed Critical Habitat*

In 2022, NMFS proposed designating critical habitat for Nassau grouper (87 FR 62930) and consists of approximately 2,353.19 square km (908.57 square miles) of aquatic habitat located off the coasts of southeastern Florida, Puerto Rico, Navassa, and the United States Virgin Islands.

Potential biological features considered essential for the conservation of Nassau grouper are: areas from nearshore to offshore necessary for recruitment, development, and growth of Nassau grouper containing a variety of benthic types that provide cover from predators and habitat for prey; and marine sites used for spawning and adjacent waters that support movement and staging associated with spawning.

#### 5.1.4.22 *Pacific Salmonid and Steelhead Designated Critical Habitat*

There are six species of Pacific salmon and steelhead comprising several ESUs and DPSs (n=28) that have designated critical habitat within Washington, Oregon, and California (Table 4). However, with the exception of a few species and select ESUs and DPSs, critical habitat is focused on the freshwater and estuarine areas required for growth, reproduction, and feeding.

The designated critical habitat for all Pacific salmon species includes locations and physical and biological features necessary to support one or more life stages. These areas are important for the species' overall conservation by protecting quality growth, reproduction, and feeding. The physical and biological features essential to Pacific salmon critical habitat include:

- Freshwater spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;

- Freshwater rearing sites with (1) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility, (2) water quality and forage that support juvenile development, and (3) natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks;

- Freshwater migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival;

- Estuarine areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation;

- Nearshore marine areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels; and

Offshore marine areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation.

#### 5.1.4.23 *Smalltooth Sawfish – U.S. Portion of Range Designated Critical Habitat*

Critical habitat for smalltooth sawfish was designated in 2009 and includes two major units: Charlotte Harbor (221,459 acres) and Ten Thousand Islands/Everglades (619,013 acres). These two units include essential sawfish nursery areas. Within the nursery areas, two features were identified as essential to the conservation of the species: red mangroves (*Rhizophora mangle*), and euryhaline habitats with water depths less than or equal to 0.9 meters (2.96 feet).

#### 5.1.4.24 *Elkhorn and Staghorn Coral Designated Critical Habitat*

Critical habitat units for elkhorn and staghorn coral were designated in 2008 and include Florida (portions of Southeastern Florida and the Florida Keys), Puerto Rico, St. Thomas/St. John, and St. Croix. The Florida unit comprises approximately 3,442.1 square kilometers (1,329 square miles) of marine habitat; Puerto Rico approximately 215 square kilometers (1,383 square miles); St. Thomas/St. John approximately 313 square kilometers (121 square miles); and St. Croix approximately 326.3 square kilometers (126 square miles). Thus, the total area covered by the designation is approximately 7,663.8 square kilometers (2,959 square miles).

Within the geographic area occupied by these two listed species, critical habitat consists of specific areas on which are found those physical or biological features essential to the conservation of each species. The feature essential to the conservation of acroporid corals is substrate of suitable quality and availability in water depths from the mean high water line to 30 meters (28.4 feet) to allow for successful sexual and asexual reproduction. Successful sexual and asexual reproduction includes flourishing larval settlement, recruitment, and reattachment of coral fragments (73 FR 72210). "Substrate of suitable quality and availability" means consolidated hard bottom or dead coral skeletons free from fleshy macroalgae or turf algae and sediment cover.

#### 5.1.4.25 *Black Abalone Designated Critical Habitat*

In 2011, NMFS designated critical habitat for black abalone. This includes rocky areas from mean high water to six meters (19.7 feet) water depth in the Farallon, Channel, and Año Nuevo islands, as well as the California coastline from Del Mar Ecological Reserve south to Government Point (excluding some stretches, such as in Monterey Bay and between Cayucos and Montaña de Oros State Park) in northern and central California and between the Palos Verdes and Torrance border south to Los Angeles Harbor.

These areas include primary biological features required by black abalone, such as rocky substrates to cling to, nourishment resources (bacterial and diatom films, crustose coralline algae, and a source of detrital macroalgae), juvenile settlement habitat (rocky intertidal habitat containing crustose coralline algae and crevices or cryptic biogenic structures (e.g., urchins, mussels, chiton holes, conspecifics, anemones)), suitable water quality (temperature, salinity, pH, and other chemical characteristics necessary for normal settlement, growth, behavior, and viability of black abalone), and suitable nearshore circulation patterns (where sperm, eggs, and larvae are retained in the nearshore environment).

#### 5.1.4.26 *Atlantic/Caribbean Coral Proposed Critical Habitat*

In 2020, 28 mostly overlapping specific occupied areas containing PBFs essential to the conservation of five species of ESA-listed corals (lobed star coral, mountainous star coral, boulder star coral, pillar coral, and rough cactus coral) were proposed to be designated as critical habitat. These areas contain approximately 15,000 $km^2$ (4,373.3 square nautical miles [$nm^2$]) of marine habitat. The proposed critical habitat boundaries are described in Table 8, which includes the locations of the critical habitat units for the five species of Atlantic/Caribbean corals. Depth contours or other identified boundaries form the boundaries of the critical habitat units. Specifically, the Convention on the International Regulations for Preventing Collisions at Sea (COLREGS, 1972) Demarcation Lines (33 C.F.R. 80), the boundary between the SAFMC and Gulf Council (50 C.F.R. 600.105), the FKNMS boundary (15 C.F.R. Part 922 Subpart P, Appendix I), and the Caribbean Islands Management Area (50 C.F.R. Part 622, Appendix E) create portions of the boundaries in several of the proposed critical habitat units.

Within the geographic area occupied by these five ESA-listed coral species, proposed critical habitat consists of specific areas where the PBFs essential to the conservation of each species are found. The PBF essential to the conservation of these five ESA-listed corals (lobed star coral, mountainous star coral, boulder star coral, pillar coral, and rough cactus coral) is reproductive, recruitment, growth, and maturation habitat found in the Caribbean, Florida, and Gulf of Mexico. Sites that support the normal function of all life stages of these five threatened coral species are natural, consolidated hard substrate or dead coral skeleton, which is free of algae and sediment at the appropriate scale at the point of larval settlement or fragment reattachment, and the associated water column. Several attributes of these sites determine the quality of the area and influence the value of the associated feature to the conservation of the species:

1. Substrate with the presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or the presence of crustose coralline algae;
2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae;
3. Marine water with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function; and
4. Marine water with levels of anthropogenically-introduced (from humans) chemical contaminants that do not preclude or inhibit any demographic function.

Naval Air Station Key West, which includes the land and waters (generally out to 45.7 m (50 yards) adjacent to the base for a total of approximately 800 in-water acres is excluded from the proposed critical habitat designation. The Integrated Natural Resources Management Plan (INRMP) for the base was determined by NMFS to provide a benefit to the four threatened coral species (pillar coral, lobed star, mountainous star, and boulder star) found within the in-water area of the base.

#### 5.1.4.27 *Indo-Pacific Coral Proposed Critical Habitat*

Reef-building corals, including the seven listed Indo-Pacific species that can be found in U.S. waters in the action area, have specific habitat requirements including hard substrate, narrow mean temperature range, adequate light, and adequate water flow, among others. These habitat requirements are most commonly found in shallow tropical and subtropical coral reef ecosystems, but can also be found in non-reef and mesophotic areas (NMFS 2019g). Since the publication of the final listing rule in 2014, new information has become available regarding locations where different listed coral species are found in U.S. waters and their depth distributions. Therefore, in the proposed critical habitat rule published in November 2020, NMFS considers the rangewide depth distributions to be: 0 to 20 meters (0 to 66 feet) for *Acropora globiceps*; 10 to 35 meters (33 to 115 feet) for *Acropora jacquelineae*; 0 to 10 meters (0 to 33 feet) for *Acropora retusa*; 12 to 40 meters (39 to 131 feet) for *Acropora speciosa*; 2 to 40 meters (6.5 to 131 feet) for *Euphyllia paradivisa*; 0 to 12 meters (0 to 39 feet) for *Isopora crateriformis*; and 3 to 40 meters (10-131 feet) for *Seriatopora aculeata*. Based on these depth distributions, in 2020, NMFS determined there are 19 specific occupied areas containing PBFs essential to the conservation of these corals in U.S. waters in the Indo-Pacific region. Of these, 17 were proposed to be designated as critical habitat for the seven coral species, although the most recent information from surveys indicates that two of these species may no longer occur in U.S. waters (Smith 2021). Two of the specific occupied areas were excluded because they are within Integrated Natural Resources Management Plans for military areas.

The PBFs identified as essential to the conservation of each species are reproductive, recruitment, growth, and maturation habitat. Sites that support the normal function of all life stages of the corals are natural, consolidated hard substrate or dead coral skeleton free of algae and sediment at the appropriate scale at the point of larval settlement of fragment reattachment, and the associated water column. Several attributes of these sites determine the quality of the area and influence the value of the associated feature of the conservation of the species (85 FR 76262):

1. Substrate with presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or presence of crustose coralline algae;
2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae;
3. Marine waters with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function; and
4. Marine water with levels of anthropogenically-introduced (from humans) chemical contaminants that do not preclude or inhibit any demographic function.

### 5.1.5 Effects to Designated and Proposed Critical Habitat

Designated critical habitat contains a variety of physical and biological features deemed essential to the conservation of the ESA-listed species for which they were designated. Table 7 lists these physical and biological features and also highlights those that may be affected by the proposed action. With some exceptions as noted below, the physical and biological features that may be affected by the proposed action can be grouped into the following categories:

1. Waters free from obstruction;

2. Habitat with sufficient water quality (e.g., specific dissolved oxygen levels and temperatures, low contaminant levels);

3. Habitat with adequate availability of prey resources (including foraging habitat);

4. Habitat with adequate availability of quality substrate, water depth, and sea state; and

5. Areas free from disturbance (including anthropogenic noise).

There are additional physical and biological features that do not fall into a group and will be addressed separately. For example, smalltooth sawfish critical habitat includes the presence of red mangroves and North Atlantic Ocean DPS of loggerhead sea turtle critical habitat includes water free of artificial lighting to allow transit through the surf zone and outward toward open water and waters with minimal manmade structures that could promote predators.

**Table 7. Essential physical and biological features for Endangered Species Act-listed species, distinct population segments, or evolutionarily significant units and effects from the proposed action.**

| Species DPS or ESU | Physical or Biological Features Essential for the Conservation of the Species, DPS, or ESU | Category for Evaluation |
|---|---|---|
| **Marine Mammals - Cetaceans** | | |
| Beluga Whale – Cook Inlet DPS | (1) Intertidal and subtidal waters of Cook Inlet with depths less than 9.1 meters | 1, 3, 5 |

| | | |
|---|---|---|
| | (30 feet) (MLLW) and within 8 kilometers (5 miles) of high and medium flow anadromous fish streams; (2) primary prey species consisting of four species of Pacific salmon (Chinook, sockeye, chum, and coho), Pacific eulachon, Pacific cod, walleye Pollock, saffron cod, and yellowfin sole; (3) the absence of toxins or other agents of a type and amount harmful to beluga whales; (4) unrestricted passage within or between the critical habitat areas; and (5) waters with in-water noise at levels resulting in the abandonment of habitat by Cook Inlet DPS of beluga whales. | |
| False Killer Whale – Main Hawaiian Islands Insular DPS | (1) Adequate space for movement and use within shelf and slope habitat; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction, and development, as well as overall population growth; (3) waters free of pollutants of a type and amount harmful of Main Hawaiian Islands insular DPS of false killer whales; and (4) sound levels that will not significantly impair false killer whales' use or occupancy. | 1, 2, 3, 5 |
| Humpback Whale – Central America, Mexico, and Western North Pacific DPS | Prey species, primarily euphausiids and small pelagic schooling fishes of sufficient quality, abundance, and accessibility within humpback whale feeding areas to support feeding and population growth | 3 |
| Killer Whale – Southern Resident DPS | (1) Water quality to support growth and development; (2) prey species of sufficient quantity, quality, and availability to support individual growth, reproduction and development, as well as overall population growth; and (3) inter-area passage conditions to allow for migration, resting, and foraging. | 1, 2, 3 |
| North Atlantic Right Whale | Foraging habitat (Unit 1) – (1) The physical oceanographic conditions and structures of the Gulf of Maine and Georges Bank region that combine to distribute and aggregate *C. finmarchicus* for North Atlantic right whale foraging, namely prevailing currents and circulation patterns, bathymetric features (basins, banks, and channels), oceanic fronts, density gradients, and temperature regimes; (2) low flow velocities in Jordan, Wilkinson, and Georges Basins that allow diapausing *C. finmarchicus* to aggregate passively below the convector layer so that the copepods are retained in the basins; (3) late stage *C. finmarchicus* in dense aggregations in the Gulf of Maine and Georges Bank region; and (4) diapausing *C. finmarchicus* in aggregations in the Gulf of Maine and Georges Bank region.<br>Calving habitat (Unit 2) – (1) Calm sea surface conditions of Force 4 or less on the Beaufort Wind Scale; (2) sea surface | 2, 3 |

| | | |
|---|---|---|
| | temperatures from a minimum of seven degrees Celsius, and never more than 17 degrees Celsius; and water depths of 6 to 28 meters (19.7 to 91.9 feet) where these features simultaneously co-occur over contiguous areas of at least 792.3 square kilometers (231 square nautical miles) of ocean waters during the months of November through April. | |
| North Pacific Right Whale | Nutrients, physical oceanography processes, certain species of zooplankton (copepods), and long photo-period due to the high latitude. | 3 |
| **Marine Mammals - Pinnipeds** | | |
| Bearded Seal – Beringia DPS | 1) Sea ice habitat suitable for whelping and nursing, defined as areas with waters 200 meters or less in depth containing pack ice of at least 25 percent concentration and providing bearded seals access to those waters from the ice; 2) sea ice habitat suitable as a platform for molting, defined as areas with waters 200 meters or less in depth containing pack ice of at least 15 percent concentration and providing bearded seals access to those waters from the ice; and 3) primary prey resources to support bearded seals: waters 200 meters or less in depth containing benthic organisms, including epifaunal and infaunal invertebrates, and demersal fishes. | 3, Other |
| Hawaiian Monk Seal | Terrestrial areas and adjacent shallow, sheltered aquatic areas with characteristics preferred by Hawaiian monk seals for pupping and nursing. Marine areas from 0 to 200 meters (0 to 656.2 feet) in depth that support adequate prey quality and quantity for juvenile and adult Hawaiian monk seal foraging. Significant areas used by Hawaiian monk seals for hauling out, resting or molting. | 3, Other |
| Ringed Seal – Arctic Subspecies | 1) Snow-covered sea ice habitat suitable for the formation and maintenance of subnivean birth lairs used for sheltering pups during whelping and nursing, which is defined as waters 3 meters (9.8 feet) or more in depth containing areas of seasonal landfast (shorefast) ice or dense, stable pack ice, that have undergone deformation and contain snowdrifts of sufficient depth to form and maintain birth lairs (typically at least 54 centimeters (21.3 inches) deep); 2) sea ice habitat suitable as a platform for basking and molting, which is defined as areas containing sea ice of 15 percent or more concentration in waters 3 meters (9.8 feet) or more in depth; and 3) primary prey resources to support Arctic ringed seals, which are defined to be small, often schooling, fishes, in particular, Arctic cod (*Boreogadus saida*), saffron cod (*Eleginus gracilis*), and rainbow smelt (*Osmerus dentex*); | 3, Other |

| | | |
|---|---|---|
| | and small crustaceans, in particular, shrimps and amphipods. | |
| Steller Sea Lion – Eastern and Western DPSs (*Eastern DPS delisted, but critical habitat still in effect*) | Terrestrial, air, and aquatic areas that support foraging, such as adequate prey resources and available foraging habitat. | 2, 3 |
| **Marine Reptiles** | | |
| Green Turtle – North Atlantic DPS | Activities requiring special management considerations include: seagrass beds for foraging, coral reefs for resting, shelter and protection, vessel traffic, coastal construction, point and non-point source pollution, fishing activities, dredge and fill activities, habitat restoration | 4, 5 |
| Hawksbill Turtle | Important features include natal development habitat, refuge from predation, shelter between foraging periods, and food for hawksbill turtle prey. | 3, 5 |
| Leatherback Turtle | U.S. East Coast – Habitat essential for nesting, within the Sandy Point National Wildlife Refuge.<br>U.S. West Coast – Prey species, primarily scyphomedusae (i.e., jellyfish) of the order Semaeostomeae (e.g., *Chrysaora*, *Aurelia*, *Phacellophora*, and *Cyanea*), of sufficient condition, distribution, diversity, abundance, and density necessary to support individual as well as population growth, reproduction, and development. | 1, 3 |
| Loggerhead Turtle – North Atlantic Ocean DPS | Nearshore Reproductive Habitat – (1) Nearshore waters directly off the highest density nesting beaches and their adjacent beaches as identified in 50 C.F.R. 17.95(c) to 1.6 kilometers (0.9 nautical miles offshore);<br>(2) waters sufficiently free of obstructions or artificial lighting to allow transit through the surf zone and outward toward open water; (3) waters with minimal manmade structures that could promote predators (i.e., nearshore predator concentration caused by submerged and emerged offshore structures), disrupt wave patterns necessary for orientation, and/or create excessive longshore currents.<br>Winter Habitat:<br>(1) Water temperatures above 10º Celsius from November through April; (2) continental shelf waters in proximity to the western boundary of the Gulf Stream; and (3) water depths between 20 and 100 meters (65.6 to 328.1 feet).<br>Breeding Habitat –<br>(1) High densities of reproductive male and female loggerheads; (2) proximity to primary Florida migratory corridor; and (3) proximity to Florida nesting grounds.<br>Migratory Habitat –<br>(1) Constricted continental shelf area relative to nearby continental shelf waters that concentrate migratory | 1, 3, 5, Other |

| | | |
|---|---|---|
| | pathways; and (2) passage conditions to allow for migration to and from nesting, breeding, and/or foraging areas.<br>Sargassum Habitat:<br>(1) Convergence zones, surface-water downwelling areas, the margins of major boundary currents (Gulf Stream), and other locations where there are concentrated components of the *Sargassum* community in water temperatures suitable for the optimal growth of *Sargassum* and inhabitance of loggerhead turtles; (2) *Sargassum* in concentrations that support adequate prey abundance and cover; (3) available prey and other material associated with Sargassum habitat including, but not limited to, plants and cyanobacteria and animals native to the *Sargassum* community such as hydroids and copepods; and (4) sufficient water depth and proximity to available currents to ensure offshore transport (out of the surf zone), and foraging and cover requirements by *Sargassum* for post-hatching loggerhead turtles, i.e., greater than 10 meters (32.8 feet) depth<br>(see **Table 5**). | |
| **Fish** | | |
| Atlantic Salmon – Gulf of Maine DPS | Freshwater physical and biological features include sites for spawning and incubation, juvenile rearing, and migration. No marine features were designated. | 4 |
| Pacific Salmonids (Salmon and Steelhead) – Multiple DPSs and ESUs | Freshwater – Spawning sites with water quantity and quality conditions and substrate that support spawning, incubation, and larval development;<br>rearing sites with (1) water quantity and floodplain connectivity to form and maintain physical habitat conditions and support juvenile growth and mobility; (2) water quality and forage that support juvenile development; and (3) natural cover such as shade, submerged and overhanging large wood, logjams and beaver dams, aquatic vegetation, large rocks and boulders, side channels, and undercut banks; migration corridors free of obstruction and excessive predation with water quantity and quality conditions and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels, and undercut banks that support juvenile and adult mobility and survival.<br>Estuarine – areas free of obstruction and excessive predation with water quality, water quantity, and salinity conditions supporting juvenile and adult physiological transitions between fresh- and saltwater; natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, side channels; and | 1,2,3,4 |

| | | |
|---|---|---|
| | juvenile and adult forage, including aquatic invertebrates and fishes, supporting growth and maturation.<br>Nearshore Marine – areas free of obstruction and excessive predation with water quality and quantity conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation; and natural cover such as submerged and overhanging large wood, aquatic vegetation, large rocks and boulders, and side channels.<br>Offshore Marine – areas with water quality conditions and forage, including aquatic invertebrates and fishes, supporting growth and maturation. | |
| Atlantic Sturgeon – New York Bight DPS, Chesapeake Bay DPS, Carolina DPS, South Atlantic DPS | Promote larval, juvenile, and sub-adult growth and development, foraging habitat, water conditions suitable for adult spawning, and an absence of physical barriers (e.g., dams) (see **Table 6**). | 4 |
| Green Sturgeon – Southern DPS | Freshwater riverine systems, estuarine habitats, and nearshore coastal marine areas that provide sufficient food resources, substrate type suitable for egg deposition, and development, water flow, water quality, migratory corridors, depth (greater than or equal to 5 meters [16.4 feet], and sediment quality. | 1, 2, 3, 4 |
| Gulf Sturgeon | Abundant food items, riverine spawning sites with substrates suitable for egg deposition and development, riverine aggregation areas, a flow regime necessary for normal behavior, growth, and survival, water and sediment quality necessary for normal behavior, growth, and viability of all life stages, and safe and unobstructed migratory pathways. | 1,2,3,4 |
| Nassau Grouper | Areas from nearshore to offshore necessary for recruitment, development, and growth of Nassau grouper containing a variety of benthic types that provide cover from predators and habitat for prey and marine sites used for spawning and adjacent waters that support movement and staging associated with spawning. | 3, 4, Other |
| Rockfish – Bocaccio – Puget Sound/Georgia Basin DPS and Yelloweye Rockfish – Puget Sound/Georgia Basin DPS | Adults – Sufficient prey resources, water quality, and rocks or highly rugose habitat (greater than 30 meters [98.4 feet]).<br>Juvenile – sufficient prey resources and water quality | 2,3,4 |
| Eulachon – Southern DPS | (1) Freshwater spawning and incubation sites with water flow, quality and temperature conditions and substrate supporting spawning and incubation, and with migratory access for adults and juveniles; (2) freshwater and estuarine migration corridors associated with spawning and incubation sites that are free of obstruction and with water flow, quality and temperature conditions supporting larval and adult mobility, and | 1,2,3 |

| | | |
|---|---|---|
| | with abundant prey items supporting larval feeding after the yok sac is depleted; and (3) nearshore and offshore marine foraging habitat with water quality and available prey, supporting juveniles and adult survival. | |
| Smalltooth Sawfish – U.S. Portion of Range DPS | Within the nursery areas: red mangroves (*Rhizophora mangle*), and euryhaline habitats with water depths less than or equal to 0.9 meters (2.96 feet). | 2, Other |
| **Marine Invertebrates** | | |
| Black Abalone | Rocky substrate to cling to, nourishment resources (bacterial and diatom films, crustose coralline algae, and a source of detrital macroalgae), juvenile settlement habitat (rocky intertidal habitat containing crustose coralline algae, and crevices or cryptic biogenic structures [e.g., urchins, mussels, chiton holes conspecifics, anemones]), suitable water quality (temperature, salinity, pH, and other chemical characteristics necessary for normal settlement, growth, behavior, and viability of black abalone), and suitable nearshore circulation patterns (where sperm, eggs, and larvae are retained in the nearshore environment). | 2, 3, 4 |
| Elkhorn Coral and Staghorn Coral | Substrate of suitable quality and availability in water depths from the mean high water line to 30 meters (28.4 feet) to allow for successful sexual and asexual reproduction. Successful sexual and asexual reproduction includes flourishing larval settlement, recruitment, and reattachment of consolidated hard bottom or dead coral skeletons free from fleshy macroalgae or turf algae and sediment cover. | 4 |
| Atalntic/Caribbean Corals and Indo-Pacific Corals | 1. Substrate with the presence of crevices and holes that provide cryptic habitat, the presence of microbial biofilms, or the presence of crustose coralline algae;<br>2. Reefscape with no more than a thin veneer of sediment and low occupancy by fleshy and turf macroalgae;<br>3. Marine water with levels of temperature, aragonite saturation, nutrients, and water clarity that have been observed to support any demographic function; and<br>4. Marine water with levels of anthropogenically-introduced (from humans) chemical contaminants that do not preclude or inhibit any demographic function. | 2, 4 |

As described in NMFS (2021c), enhancement and baseline health research activities occur in each of the critical habitats evaluated in this consultation. Therefore, each critical habitat has the potential to be exposed to stressors associated with the proposed action. Below, we evaluate the possible effects the proposed action may have on the physical and biological features of proposed or designated critical habitat.

Potential stressors from the proposed action that may affect the physical and biological features of designated or proposed critical habitat (identified in Table 7) include pollution, aerial surveys, vessel surveys (including vessel transit, noise and visual disturbance), passive acoustic monitoring, active acoustics, biological sampling (e.g., biopsies, blood sampling, breath sampling, etc.), tagging, use of deterrents, and introduction of chemicals into the environment (e.g., euthanasia, vaccinations, etc.).

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

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

The MMHSRP activities would not have a measurable impact on the essential features of any marine mammal designated critical habitat such as passable waters of appropriate depth that are free of toxins, and have minimal noise pollution and abundant prey to support growth and reproduction. Hence the effects to the quantity, quality, or availability of the essential physical or biological features of designated marine mammal critical habitat would be insignificant.

The proposed action will not result in obstructions to migratory pathways for any species in areas of designated or proposed critical habitat. While MMHSRP activities may result in individual animals temporarily avoiding a small area in critical habitat, the avoidance will be short in duration (i.e., lasting a few hours) and localized. During the short time periods that enhancement and baseline health research activities are conducted, any animals in the vicinity of these activities will be able to slightly alter course and access preferred habitats a short distance away. Further, while a transiting animal may need to slightly alter course (i.e., by a few meters) to avoid enhancement and baseline health research activities, the presence of these researchers does not prevent animals from accessing preferred habitat areas. For these reasons, the enhancement and baseline health research activities are expected to have an insignificant effect on physical and biological features of designated and proposed critical habitat related to obstructions and migratory pathways.

All enhancement and baseline health research activities will be directed at individual marine mammals, with the exception of aerial and vessel surveys and active acoustics. Given the nature of these aerial and vessel surveys, none of the physical and biological features essential to the conservation of the ESA-listed species found in these critical habitats will be measurably altered. Aerial and vessel surveys will not measurably alter large-scale physical or oceanographic conditions or processes, nutrients, bathymetry, photoperiod, or prey availability. While vessel operations can result in minor changes in water flow, turbidity, and movement, these will be extremely local and temporary and thus not meaningful on a scale that would be expected to adversely affect critical habitat. Research vessels can come into close proximity with, or even in contact with, prey of ESA-listed species found within these critical habitats. We expect that any such interactions will only result in a slight displacement of prey. If larger prey were to come into contact with the research vessel's propellers, it is possible that several individual prey could be killed. However, even if this unlikely event were to occur, the removal of several individual prey will have an immeasurable impact on the overall abundance of prey in these proposed or designated critical habitat areas. Given the short-term nature of aerial and vessel surveys, they will not restrict inter-area passage or significantly alter ambient noise levels. Noise and possible pollution resulting from surveys will be short-term, minimal, diluted, and will not have any measurable impact on the physical and biological features. Thus, the effects of the proposed action on these physical and biological features of critical habitat will be insignificant.

While the proposed enhancement and baseline health research activities may directly overlap with the physical and biological features including water quantity, and quality and prey availability, very few if any, effects are possible. The proposed enhancement and baseline health research activities will not measurably alter the physical or oceanographic conditions within the action area, as only very minor changes in water flow and current would be expected from vessel traffic and no changes in ocean bathymetry will occur. The proposed enhancement and baseline health research activities will in no way alter the sea state, temperature, or water depth, meaning the effects of these activities on critical habitat will be insignificant.

Vessel traffic, noise, and discharge are expected to have an insignificant effect on proposed or designated critical habitat physical and biological features. Large and small research vessels will be used during enhancement and baseline health research activities that fit within the scope of this programmatic consultation. Operation of research vessels will result in a temporary increase of vessel traffic within proposed or designated critical habitat. This increase in vessel traffic is likely to consist of only one research vessel operating within a particular critical habitat. The physical transit of research vessels may result in brief obstruction of surface waters due to the presence of a vessel and slight changes in dissolved oxygen levels, water temperature, and currents due to the vessel displacement and mixing of water, but is not expected to have any effect on contaminant levels, depth, benthic habitat, and sea state. Vessel presence may also cause a slight change in distribution of prey. These effects will be highly localized; occurring only within close proximity to the transiting research vessel, and temporary, with habitat conditions quickly returning to pre-exposure values once the research vessel leaves the area. Given the localized and short-term nature of vessel operation in critical habitat, they are expected to have an insignificant effect on the physical and biological features of proposed or designated critical habitat.

Discharge and pollution from research vessels may occur as a result of enhancement and baseline health research activities. The International Convention for the Prevention of Pollution from Ships (MARPOL73/78) prohibits certain discharges of oil, noxious liquid substances, sewage, garbage, and air pollution from vessels within certain distances of the coastline. Unintentional and intentional discharge of pollutants may occur. These potential discharges may affect certain water quality properties, trigger harmful algal blooms, and temporarily affect distributions and behaviors of ESA-listed species and their prey. However, the localized extent of any discharges from a few research vessels associated with the proposed action will likely be minor relative to the size of the research area. In addition, any pollutant discharge will be mixed rapidly into the water column and is likely to be indistinguishable from discharges associated with vessel traffic that is common in the research areas proposed under this programmatic consultation. Therefore, the effects of discharge and pollution from research vessels on proposed or designated critical habitat are considered to be insignificant.

Transiting vessels also produce a variety of sounds characterized as low-frequency, continuous, or tonal, with sound pressure levels at a source varying according to speed, burden, capacity, and length (Richardson et al. 1995b); (Kipple and Gabriele 2007); (McKenna et al. 2012). While such noise will not physically obstruct water passage or affect water properties, depth, sea state, or oceanographic, benthic and algal features, it may affect prey in proposed or designated critical habitat. However, the vast majority of fishes do not show strong responses to low frequency sound. Although avoidance behavior in prey may lead to a change in distribution, any such change will be short-lived, likely lasting only while the research vessel is in the area. Thus, we believe the effects of vessel transit on proposed or designated critical habitat associated with the proposed enhancement and baseline health research activities are insignificant.

The operation of active acoustics (i.e., playbacks, prey mapping, and remote ultrasound) involves actively transmitting sounds in the marine environment. Like noise from research vessels, such transmission will not physically obstruct water passage or affect water properties, depth, sea state, or oceanography, benthic, and algal features, but as further outlined below, it may affect prey in proposed or designated critical habitat for fish and invertebrates, respectively. However, given the frequency bandwidth and sound sources, the Permits Division expects sounds originating from the active acoustic sound sources will be beyond the audible hearing range or reduced to negligible sound levels by the time they reach prey due to transmission loss. We do not expect any such responses to have a measurable impact on the abundance of prey within proposed or designated critical habitat. We do not expect the proposed research and enhancement activities to affect the oceanographic features that concentrate copepod prey in the action area. One essential feature of the critical habitat for the Main Hawaiian Islands insular DPS of false killer whale is "sound levels that would not significantly impair false killer whales' use or occupancy" (83 FR 35062). The use of active acoustics (detailed in Section 3.2.3.16) are temporary, short duration sounds, and will only result in temporary ESA harassment, therefore the use of active acoustics are not expected to significantly impair the use or occupancy for the Main Hawaiian Islands insular DPS of false killer whale. Thus, we find that the effects of operating the active acoustic sound sources on proposed or designated critical habitat within the action area are insignificant.

In conclusion, we find that the effects of the proposed enhancement and baseline health research activities on the physical and biological features of the proposed or designated critical habitat listed in Table 7 are insignificant. As such, these proposed enhancement and baseline health activities are not likely to adversely affect proposed or designated critical habitat under NMFS jurisdiction.

## 5.2 Species Likely to Be Adversely Affected

This opinion examines the status of each species that are likely to be adversely affected by the proposed action. These species include the beluga whale (Cook Inlet DPS), blue whale, bowhead whale, Chinese river dolphin, false killer whale (Main Hawaiian Islands Insular DPS), fin whale, gray whale (Western North Pacific DPS), Gulf of California harbor porpoise (vaquita), humpback whale (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), Indus river dolphin, killer whale (Southern Resident DPS), Maui's and South Island Hector's dolphins, North Atlantic right whale, North Pacific right whale, Rice's whale, sei whale, southern right whale, sperm whale, Taiwanese humpback dolphin, bearded seal (Beringia and Okhotsk DPSs), Guadalupe fur seal, Hawaiian monk seal, Mediterranean monk seal, ringed seal (Arctic, Baltic, Ladoga, Okhotsk, and Saimaa subspecies), spotted seal (Southern DPS), Steller sea lion (Western DPS), green turtle (Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, North Atlantic, and South Atlantic DPSs), hawksbill turtle, Kemp's ridley turtle, leatherback turtle, loggerhead turtle (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific ocean DPSs), olive ridley turtle (Mexico's Pacific coast breeding colonies and all other areas), Atlantic sturgeon (Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic DPSs), green sturgeon (Southern DPS), gulf sturgeon, shortnose sturgeon, and smalltooth sturgeon (U.S. portion of range DPS).

The evaluation of adverse effects in this opinion begins by summarizing the biology and ecology of those species that are likely to be adversely affected 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 face based on parameters considered in documents such as recovery plans, status reviews, and listing decisions. This helps to inform the description of the species' current "reproduction, numbers, or distribution" that is part of the jeopardy determination as described in 50 C.F.R. §402.02. More detailed information on the status and trends of these ESA-listed species, 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 NMFS' website: (https://www.fisheries.noaa.gov/species-directory/threatened-endangered).

### 5.2.1 Beluga Whale (Cook Inlet Distinct Population Segment)

Cook Inlet beluga whales reside in Cook Inlet (Figure 3) year-round, which makes them geographically and genetically isolated from other beluga whale stocks in Alaska (Allen et al. 2011). Within Cook Inlet, they generally occur in shallow, coastal waters, often in water barely deep enough to cover their bodies (Harrison and Ridgway 1981).

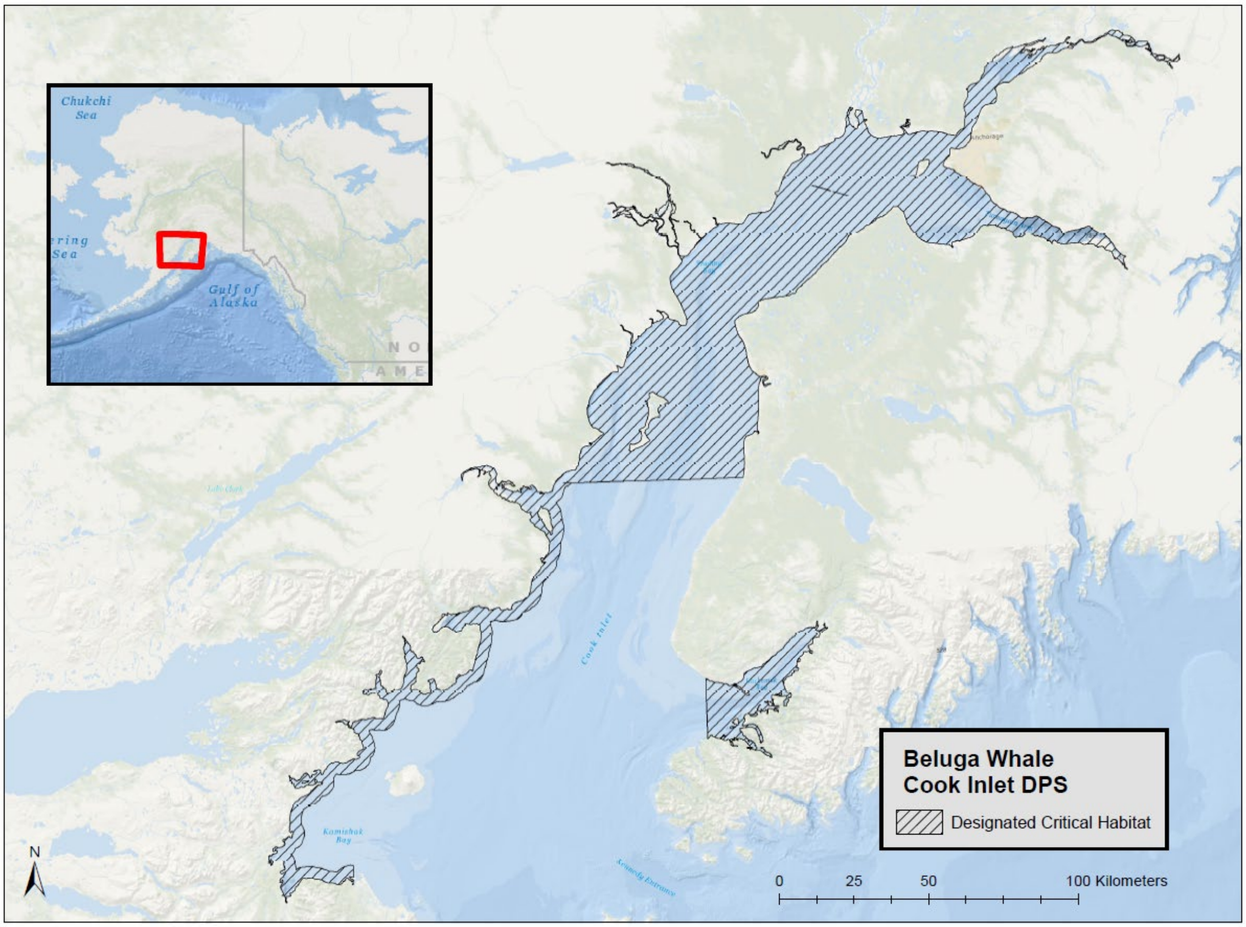


**Figure 3.** Beluga Whale Cook Inlet distinct population segment general range and designated critical habitat.

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

Information available from the recovery plan (NMFS 2016g), recent stock assessment reports (Muto et al. 2021), and the status review (NMFS 2017f) were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.1.1 *Life history*

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

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

#### 5.2.1.2 *Population Dynamics*

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

The best available historical abundance estimate of 1,293 Cook Inlet beluga whales was obtained from an aerial survey conducted in 1979 (Calkins 1989). Cook Inlet belugas experienced a decline in abundance of nearly 50 percent between 1994 and 1998, from an estimate of 653 whales to 347 whales. This period of rapid decline was associated with a substantial, unregulated subsistence hunt. With the regulation of hunting beginning in 1999 (a total of five whales hunted from 1999 to 2014, 16 years), NMFS anticipated that the population would begin to increase at a growth rate of between two and six percent per year (NMFS 2016g). The 2014 abundance estimate was 340 belugas, with a declining trend for both the most recent 10-year time period (–0.4 percent per year; standard error = 1.3 percent) and since the hunt was managed in 1999 (–1.3 percent per year, standard error = 0.7 percent) (Shelden et al. 2015). During the most recent 10-year time period (2008 to 2018), the estimated exponential trend in the abundance estimates is a decline of 2.3 percent per year (95 percent PI: -4.1 percent to -0.6 percent) (Muto et al. 2021). The current best estimate of population size is 279 whales (coefficient of variation (CV) = 0.061; 95 percent probability interval (PI): 250 to 317) (Muto et al. 2021). Thus, the population is not growing as expected despite the regulation of the subsistence harvest.

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

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

#### 5.2.1.3 *Hearing*

Beluga whales have highly developed hearing abilities. Their hearing is most sensitive from 10 to 100 kiloHertz (Awbrey et al. 1988); (Johnson et al. 1989); (Richardson et al. 1995b) and is related to their use of high frequencies for echolocation and communication (Richardson et al. 1995b).

#### 5.2.1.4 *Status*

Although the cause of death for most Cook Inlet belugas remains unknown, natural sources include predation by "transient" killer whales, live strandings, and potentially disease; anthropogenic sources include subsistence harvest, poaching or intentional harassment, and mortalities or injuries incidental to other human activities. Climate change has also been identified as a potential threat to Cook Inlet beluga recovery (NMFS 2016g).

#### 5.2.1.5 *Critical Habitat*

See Section 5.1.4.1 for a description of designated critical habitat for Cook Inlet beluga whales.

#### 5.2.1.6 *Recovery Goals*

The 2016 Cook Inlet Beluga recovery plan (NMFS 2016g) contains complete demographic and threat-based downlisting and delisting criteria. A general summary of the criteria is provided in Table 8 below.

**Table 8:** Criteria for considering reclassification (from endangered to threatened, or from threatened to not listed) for Cook Inlet beluga whales.

| Status | Demographic criteria | | Threats-Based criteria |
|---|---|---|---|
| Reclassified from Endangered to Threatened<br>(i.e., downlisted) | The abundance estimate for CI belugas is greater than or equal to 520 individuals, and there is a 95 percent or greater probability that the most recent 25-year | AND | The 10 downlisting threats-based criteria are satisfied. |

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

### 5.2.2 Blue Whale

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

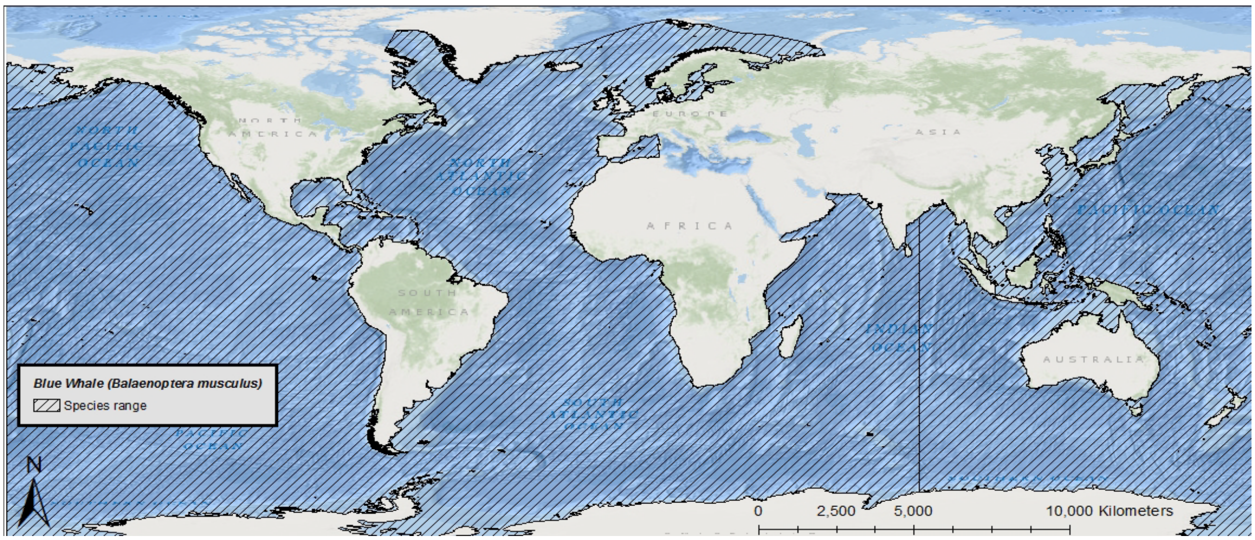


**Figure 4:** Map identifying the range of the blue whale.

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

Information from the recovery plan (NMFS 2020b), recent stock assessment reports (Carretta et al. 2020; Hayes et al. 2019; Muto et al. 2019), and the status review (COSEWIC 2002) were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.2.1 *Life History*

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

#### 5.2.2.2 *Population Dynamics*

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

The global, pre-exploitation estimate for blue whales is approximately 181,200 (IWC 2007). Current estimates indicate approximately 5,000 to 12,000 blue whales globally (IWC 2007). Blue whales are separated into populations by ocean basin in the North Atlantic, North Pacific, and Southern Hemisphere. There are three stocks of blue whales designated in U.S. waters: the Eastern North Pacific (current best estimate N = 1,496, $N_{min}$ = 1,050 (Carretta et al. 2020)) Central North Pacific (N = 133, $N_{min}$ = 63 (Carretta et al. 2021)), and Western North Atlantic (N = 402, $N_{min}$ = 402; (Hayes et al. 2019)). In the southern hemisphere, the latest abundance estimate for Antarctic blue whales is 2,280 individuals in 1997/1998 (95 percent confidence intervals 1,160-4,500) (Branch 2007). While no range-wide estimate for pygmy blue whales exists (Thomas et al. 2016a), the latest estimate for pygmy blue whales off the west coast of Australia is 662 to 1,559 individuals based on passive acoustics (McCauley and Jenner 2010), or 712 to 1,754 individuals based on photographic mark-recapture (Jenner et al. 2008).

The default net productivity rate of 4 percent is currently used for all U.S. blue whale stocks, as maximum net productivity estimates are currently lacking for these populations (Carretta et al. 2021). In the southern hemisphere, population growth estimates are available only for Antarctic blue whales, which estimate a population growth rate of 8.2 percent per year (95 percent confidence interval 1.6–14.8 percent) (Branch 2007).

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

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

#### 5.2.2.3 *Hearing*

Direct studies of blue whale hearing have not been conducted, but it is assumed that blue whales can hear the same frequencies that they produce (low frequency) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995b). Based on vocalizations and anatomy, blue whales are assumed to predominantly hear low-frequency sounds below 400 Hertz (Croll et al. 2001; Oleson et al. 2007; Stafford and Moore 2005). In terms of functional hearing capability, blue whales belong to the low frequency group, which have a hearing range of 7 Hertz to 35 kiloHertz (NOAA 2018).

#### 5.2.2.4 *Status*

Commercial whaling no longer occurs, but blue whales are threatened by vessel strikes, entanglement in fishing gear, pollution, harassment due to whale watching, and reduced prey abundance and habitat degradation due to climate change. Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats; however, the species has not recovered to pre-exploitation levels.

#### 5.2.2.5 *Critical Habitat*

No critical habitat has been designated for the blue whale.

#### 5.2.2.6 *Recovery Goals*

See the 2020 Recovery Plan (First Revision to the July 1998 Recovery Plan) (NMFS 2020b) for the blue whale for complete down listing/delisting criteria for each of the following recovery goals:

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

### 5.2.3 Bowhead Whale

The bowhead whale is a circumpolar baleen whale found throughout high latitudes in the Northern Hemisphere (Figure 5).

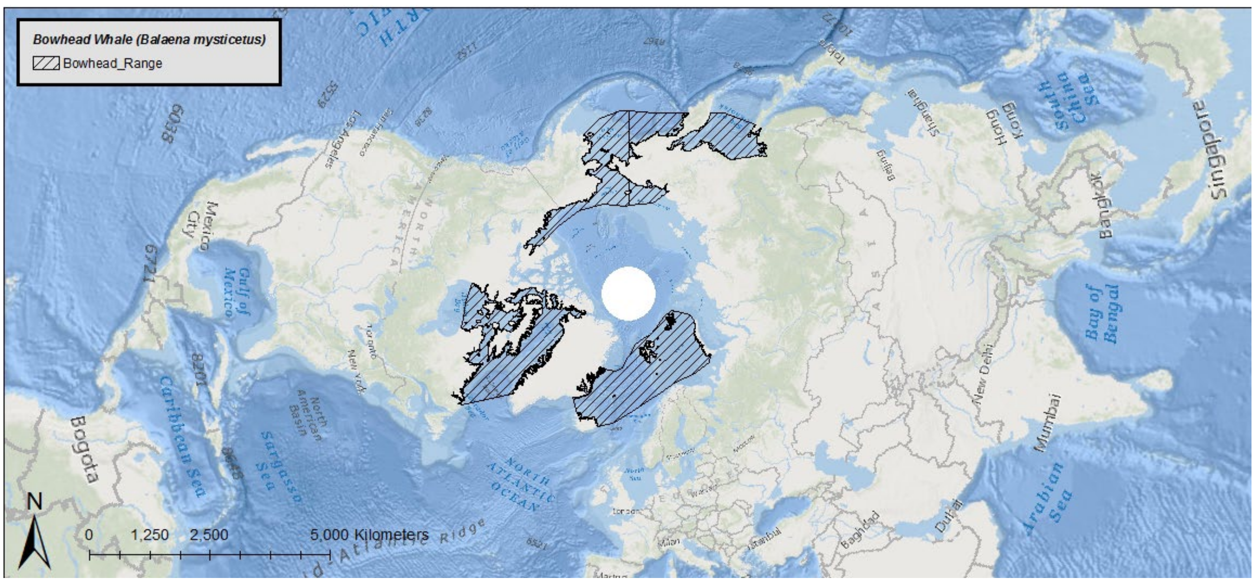


**Figure 5:** Map identifying the range of bowhead whales.

Bowheads are baleen whales distinguishable from other whales by a dark body with distinctive white chin, no dorsal fin, and a bow-shaped skull that takes up about thirty-five percent of their total body length. The bowhead whale was originally listed as endangered on December 2, 1970. Information available from the recent stock assessment report (Muto et al. 2021) and the scientific literature was used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.3.1 *Life History*

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

#### 5.2.3.2 *Population Dynamics*

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

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

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

Genetic studies conducted on the Western Arctic stock of bowhead whales revealed sixty-eight different haplotypes defined by forty-four variable sites (Leduc et al. 2008) making it the most diverse stock of bowheads. These results are consistent with a single stock with genetic heterogeneity related to age cohorts and indicate no historic genetic bottlenecks (Rugh et al. 2003). In the Okhotsk Sea stock, only four to seven mitochondrial DNA (mtDNA) haplotypes have been identified, three of which are shared with the Western Arctic Stock, indicating lower genetic diversity, as might be expected given its much small population size (Alter et al. 2012;

LeDuc et al. 2005; MacLean 2002). The Davis Strait-Hudson Bay stock has 23 mtDNA haplotypes, making it more diverse than the Okhotsk but less diverse than the large Western Arctic stock (Alter et al. 2012). Based on historic mtDNA, the Spitsbergen stock previously had at least 58 mtDNA haplotypes, but its current genetic diversity remains unknown (Borge et al. 2007). However, given its near extirpation, it likely has low genetic diversity.

The Western Arctic stock is found in waters around Alaska, the Okhotsk Sea stock in eastern Russia waters, the Davis Strait and Hudson Bay stock in northeastern waters near Canada, and the Spitsbergen stock in the northeastern Atlantic (Rugh and Shelden 2009) (Figure 5).

#### 5.2.3.3 *Hearing*

We are aware of no information directly on the hearing abilities of bowhead whales, but all marine mammals, we presume they hear best in frequency ranges at which they produce sounds (444±48 Hz).

#### 5.2.3.4 *Status*

Bowhead whales may be killed under "aboriginal subsistence whaling" provisions of the IWC. Additional threats include vessel strikes, fisheries interactions (including entanglement), contaminants, and noise. The species' large population size and increasing trends indicate that it is resilient to current threats.

#### 5.2.3.5 *Critical Habitat*

No critical habitat has been designated for the bowhead whale.

#### 5.2.3.6 *Recovery Goals*

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

### 5.2.4 Chinese River dolphin

The Chinese river dolphin is a freshwater dolphin, and is one of the most endangered animals on Earth. The Chinese river dolphin has several common names: baiji, Yangtze River dolphin, white-flag dolphin, and white-fin dolphin. It lives exclusively in the Yangtze River in China (Figure 6).

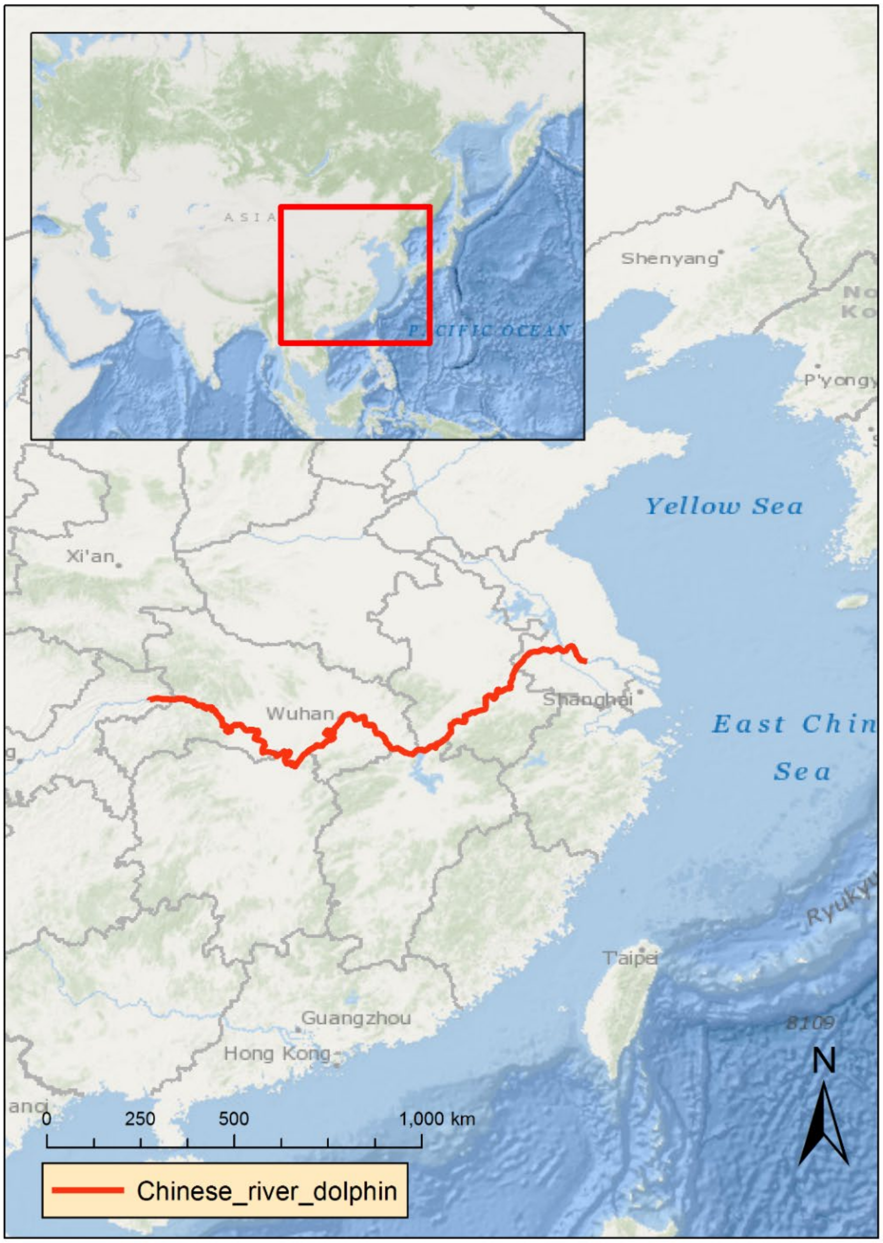


**Figure 6.** Map identifying the range of the Chinese river dolphin.

Chinese river dolphins are pale blue or gray on the dorsal side, and white on the ventral side. They can grow to 2.5 meters long and weigh up to 220 kilograms. Chinese river dolphins have a long, slightly upturned beak, and a low, triangular dorsal fin. The Chinese river dolphin was originally listed as endangered on May 30, 1989. Information available from the most recent five-year status reviews (NMFS 2017a) and (NMFS 2012b) were used to summarize the life history, population dynamics, and status of the Chinese river dolphin as follows.

#### 5.2.4.1 *Life History*

Not much is known about the life history of Chinese river dolphins. The lifespan of Chinese river dolphins is thought to be as long as 25 years, based on the lifespan of a captive individual. Gestation lasts between 10 and 11 months. Sexual maturity is reached at between four and six years of age. Chinese river dolphins have smaller eyes than marine dolphins, and rely on echolocation to find prey and navigate the turbid waters of the Yangtze River. They echolocate using clicks and whistles. Chinese river dolphins are usually in small groups of two to four individuals, and occasionally, in groups of as many as 16 individuals. Chinese river dolphins eat various freshwater fishes (NMFS 2017a).

#### 5.2.4.2 *Population Dynamics*

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

Abundance surveys were first conducted in the late 1970s. Based on data from 1979 to 1981, there were about 400 Chinese river dolphins in the Yangtze River. Surveys continued, and the population estimates varied from 300 individuals in 1985 to 1986, and 100 animals from 1982 to 1986. Surveys of the middle and lower Yangtze River and estuary from 1997 to 1999 indicated that there were 13 Chinese river dolphins remaining. The most recent survey in 2006 did not locate any Chinese river dolphins, leading to conclusions that the species is extinct. There have been a few unconfirmed sightings since the 2006 survey (NMFS 2017a).

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

Chinese river dolphins occupy freshwater in the Yangtze River in China, from the mouth of the river at Shanghai to the Three Gorges area (Figure 6). Chinese river dolphins favor calm areas of the river near counter-current eddies around banks and sandbars that help trap fish.

#### 5.2.4.3 *Hearing*

While we are aware of no hearing data on Chinese river dolphins specifically, data from other river dolphins indicate they are high frequency specialists, with a likely hearing range between 275 Hz to 160 kHz (NOAA 2016).

#### 5.2.4.4 *Status*

Fisheries in the Yangtze River are thought to be the principal cause of the Chinese river dolphin's decline, primarily through incidental bycatch in fisheries using rolling hooks, gillnets, fyke nets, and electrofishing (Turvey et al. 2007). China banned the use of rolling hook longlines, fyke nets, and electrofishing, but these measures were not enforced. Overfishing also severely reduced the available prey for Chinese river dolphins. Water pollution also degrades habitat for the Chinese river dolphin. Sources of pollution include billions of tons of untreated wastewater discharged into the Yangtze River annually, as well as nutrients from agricultural runoff. Chinese river dolphins are also at risk of vessel strike and injuries or mortality from propellers due to the high degree of vessel traffic in the Yangtze River (NMFS 2017a). Water development and dam construction are also thought to negatively impacts Chinese river dolphins. Construction of the first dam on the mainstem of the Yangtze River in 1970 blocked dolphin movement in upstream habitat between the dam and the Three Gorges area, affected counter-current below the dam, and reduced fish populations (NMFS 2017a). Subsequent dams, including the large Three Gorges dam completed in 2012, further modified and degraded habitat, as well as increased ship traffic and thus the threat of vessel strikes. Despite efforts to protect it, Chinese river dolphins face numerous threats from overfishing, incidental bycatch, pollution, and dams and habitat degradation; these threats are expected to continue in the future. Due to its dramatic decline in abundance, the inability to locate individuals during surveys or confirm sightings, and ongoing threats, NMFS determined that the Chinese river dolphin became functionally extinct in 2012 (NMFS 2012b).

#### 5.2.4.5 *Critical Habitat*

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

#### 5.2.4.6 *Recovery Goals*

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

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

False killer whales are distributed worldwide in tropical and temperate waters more than 1,000 meters deep. The Main Hawaiian Islands Insular DPS of false killer whales is found in waters around the Main Hawaiian Islands (Figure 7).

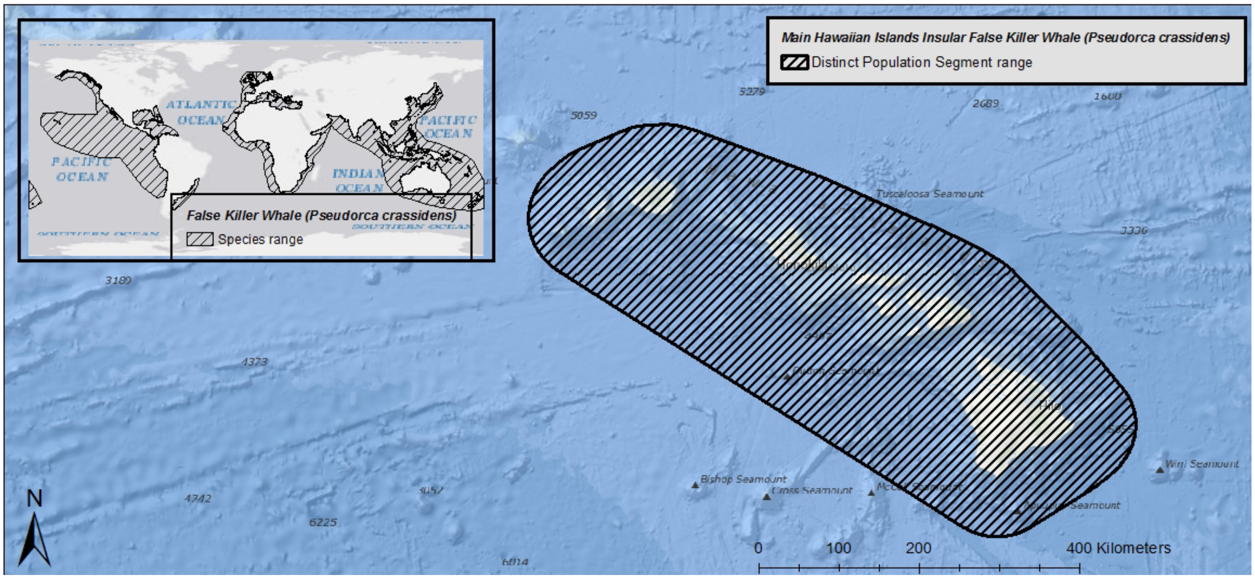


**Figure 7:** Map identifying the range of false killer whales and the Main Hawaiian Islands Insular distinct population segment of false killer whale.

The false killer whale is a toothed whale and large member of the dolphin family. False killer whales are distinguishable from other whales by having a small conical head without a beak, tall dorsal fin, and a distinctive bulge in the middle of the front edge of their pectoral fins. The Main Hawaiian Islands Insular DPS of false killer whale was originally listed as endangered on November 28, 2012. Information available from the most recent five-year review (NMFS 2022e) and recent stock assessment (Carretta et al. 2021) were used to summarize the status of the species as follows.

### 5.2.5.1 *Life History*

False killer whales can live, on average, for 60 years. They have a gestation period of 14 to 16 months, and calves nurse for 1.5 to two years. Sexual maturity is reached around 12 years of age with a very low reproduction rate and calving interval of approximately seven years. False killer whales prefer tropical to temperate waters that are deeper than 1,000 meters (3,281 feet). They feed during the day and at night on fishes and cephalopods, and are known to attack other marine mammals, indicating they may occasionally feed on them.

### 5.2.5.2 *Population Dynamics*

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

Annual population estimates from 2000 to 2015 have ranged from 144 to 187 false killer whales. The minimum population estimate for the Main Hawaiian Islands Insular DPS of false killer whale is 149 animals (Carretta et al. 2021; NMFS 2022e).

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

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

NMFS currently recognizes three stocks of false killer whales in Hawaiian waters: the Main Hawaiian Islands Insular, Hawaii pelagic, and the Northwestern Hawaiian Islands. All false killer whales found within forty kilometers of the Main Hawaiian Islands belong to the insular stock and all false killer whales beyond 140 kilometers belong to the pelagic stock. Animals belonging to the Northwest Hawaiian Islands stock are insular to the Northwest Hawaiian Islands (Bradford et al. 2012), however, this stock was identified by animals encountered off Kauai.

#### 5.2.5.3 *Vocalization and Hearing*

Functional hearing in mid-frequency cetaceans, including Main Hawaiian Islands insular DPS of false killer whales, is conservatively estimated to be between approximately 150 Hertz and 160 kiloHertz (Southall et al. 2007).

#### 5.2.5.4 *Status*

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

#### 5.2.5.5 *Critical Habitat*

See Section 5.1.4.2 for a description of Hawaiian Island Insular DPS false killer whales.

#### 5.2.5.6 *Recovery Goals*

In response to the current threats facing the species, NMFS developed goals to recover Main Hawaiian Island Insular DPS false killer whales. These threats will be discussed in further detail in the *Environmental Baseline* section of this consultation. See the 2021 Final Recovery Plan (NMFS 2021b)for the false killer whale Main Hawaiian Island Insular DPS for complete down listing/delisting criteria for each of the following recovery goals:

1. Ensure productivity and social connectedness of the Main Hawaiian Islands Insular false killer whale (trend, abundance, and social clusters) have met or exceeded target levels.
2. Address threats from fisheries including incidental take and competition for prey.
3. Address threats from environmental contaminants and biotoxins.
4. Address threats from anthropogenic noise.
5. Better understand the effects of climate change and manage accordingly.
6. Ensure that regulatory mechanisms, including state and federal management and post-delisting monitoring, are in plce prior to delisting.
7. Ensure secondary threats and synergies among threats are not limiting recovery of the population.

### 5.2.6 Fin Whale

The fin whale is a large, widely distributed baleen whale found in all major oceans and comprised of three subspecies: *B. p. physalus* in the Northern Hemisphere, and *B. p. quoyi* and *B. p. patachonica* (a pygmy form) in the Southern Hemisphere (Figure 8).

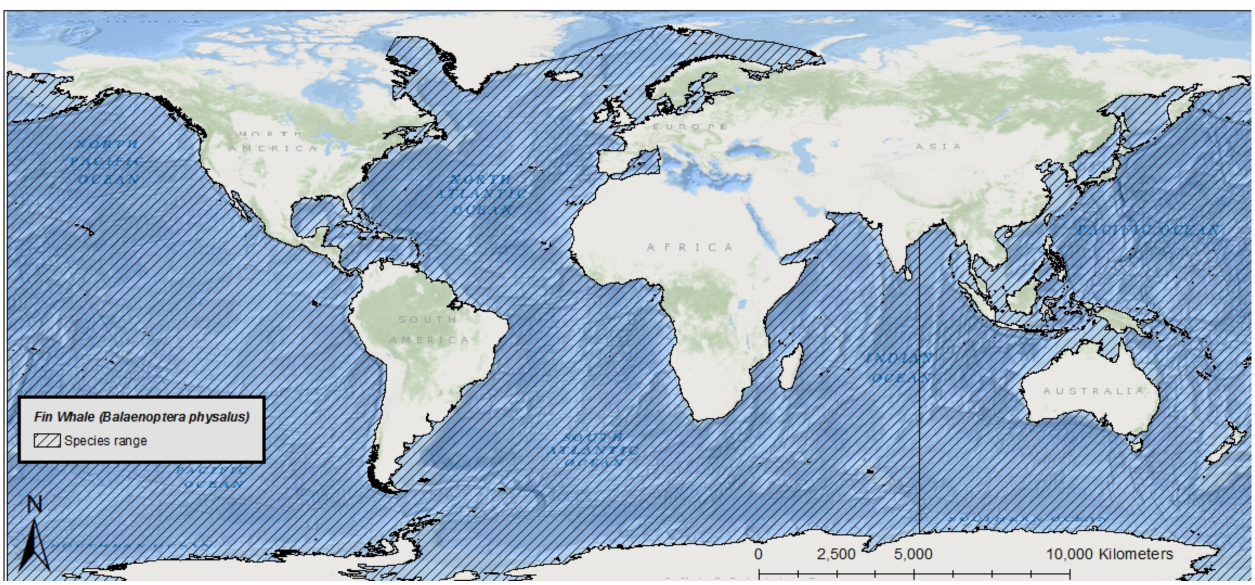


**Figure 8:** Map identifying the range of the fin whale.

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

December 2, 1970. Information available from the recovery plan (NMFS 2010c), recent stock assessment reports (Carretta et al. 2021; Hayes et al. 2021; Muto et al. 2021), and the status review (NMFS 2019i) were used to summarize the life history, population dynamics and status of the species as follows.

### 5.2.6.1 *Life History*

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

### 5.2.6.2 *Population Dynamics*

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

The pre-exploitation estimate for the fin whale population in the North Pacific was 42,000 to 45,000 (Ohsumi and Wada 1974). In the North Pacific, at least 74,000 whales were killed between 1910 and 1975. In the North Atlantic, at least 55,000 fin whales were killed between 1910 and 1989. Approximately 704,000 whales were killed in the Southern Hemisphere from 1904 to 1975. Of the three to seven stocks in the North Atlantic (approximately 50,000 individuals), one occurs in U.S. waters, the Western North Atlantic stock, where the best estimate of abundance is 6,802 individuals ($N_{min}$= 5,573) (Hayes et al. 2021). There are three stocks in U.S. Pacific waters: Northeast Pacific ($N_{min}$= 2,554 individuals; (Muto et al. 2021)) , Hawaii (approximately 203 individuals ($N_{min}$=101); (Carretta et al. 2021)), and California/Oregon/Washington [approximately 9,029 ($N_{min}$=8,127 individuals); (Carretta et al. 2021; Nadeem et al. 2016)]. The IWC also recognizes the China Sea stock of fin whales, found in the Northwest Pacific, which currently lacks an abundance estimate (Reilly et al. 2013). Abundance data for the Southern Hemisphere stock are limited; however, there were assumed to be somewhat more than 15,000 in 1983 (Thomas et al. 2016a).

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

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

There are over 100,000 fin whales worldwide, occurring primarily in the North Atlantic, North Pacific, and Southern Hemisphere (Figure 8), where they appear to be reproductively isolated. The availability of prey, sand lice in particular, is thought to have a strong influence on the distribution and movements of fin whales.

#### 5.2.6.3 *Hearing*

Direct studies of fin whale hearing have not been conducted, but it is assumed that fin whales can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995b). This suggests fin whales, like other baleen whales, are more likely to have their best hearing capacities at low frequencies, including frequencies lower than those of normal human hearing, rather than mid- to high-frequencies (Ketten 1997). In a study using computer tomography scans of a calf fin whale skull, Cranford and Krysl (2015) found sensitivity to a broad range of frequencies between 10 Hertz and 12 kiloHertz and a maximum sensitivity to sounds in the 1 to 2 kiloHertz range. In terms of functional hearing capability, fin whales belong to the low-frequency group, which have a hearing range of 7 Hertz to 35 kiloHertz (NOAA 2018).

#### 5.2.6.4 *Status*

Fin whales may be killed under "aboriginal subsistence whaling" in Greenland, under Japan's scientific whaling program, and Iceland's formal objection to the IWC ban on commercial whaling. Additional threats include vessel strikes, reduced prey availability due to overfishing or climate change, and noise. The species' overall large population size may provide some resilience to current threats, but trends are largely unknown.

#### 5.2.6.5 *Critical Habitat*

No critical habitat has been designated for the fin whale.

#### 5.2.6.6 *Recovery Goals*

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

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

### 5.2.7 Gray Whale (Western North Pacific Distinct Population Segment)

The gray whale is a baleen whale and the only species in the family Eschrichtiidae. There are two isolated geographic distributions of gray whales in the North Pacific Ocean: the Eastern North Pacific stock, found along the west coast of North America, and the Western North Pacific or "Korean" stock, found along the coast of eastern Asia (Figure 9).

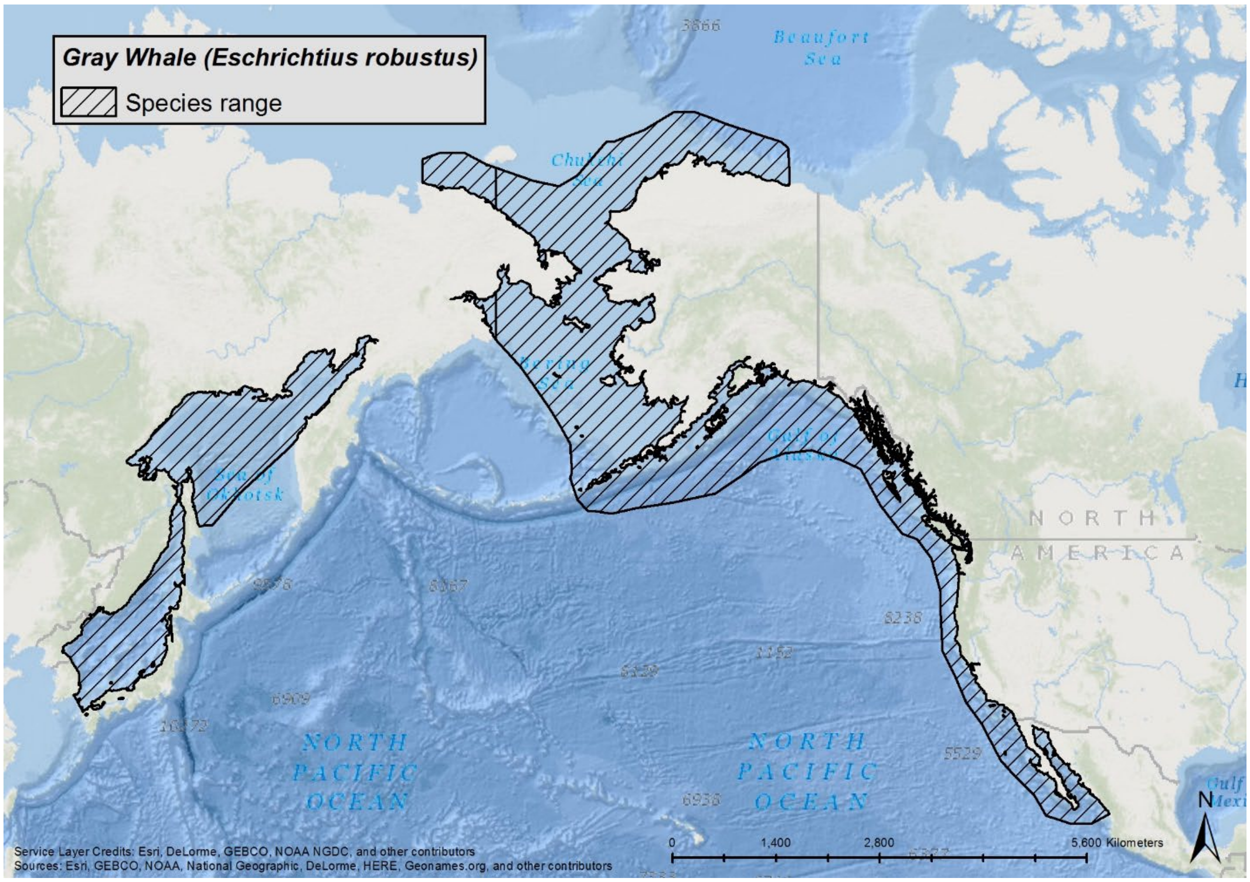


**Figure 9:** Map identifying the range of the gray whales.

Gray whales are distinguishable from other whales by a mottled gray body, small eyes located near the corners of their mouth, no dorsal fin, broad, paddle-shaped pectoral fins and a dorsal hump with a series of eight to fourteen small bumps known as "knuckles". The gray whale was originally listed as endangered on December 2, 1970. The Eastern North Pacific stock was officially delisted on June 16, 1994 when it reached pre-exploitation numbers. The Western North Pacific population of gray whales remained listed as endangered. Information available from the recent stock assessment reports (Carretta et al. 2021) were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.7.1 *Life History*

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

#### 5.2.7.2 *Population Dynamics*

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

The current abundance estimate of Western North Pacific gray whales is 290 animals. The minimum population estimate for the Western North Pacific stock is 271 animals. The current best growth rate estimate for the Western North Pacific gray whale stock is 2 to 5 percent annually (Carretta et al. 2021).

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

Gray whales in the Western North Pacific population are thought to feed in the summer and fall in the Okhotsk Sea, primarily off Sakhalin Island, Russia and the Kamchatka peninsula in the Bering Sea, and winter in the South China Sea (Figure 9). However, tagging, photo-identification, and genetic studies have shown that some whales identified as members of the Western North Pacific stock have been observed in the Eastern North Pacific, which may indicate that not all gray whales share the same migratory patterns.

#### 5.2.7.3 *Hearing*

No data are available regarding Western North Pacific population of gray whale hearing. Auditory structure suggests hearing is attuned to low frequencies (Ketten 1992a; Ketten 1992b). Responses of free-ranging and captive individuals to playbacks in the 160 Hertz to 2 kiloHertz range demonstrate the ability of individuals to hear within this range (Buck and Tyack 2000; Cummings and Thompson 1971; Dahlheim and Ljungblad 1990; Moore and Clark 2002;

Wisdom et al. 2001). Responses to low-frequency sounds stemming from oil and gas activities also support low-frequency hearing (Malme et al. 1986; Moore and Clark 2002).

#### 5.2.7.4 *Status*

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

#### 5.2.7.5 *Critical Habitat*

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

#### 5.2.7.6 *Recovery Goals*

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

### 5.2.8 Gulf of Califronia Harbor Porpoise/Vaquita

The vaquita, or Gulf of California harbor porpoise, is the smallest of all porpoise species and can only be found in the upper Gulf of California (Figure 10).

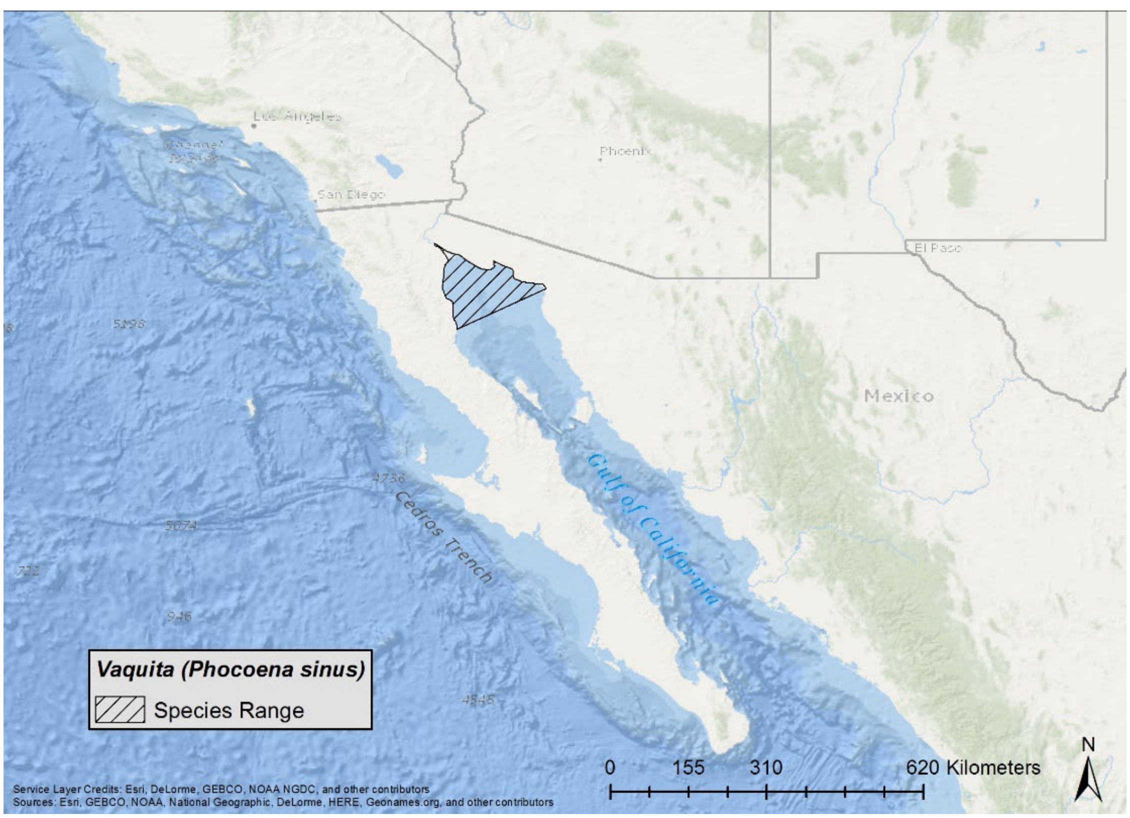


**Figure 10.** Map identifying the range of Vaquita in the upper Gulf of California.

Vaquita are one the world's smallest cetacean species, with males being slightly smaller (approximately 1.3 meters) than females (approximately 1.4 meters) (Rojas-Bracho and Jaramillo-Legoretta 2009). Compared to other porpoises, vaquita have proportionally larger flippers and a more falcate dorsal fin. They are further distinguished by their unique black eye rings and lip patches. The vaquita was listed as endangered under the ESA in 1985. Information available from reports and the peer-reviewed literature were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.8.1 *Life History*

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

#### 5.2.8.2 *Population Dynamics*

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

Vaquita were only discovered in the late 1950s, and it wasn't until 1997 that data were available for abundance estimates, which produced estimates ranging from 224 to 885 depending on the methods used, for periods between 1986 and 1993 (Barlow et al. 1997). For this period between 1986 and 1993, the population was estimated to have experienced a drastic decline of 17.7 percent per year (95 percent confidence intervals -43.2 percent to +19.3 percent). Dedicated vaquita vessel surveys in 1997 produced a more robust population estimate of 567 individuals (95 percent confidence intervals 177 to 1,073) (Jaramillo-Legorreta et al. 1999). In 2008, combined vessel transect and passive acoustic data produced an estimate of 245 individuals (95 percent confidence intervals 68 to 884) (Gerrodette et al. 2011). This estimate indicated more than a 50 percent reduction as compared to the 1997 estimate, with an average rate of decline of 7.6 percent per year. To examine the likelihood of decline, Gerrodette et al. (2011) conducted a Bayesian analyses, which estimated an 89 percent probability of decline between 1997 and 2008. In more recent years the population has only continued to decline, as indicated primarily by acoustic data (Jaramillo-Legorreta et al. 2017). There were estimated to be only 59 individuals remaining (95 percent Bayesian Credible Interval 22 to 145) in the fall of 2015 based on both line transect survey and acoustic data (Taylor et al. 2016). The Comité Internacional para la Recuperación de la Vaquita (CIRVA) estimated that only about 30 individuals remain as of November 2016 (CIRVA 2016), and at least six individuals have died since this time putting the population below 30 individuals (CIRVA 2017). During recent efforts between March 6 to April 17, 2017, only two encounters with vaquita were recorded (CIRVA 2017). (Jaramillo-Legoretta et al. 2019) estimate fewer than 19 vaquitas remained as of summer 2018. Others now estimate 10 or fewer animals remain (Robinson et al. 2022).

Not surprisingly given their low abundance, vaquita have low genetic diversity. Genetic analysis of 43 individuals sampled between 1985 and 1993, revealed a complete lack of variability in a 400 to 600 base pair control region of mtDNA (Rosel and Rojas-Bracho 1999). However, low genetic diversity and inbreeding is not considered a major threat to the species as its effective population size and, thus, genetic diversity, appears to have always been low (Robinson et al. 2022; Rojas-Bracho and Taylor 1999; Taylor and Rojas-Bracho 1999). Nonetheless, vaquita appear to also have low variability at two major histocompatibility complex class II loci, suggesting the species may have high susceptibility to novel pathogens and diseases (Munguia-Vega et al. 2007).

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

#### 5.2.8.3 *Hearing*

Based on vocalizations and data from related harbor porpoises (*Phocoena phocoena*), vaquita are expected to have a hearing range between 275 Hz to 160 kHz (NOAA 2016).

#### 5.2.8.4 *Status*

The decline in vaquita abundance is attributed almost exclusively to bycatch from gill net and shrimp fisheries, especially illegal gill net fisheries targeting totoaba (*Totoaba macdonaldi*) (Rojas-Bracho et al. 2006). While additional threats such as indirect effects of trawling on vaquita prey, dam construction on the Colorado River, and subsequent loss of fresh water input to the Gulf of California are possible, but not immediate or well understood (Rojas-Bracho et al. 2006). Between 1993 and 1994 estimate rates of bycatch ranged between 39 and 84 animals per year, but actual rates could be as high as 155 animals per year, and perhaps even higher (Rojas-Bracho et al. 2006). This is well above rates the small population can withstand.

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

#### 5.2.8.5 *Critical Habitat*

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

#### 5.2.8.6 *Recovery Goals*

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

### 5.2.9 Rice's Whale (formerly Gulf of Mexico Bryde's Whale)

The Rice's whale is a widely distributed baleen whale found in tropical and subtropical oceans. The Rice's whale is the only known baleen whale to inhabit the Gulf of Mexico year-round. The Rice's whale is found in the northeastern Gulf of Mexico near De Soto Canyon between the 100 and 300 meter (328.1 to 984.3 feet) depth contours.

Consequently, LaBrecque et al. (2015) designated this area as a Biologically Important Area. There have also been sightings at 302 and 309 meters (990.8 and 1,013.8 feet) depth in this region and west of Pensacola, Florida; for this reason, the core area inhabited by the species is probably better described out to the 400 meter (1,312.3 feet) depth contour and to Mobile Bay, Alabama, to provide some buffer around the deeper water sightings and to include all sighting locations in the northeastern Gulf of Mexico, respectively (Rosel 2016b). From historical whaling records and several recent sightings, there some evidence of a former distribution of these whales in waters of north-central and southern Gulf of Mexico (Rosel 2016b).

Bryde's whales, in general, grow to lengths of 13 to 16.5 meters (42.7 to 54.1 feet). Rice's whales are somewhat smaller and have a large falcate dorsal fin, streamlined body shape, and pointed, flat rostrum. There are three ridges on the dorsal surface of the rostrum that distinguish it from other similar-looking species, such as the sei whale (Rosel 2016b). Bryde's whales have a counter-shaded color that is uniformly dark dorsally and light to pinkish ventrally. The Gulf of Mexico subspecies of Bryde's whale was listed under the ESA as endangered on April 15, 2019 (84 FR 15446). In 2021, NMFS revised the common name from Gulf of Mexico Bryde's whale to Rice's whale, as well as the classification from subspecies to species.

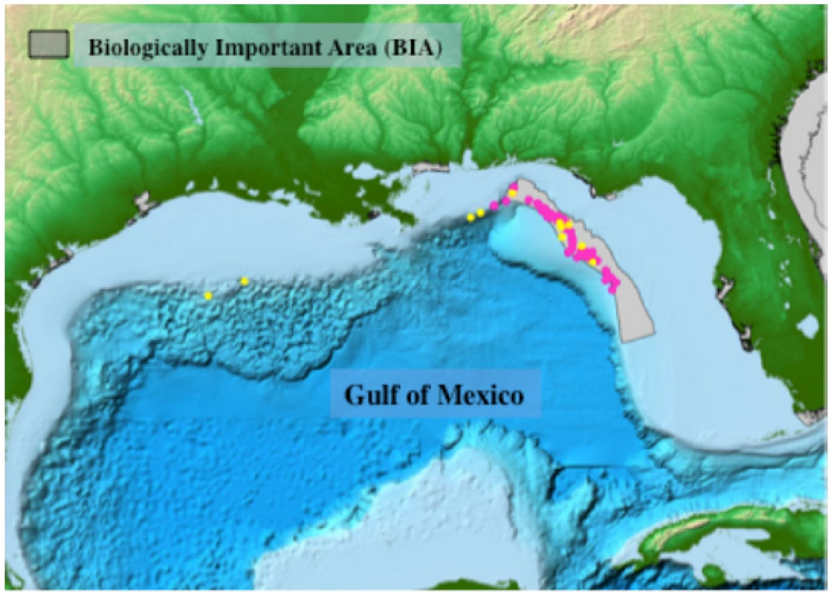


**Figure 11:** Map identifying the biologically important area and known range of Rice's whales. From (Rosel et al. 2016).

Information available from the status review (Rosel et al. 2016), most recent stock assessment report (Hayes et al. 2021), and available literature were used to summarize the life history, population dynamics, and status of the species as follows.

### 5.2.9.1 *Life History*

Little is known about the Rice's whale life history compared to Bryde's whales more generally and worldwide. The life expectancy of Rice's whales is unknown. Other stocks of this species have a gestation period of 11 to 12 months, give birth to a single calf, which is nursed for six to 12 months. Age of sexual maturity is not known for Rice's whales specifically, but Bryde's whales are thought to be sexually mature at eight to 13 years. Peak breeding and calving probably occurs in the fall. Females breed every second year. Rice's whales exhibit a typical diel dive pattern, with deep dives in the daytime, and shallow dives at night. Bryde's whales generally feed on schooling fishes (e.g., anchovy, sardine, mackerel, and herring) and small crustaceans (Rosel 2016b).

Bryde's whales, unlike other baleen whales, are not known to make long foraging migrations (Figueiredo et al. 2014). The Rice's whale is a year-round resident of the Gulf of Mexico. Bryde's whales are known to dive to over 200 meters (656.2 feet) depth to feed on small fish or crustaceans and their occurrence is thought to be determined to prey abundance (Kerosky et al. 2012). They are observed in small groups, pairs or solitary and reportedly seem curious about ships (Lodi et al. 2015; Rosel 2016b; Tershy 1992).

According to Rice (1998), adult *B. e. edeni* rarely exceed 11.5 meters (37 feet) total length and adult *B. e. brydei* reach approximately 14 to 15 meters (46 to 49 feet). Rosel and Wilcox (2014) summarized body length information in the Gulf of Mexico from strandings and concluded that they may have a size range intermediate to the currently recognized subspecies. This is similar to Bryde's whales off the coast of South Africa where inshore males are estimated to attain maturity at 12.2 to 12.5 meters (40 to 41 feet) compared to 12.8 to 13.7 meters (42 to 45 feet) for offshore males, while inshore females reach sexual maturity at 11.9 to 12.5 meters (39 to 41 feet) compared to 12.8 to 13.1 meters (42 to 43 feet) for offshore females (Best 2001).

#### 5.2.9.2 *Population Dynamics*

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

The Rice's whale population is very small; an estimate from 2009 places the population size at 33 individuals ($N_{min}$=16). A second estimate incorporating visual survey data from 1992 through 2009 estimated 44 individuals (Rosel 2016b). Currently, the best estimate of population size is 51 animals and the minimum population size is 34 animals (Hayes et al. 2021). There is no population trend information available for the Rice's whale.

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

Phylogenetic reconstruction using the control region and all published Bryde's whale sequences reveal that the Rice's whale haplotypes are evolutionarily distinct from the other two recognized subspecies of Bryde's whale as the two subspecies are from each other. In addition, the Rice's whale is more genetically differentiated from the two recognized subspecies than is the sei whale, which is an entirely different species (Rosel and Wilcox 2014).

The range of Rice's whales is primarily in a small, biologically important area in the northeastern Gulf of Mexico near De Soto Canyon, in waters 100 to 400 meters (328 to 1,312 feet) deep along the continental shelf break. It inhabits the Gulf of Mexico year round, but its distribution outside of this biologically important area is unknown.

#### 5.2.9.3 *Hearing*

While no data exist on the hearing abilities of Bryde's whale, as with other marine mammals we assume they hear best in the frequency range in which they produce calls, which have been recorded ranging in frequency from 43 to 208 Hertz (Rice et al. 2014).

#### 5.2.9.4 *Status*

Historically, commercial whaling did occur in the Gulf of Mexico, but the area was not considered prime whaling grounds. Bryde's whales were not specifically targeted by commercial whalers, but the "finback whales" which were caught between the mid-1700s and late 1800s were likely Bryde's whales (Reeves et al. 2011). The Bryde's whale status review identified 27 possible threats to Rice's whales, with the following four being the most significant: (1) sound; (2) vessel collisions; (3) energy exploration; (4) oil spills and oil spill response. Noise from shipping traffic and seismic surveys in the region may impact Rice's whales' ability to communicate. Vessel traffic from commercial shipping and the oil and gas industry also poses a risk of vessel strike for Rice's whales. Entanglement from fishing gear is also a threat, and several fisheries operate within the range of the species. The *Deepwater Horizon* oil spill severely impacted Rice's whales in the Gulf of Mexico, with an estimated 17 percent of the population killed, 22 percent of females exhibiting reproductive failure, and 18 percent of the population suffering adverse health effects (DWHTrustees 2016). Because the Rice's whale population is so small size and has low genetic diversity, it is highly susceptible to further perturbations.

#### 5.2.9.5 *Critical Habitat*

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

#### 5.2.9.6 *Recovery Goals*

See the 2020 Recovery Plan outline (NMFS 2020a) for the Rice's whale for details of the interim recovery program, the focus of which includes:

1. Controlling threats to the species in its known range and
2. Gathering additional information through research and monitoring on the species'current distribution and abundance, reproductive periodicity and seasonality, location of breeding and nursing grounds, mortality causes and rates, and prey species and the status and distribution of those species.

### 5.2.10 Humpback Whale (Arabian Sea Distinct Population Segment)

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 12).

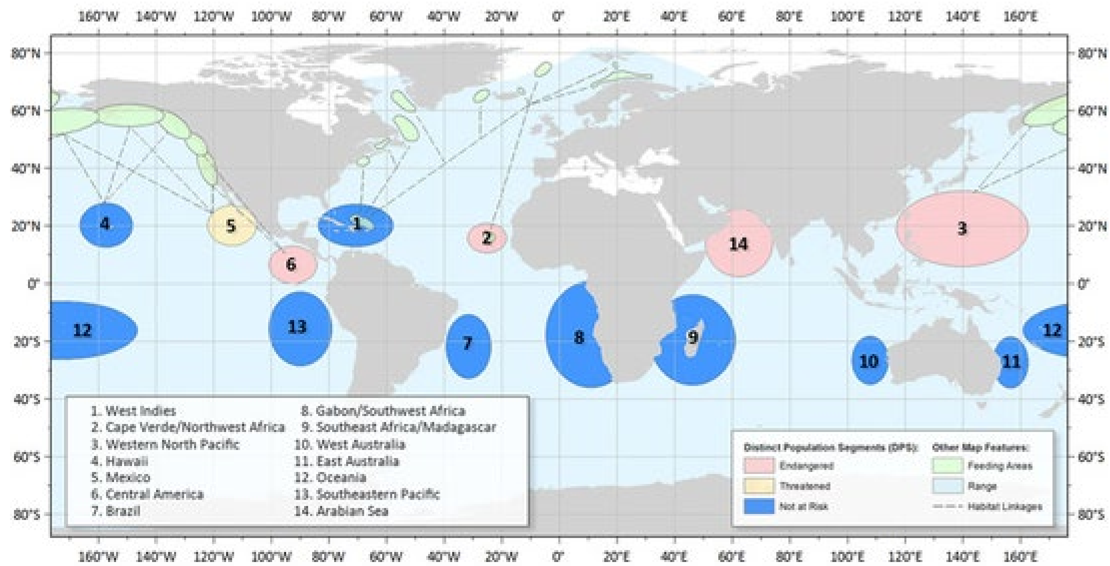


**Figure 12. Map identifying 14 distinct population segments with one threatened and four endangered, based on primarily breeding location of the humpback whale, their range, and feeding areas (Bettridge et al. 2015).**

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

Information available from the recovery plan (NMFS 1991a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

### 5.2.10.1 *Life History*

Humpback whales can live, on average, 50 years. They have a gestation period of 11 to 12 months, and calves nurse for one year. Sexual maturity is reached between five to 11 years of age with an average calving interval of two to three years. Humpback whales mostly inhabit coastal and continental shelf waters. They winter at lower latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpback whales exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

### 5.2.10.2 *Population Dynamics*

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

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Arabian Sea DPS is 82. A population growth rate is currently unavailable for the Arabian Sea DPS of humpback whale.

For humpback whales, DPSs that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population of 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Population at low densities (less than one hundred) are more likely to suffer from the ‘Allee” effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The entire range of the Arabian Sea DPS has not been surveyed, but the most recent estimate abundance is less than 100 individuals, putting it at high risk of extinction due to lack of genetic diversity. The low abundance of this DPS suggests that the population has reached a genetic bottleneck and is at an increased risk to impacts from inbreeding, such as reduced genetic fitness and susceptibility to disease (Bettridge et al. 2015).

#### 5.2.10.3 *Hearing*

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018f). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hertz to 10 kiloHertz, with maximum relative sensitivity between 2 kiloHertz and 6 kiloHertz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kiloHertz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kiloHertz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kiloHertz at 219 decibels re: 1 μPa-meter or frequency sweep of 3.1 to 3.6 kiloHertz. In addition, the system had some low frequency components (below 1 kiloHertz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

#### 5.2.10.4 *Status*

Global abundance declined to the low thousands by 1968, the last year of substantial catches (IUCN 2012). Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling” provisions of the International Whaling Commission. Additional threats include vessel strikes, fisheries interactions (including entanglement), energy development, harassment from whaling watching noise, harmful algal blooms, disease, parasites, and climate change. Along with sperm whales, humpback whales have been identified as the marine mammal species most affected by anthropogenic activities worldwide in terms of overall area of documented risk (Avila 2018). The species' large population size and increasing trends indicate that it is resilient to current threats, but the Arabian Sea DPS of humpback whales still faces a risk of extinction.

#### 5.2.10.5 *Critical Habitat*

No critical habitat has been designated for the humpback whale Arabian Sea DPS.

#### 5.2.10.6 *Recovery Goals*

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

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

### 5.2.11 Humpback Whale (Cape Verde Islands/Northwest Africa Distinct Population Segment)

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 12). Humpback whales are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. The humpback whale was originally listed as endangered on December 2, 1970 (35 FR 18319). Since then, NMFS has designated 14 DPSs with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one as threatened (Mexico).

Information available from the recovery plan (NMFS 1991a), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.11.1 *Life History*

Humpback whales can live, on average, 50 years. They have a gestation period of 11 to 12 months, and calves nurse for one year. Sexual maturity is reached between five to 11 years of age with an average calving interval of two to three years. Humpback whales mostly inhabit coastal and continental shelf waters. They winter at lower latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpback whales exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

#### 5.2.11.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the Cape Verde Islands/Northwest Africa DPS of humpback whales.

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance of the Cape Verde Islands/Northwest Africa DPS of humpback whales is unknown (81 FR 62259). Ryan et al. (2014) states that the best abundance estimate for the Cape Verde Islands/Northwest Africa DPS of humpback whales is 171 to 260 animals, which is higher than the 99 animals previously reported by Punt et al. (2006). Corkeron and Wenzel have reanalyzed the population size of the Cape Verde Islands/Northwest Africa DPS of humpback whales from 2010 through 2018 and state the abundance estimate is just under approximately 300 animals (P. Corkeron, NMFS Northeast Fisheries Science Center, personal communication to Howard Goldstein, NMFS, April 4, 2019). A population growth rate is currently unavailable for the Cape Verde Islands/Northwest Africa DPS of humpback whales.

For humpback whales, DPSs that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population of five hundred individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Population at low densities (less than one hundred) are more likely to suffer from the ‘Allee” effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The exact population size of the Cape Verde Islands/Northwest Africa DPS of humpback whales is unknown at this time and therefore evidence of genetic diversity (or lack of) cannot be determined (Bettridge et al. 2015).

The Cape Verde Islands/Northwest Africa DPS consists of humpback whales whose breeding range includes waters surrounding the Cape Verde Islands as well as undetermined breeding area in the eastern tropical Atlantic Ocean, and possibly the Caribbean Sea. Evidence shows that some humpback whales using Eastern North Atlantic Ocean feeding areas that migrate to the Cape Verde Islands (Reiner et al. 1996; Stevick et al. 2016; Wenzel et al. 2009) as four have been photographed and identified in both the Cape Verde Islands and the Caribbean Sea (Stevick et al. 2016).

The Cape Verde Islands are the only known breeding area for humpback whales in the Eastern North Atlantic Ocean (Ryan et al. 2014). Its feeding range includes primarily Iceland and Norway. The population of humpback whales breeding in the Cape Verde Islands, plus this unknown area, likely represent the remnants of a historically larger population breeding around the Cape Verde Islands and Northwestern Africa (Reeves et al. 2002a). Recent information provides some evidence to indicate there may be two different breeding areas in the Caribbean Sea, with different breeding times, and the humpback whales breeding in the Southeast Caribbean Sea seem to be more prevalent in the Eastern North Atlantic Ocean feeding areas (Stevick et al. 2016). Some humpback whales from the Cape Verde Islands breeding areas have been resighted in the Southeast Caribbean Sea (Guadeloupe) (Stevick et al. 2016), suggesting the Caribbean Sea may be part of Cape Verde Islands/Northwest Africa DPS breeding area, though this has not been confirmed. Preliminary results from whaling records, photo-identification, and genetic analysis studies suggest that the Cape Verde Islands/Northwest Africa DPS is reproductively isolated from other populations (e.g., West Indies DPS) breeding in other locations in the North Atlantic Ocean (Ryan et al. 2014).

Clapham and Wade (in review) state that recent genetic analysis by Palsboll indicates that humpback whales from the Eastern North Atlantic Ocean likely belong to a separate breeding population from the West Indies, but the migratory destination is unknown and is unlikely to be just the Cape Verde Islands. The number of animals in the Cape Verde Islands/Northwest Africa DPS is too small to account for all of the animals feeding in the Eastern North Atlantic Ocean. Most animals from the Cape Verde Islands/Northwest Africa DPS come from the Eastern North Atlantic Ocean feeding area, but not all animals from the Eastern North Atlantic Ocean feeding area migrate to the Cape Verde Islands to breed (Clapham and Wade in review).

Based on Stevick et al. (2016) there have been four animals resighted from the Cape Verde Islands in the Guadeloupe region (Lesser Antilles) of the Caribbean Sea. Two of these humpback whales are assumed/confirmed as males (one was a biopsy confirmation and in a competitive group, one was a singer, and the other was in a competitive group). The male humpback whales were matched/resighted in the Cape Verde Islands, one was a resight in the northern feeding area (Norway), and all four were seen in Guadeloupe. None of these four animals has been resighted in the Cape Verde Islands and Guadeloupe during the same year. No resightings of Cape Verde Islands/Northwest Africa DPS of humpback whales have been made in the Navidad/Silver Bank breeding/calving area. The assumption is that the animals are traveling from the Cape Verde Islands to the northern feeding areas (Eastern North Atlantic Ocean) and then continuing to the Southeast Caribbean Sea in subsequent seasons. This is approximately 7,000 kilometers (3,779.7 nautical miles) from the Cape Verde Islands to Norway and 7,700 kilometers (4,158 nautical miles) from Norway to Guadeloupe. The two breeding and calving area sites (Cape Verde Islands and Caribbean Sea) are separated by an ocean basin and greater than approximately 4,000 kilometers (2,160 nautical miles). Timing of the humpback whales (all) arrival in Guadeloupe (February through May) is approximately six weeks later (greatest abundance) than the humpback whales in Navidad Bank/Silver Bank (January through April) and may be related to the feeding area origin/destination (Stevick et al. 2018).

During a passive acoustic monitoring study from 2016 through 2017, humpback whales in the Greater Antilles were recorded singing from December through May and in the Lesser Antilles from January through June (Heenehan et al. in review). Humpback whale songs were detected four to six weeks later in the Lesser Antilles (Guadeloupe and Martinique) (Corkeron et al. in review). These passive acoustic monitoring data provide additional evidence of a delayed arrival and late departure in the Lesser Antilles compared to the Greater Antilles.

The status of populations of humpback whale in the breeding areas of the Caribbean Sea is unresolved (Corkeron et al. in review). There are currently two competing hypotheses for humpback whales in the North Atlantic Ocean: (1) humpback whales in the Caribbean Sea consist of a single population; and (2) humpback whales in the Caribbean Sea consist of two subpopulations – a larger number of animals from the Western North Atlantic Ocean occur in the Northwestern Caribbean Sea or West Indies (Greater Antilles) earlier in the breeding season (December through early March) and a smaller number of animals from the Eastern North Atlantic Ocean occur in the Southeast Caribbean Sea (Lesser Antilles) later in the breeding season (mid-March through late May) and include the Cape Verde Islands/Northwest Africa DPS (Stevick et al. 2018) (Corkeron et al. in review). Kennedy and Clapham (2018) state that the two population hypothesis is unlikely due to animals from the Western North Atlantic feeding area have been matched using photo-identification to the breeding areas in the Greater Antilles and Lesser Antilles. Photo-identification matches within the range of the breeding area also indicate some inter-island movement (Kennedy et al. 2014). However, (Heenehan et al. 2019) states that passive acoustic monitoring data from the five sites on four islands in the Caribbean Sea supports the two population hypothesis. If the two population hypothesis is correct, a key question to consider is whether or not humpback whales that use the Eastern North Atlantic Ocean as a feeding area and have a delayed migration to the breeding area in the Caribbean Sea be considered part of the West Indies DPS or Cape Verde Islands/Northwest Africa DPS (P. Corkeron, NMFS Northeast Fisheries Science Center, personal communication to Howard Goldstein, NMFS, April 4, 2019).

#### 5.2.11.3 *Hearing*

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018f). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hertz to 10 kiloHertz, with maximum relative sensitivity between 2 kiloHertz and 6 kiloHertz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kiloHertz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kiloHertz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kiloHertz at 219 decibels re: 1 μPa-meter or frequency sweep of 3.1 to 3.6 kiloHertz. In addition, the system had some low frequency components (below 1 kiloHertz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

#### 5.2.11.4 *Status*

Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling” provisions of the International Whaling Commission. Additional threats include vessel strikes, fisheries interactions (including entanglement), energy development, harassment from whaling watching noise, harmful algal blooms, disease, parasites, and climate change. Along with sperm whales, humpback whales have been identified as the marine mammal species most affected by anthropogenic activities worldwide in terms of overall area of documented risk (Avila 2018). The species' large population size and increasing trends indicate that it is resilient to current threats, but the Cape Verde Islands/Northwest Africa DPS of humpback whales still faces a risk of extinction.

#### 5.2.11.5 *Critical Habitat*

No critical habitat has been designated for the humpback whale Cape Verde/Northwest Africa DPS.

#### 5.2.11.6 *Recovery Goals*

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

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

### 5.2.12 Humpback Whale (Central America Distinct Population Segment)

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 12). Humpbacks are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. The humpback whale was originally listed as endangered on December 2, 1970. Since then, NMFS has designated 14 distinct population segments (DPSs) with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one as threatened (Mexico).

Information available from the recovery plans (NMFS 1991a), recovery plan outline serving as interim guidance until a final recovery plan is available for the humpback whale Central America DPS (NMFS 2022j), recent stock assessment report (Carretta et al. 2020), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.12.1 *Life History*

Humpback whales can live, on average, 50 years. They have a gestation period of 11 to 12 months, and calves nurse for one year. Sexual maturity is reached between five to 11 years of age with an average calving interval of two to three years. Humpback whales mostly inhabit coastal and continental shelf waters. They winter at lower latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpback whales exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

#### 5.2.12.2 *Population Dynamics*

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

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The abundance of the Central America DPS has been estimated to be 1,476 whales with an estimated annual growth rate of 1.6 percent (NMFS 2022j).

For humpback whales, DPSs that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population of 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Population at low densities (less than one hundred) are more likely to suffer from the 'Allee" effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The Central America DPS has less than 2,000 individuals total. Thus, while its genetic diversity may be protected from moderate environmental variance, it could be subject to extinction due to genetic risks due to low abundance (Bettridge et al. 2015).

The Central America DPS is composed of humpback whales that breed along the Pacific coast of Costa Rica, Panama, Guatemala, El Salvador, Honduras, and Nicaragua. This DPS feeds almost exclusively offshore of California and Oregon in the eastern Pacific Ocean, with only a few individuals identified at the northern Washington – southern British Columbia feeding grounds (Figure 12).

#### 5.2.12.3 *Hearing*

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018f). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hertz to 10 kiloHertz, with maximum relative sensitivity between 2 kiloHertz and 6 kiloHertz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kiloHertz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kiloHertz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kiloHertz at 219 decibels re: 1 µPa-meter or frequency sweep of 3.1 to 3.6 kiloHertz. In addition, the system had some low frequency components (below 1 kiloHertz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

#### 5.2.12.4 *Status*

Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the International Whaling Commission. Additional threats include vessel strikes, fisheries interactions (including entanglement), energy development, harassment from whaling watching noise, harmful algal blooms, disease, parasites, and climate change. Along with sperm whales, humpback whales have been identified as the marine mammal species most affected by anthropogenic activities worldwide in terms of overall area of documented risk (Avila 2018). The species' large population size and increasing trends indicate that it is resilient to current threats, but the Central America DPS still faces a risk of extinction.

#### 5.2.12.5 *Critical Habitat*

See Section 5.1.4.3 for a description of Central America DPS humpback whale critical habitat.

#### 5.2.12.6 *Recovery Goals*

See the 2022 Recovery Plan outline (NMFS 2022j) for the humpback whale Central America DPS for details of the interim recovery program, the focus of which includes:

1. Management activities that continue to protect humpback whales and their critical habitat;
2. Management activities that reduce medium and high risk threats to humpback whales, including vessel strike and entanglement in fishing gear;
3. Research activities to fill critical information gaps necessary to inform management actions;
4. Education and outreach activities to engage ocean users and to promote public involvement in humpback whale research and recovery.

### 5.2.13 Humpback Whale (Mexico Distinct Population Segment)

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 12). Humpbacks are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. The humpback whale was originally listed as endangered on December 2, 1970. Since then, NMFS has designated 14 distinct population segments (DPSs) with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one as threatened (Mexico).

Information available from the recovery plans (NMFS 1991a), recovery plan outline serving as interim guidance until a final recovery plan is available for the humpback whale Mexico DPS (NMFS 2022j), recent stock assessment report (Carretta et al. 2020), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.13.1 *Life History*

Humpback whales can live, on average, 50 years. They have a gestation period of 11 to 12 months, and calves nurse for one year. Sexual maturity is reached between five to 11 years of age with an average calving interval of two to three years. Humpback whales mostly inhabit coastal and continental shelf waters. They winter at lower latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpback whales exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

#### 5.2.13.2 *Population Dynamics*

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

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). The current abundance and population growth rate of the Mexico DPS is unavailable (NMFS 2022j).

For humpback whales, DPSs that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population of 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Population at low densities (less than one hundred) are more likely to suffer from the 'Allee" effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The Mexico DPS is estimated to have more than 2,500 individuals and thus, should have enough genetic diversity for long-term persistence and protection from substantial environmental variance and catastrophes (Bettridge et al. 2015).

The Mexico DPS is composed of humpback whales that breed along the Pacific coast of mainland Mexico, and the Revillagigedos Islands, and transit through the Baja California Peninsula coast. This DPS feeds across a broad geographic range from California to the Aleutian Islands, with concentrations in California-Oregon, northern Washington-southern British Columbia, northern and western Gulf of Alaska, and Bering Sea feeding grounds (Figure 12)(81 FR 62259).

#### 5.2.13.3 *Hearing*

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018f). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hertz to 10 kiloHertz, with maximum relative sensitivity between 2 kiloHertz and 6 kiloHertz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kiloHertz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kiloHertz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kiloHertz at 219 decibels re: 1 μPa-meter or frequency sweep of 3.1 to 3.6 kiloHertz. In addition, the system had some low frequency components (below 1 kiloHertz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

#### 5.2.13.4 *Status*

Humpback whales may be killed under "aboriginal subsistence whaling" and "scientific permit whaling" provisions of the International Whaling Commission. Additional threats include vessel strikes, fisheries interactions (including entanglement), energy development, harassment from whaling watching noise, harmful algal blooms, disease, parasites, and climate change. Along with sperm whales, humpback whales have been identified as the marine mammal species most affected by anthropogenic activities worldwide in terms of overall area of documented risk (Avila 2018). The species' large population size and increasing trends indicate that it is resilient to current threats, but the Mexico DPS still faces a risk of becoming endangered within the foreseeable future throughout all or a significant portion of its range.

#### 5.2.13.5 *Critical Habitat*

See Section 5.1.4.3 for a description of Mexico DPS humpback whale critical habitat.

#### 5.2.13.6 *Recovery Goals*

See the 2022 Recovery Plan outline (NMFS 2022j) for the humpback whale Mexico DPS for details of the interim recovery program, the focus of which includes:

1. Management activities that continue to protect humpback whales and their critical habitat;
2. Management activities that reduce medium and high risk threats to humpback whales, including vessel strike and entanglement in fishing gear;
3. Research activities to fill critical information gaps necessary to inform management actions; and
4. Education and outreach activities to engage ocean users and to promote public involvement in humpback whale research and recovery.

### 5.2.14 Humpback Whale (Western North Pacific Distinct Population Segment)

The humpback whale is a widely distributed baleen whale found in all major oceans (Figure 12). Humpbacks are distinguishable from other whales by long pectoral fins and are typically dark grey with some areas of white. The humpback whale was originally listed as endangered on December 2, 1970. Since then, NMFS has designated 14 distinct population segments (DPSs) with four identified as endangered (Cape Verde Islands/Northwest Africa, Western North Pacific, Central America, and Arabian Sea) and one as threatened (Mexico).

Information available from the recovery plans (NMFS 1991a), recovery plan outline serving as interim guidance until a final recovery plan is available for the humpback whale Western North Pacific DPS (NMFS 2022j), recent stock assessment report (Carretta et al. 2020), the status review (Bettridge et al. 2015), and the final listing were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.14.1 *Life History*

Humpback whales can live, on average, 50 years. They have a gestation period of 11 to 12 months, and calves nurse for one year. Sexual maturity is reached between five to 11 years of age with an average calving interval of two to three years. Humpback whales mostly inhabit coastal and continental shelf waters. They winter at lower latitudes, where they calve and nurse, and summer at high latitudes, where they feed. Humpback whales exhibit a wide range of foraging behaviors and feed on a range of prey types, including: small schooling fishes, euphausiids, and other large zooplankton (Bettridge et al. 2015).

#### 5.2.14.2 *Population Dynamics*

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

The global, pre-exploitation estimate for humpback whales is 1,000,000 (Roman and Palumbi 2003). Data collected from 2004 to 2006 estimated the abundance of the Western North Pacific DPS to be 1,084 whales (NMFS 2022j). Current abundance and population growth estimates of the Western North Pacific DPS are not available.

For humpback whales, DPSs that have a total population size of 2,000 to 2,500 individuals or greater provide for maintenance of genetic diversity resulting in long-term persistence and protection from substantial environmental variance and catastrophes. Distinct population segments that have a total population of 500 individuals or less may be at a greater risk of extinction due to genetic risks resulting from inbreeding. Population at low densities (less than one hundred) are more likely to suffer from the 'Allee" effect, where inbreeding and the heightened difficulty of finding mates reduces the population growth rate in proportion with reducing density. The Western North Pacific DPS has less than 2,000 individuals total, and is made up of two sub-populations, Okinawa/Philippines and the Second West Pacific. Thus, while its genetic diversity may be protected from moderate environmental variance, it could be subject to extinction due to genetic risks due to low abundance (Bettridge et al. 2015).

The Western North Pacific DPS is composed of humpback whales that breed/winter in the area of Okinawa and the Philippines, another unidentified breeding area (inferred from sightings of whales in the Aleutian Islands area feeding grounds), and those transiting from the Ogasawara area. These whales migrate to feeding grounds in the northern Pacific Ocean, primarily off the Russian coast (Figure 12).

#### 5.2.14.3 *Hearing*

NMFS categorizes humpback whales in the low-frequency cetacean functional hearing group, with an applied frequency range between 7 Hertz and 35 kiloHertz (NMFS 2018f). Humpback whale audiograms using a mathematical model based on the internal structure of the ear estimate sensitivity is from 700 Hertz to 10 kiloHertz, with maximum relative sensitivity between 2 kiloHertz and 6 kiloHertz (Ketten and Mountain 2014). Research by Au et al. (2001) and Au et al. (2006) off Hawaii indicated the presence of high frequency harmonics in vocalizations up to and beyond 24 kiloHertz. While recognizing this was the upper limit of the recording equipment, it does not demonstrate that humpback whales can actually hear those harmonics, which may simply be correlated harmonics of the frequency fundamental in the humpback whale song. The ability of humpback whales to hear frequencies around 3 kiloHertz may have been demonstrated in a playback study. Maybaum (1990) reported that humpback whales showed a mild response to a handheld sonar marine mammal detection and location device with frequency of 3.3 kiloHertz at 219 decibels re: 1 μPa-meter or frequency sweep of 3.1 to 3.6 kiloHertz. In addition, the system had some low frequency components (below 1 kiloHertz) which may have been an artifact of the acoustic equipment. This possible artifact may have affected the response of the whales to both the control and sonar playback conditions.

#### 5.2.14.4 *Status*

Humpback whales may be killed under “aboriginal subsistence whaling” and “scientific permit whaling” provisions of the International Whaling Commission. Additional threats include vessel strikes, fisheries interactions (including entanglement), energy development, harassment from whaling watching noise, harmful algal blooms, disease, parasites, and climate change. Along with sperm whales, humpback whales have been identified as the marine mammal species most affected by anthropogenic activities worldwide in terms of overall area of documented risk (Avila 2018). The species’ large population size and increasing trends indicate that it is resilient to current threats, but the Western North Pacific DPS of humpback whales still faces a risk of extinction.

#### 5.2.14.5 *Critical Habitat*

See Section 5.1.4.3 for a description of Western North Pacific DPS humpback whale critical habitat.

#### 5.2.14.6 *Recovery Goals*

See the 2022 Recovery Plan outline (NMFS 2022j) for the humpback whale Western North Pacific DPS for details of the interim recovery program, the focus of which includes:

1. Management activities that continue to protect humpback whales and their critical habitat;
2. Management activities that reduce medium and high risk threats to humpback whales, including vessel strike and entanglement in fishing gear;
3. Research activities to fill critical information gaps necessary to inform management actions; and
4. Education and outreach activities to engage ocean users and to promote public involvement in humpback whale research and recovery.

### 5.2.15 Indus River dolphin

The Indus River dolphin is a subspecies of the Ganges river dolphin. It lives exclusively in the Indus River system in Pakistan and India (Figure 13).

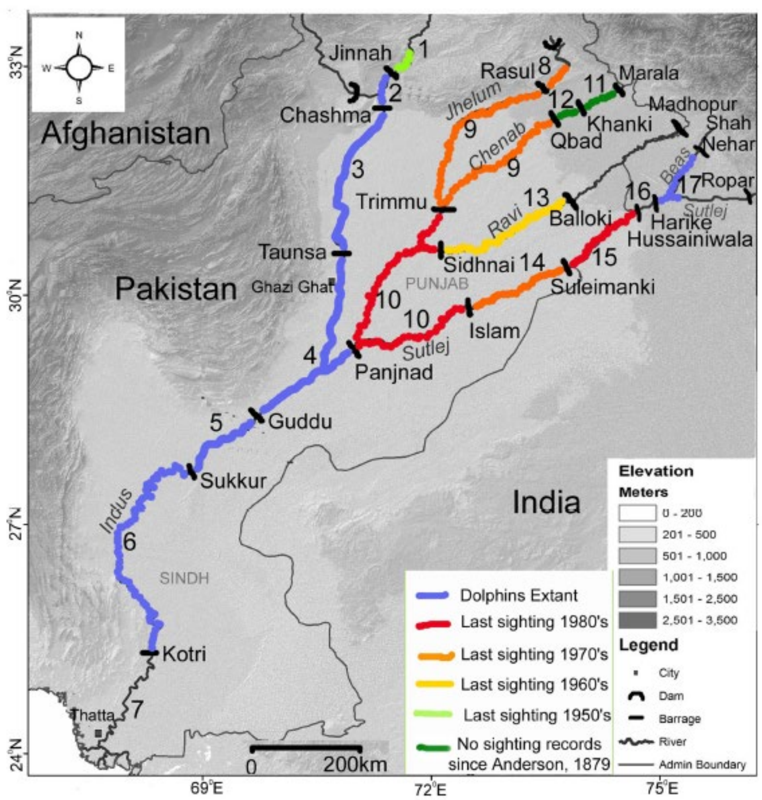


**Figure 13.** Map identifying the range of the Indus River dolphin subpopulations. From (Braulik et al. 2014).

Indus River dolphins have rounded stocky bodies and a long narrow beak. They can grow to 2.6 meters long and weigh 70 to 90 kilograms. Indus River dolphins have very small eyes and are functionally blind. The Indus River dolphin was originally listed as endangered on January 14, 1991. Information available from the five-year status review (NMFS 2016e) and available literature were used to summarize the life history, population dynamics and status of the Indus River dolphin as follows.

#### 5.2.15.1 *Life History*

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

#### 5.2.15.2 *Population Dynamics*

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

The minimum population estimate for the Indus River dolphin was 1,452 in 2011 (Braulik et al. 2015b; NMFS 2016e). The Indus River dolphin is composed of six extant subpopulations, described as those individuals residing in sections of the Indus River defined by barrages, or dams used for irrigation, as dividing points for the subpopulations (Figure 13). The three largest subpopulations—between the Chashma and Taunsa Barrages, between the Taunsa and Guddu Barrages, and between the Guddu and Sukkur Barrages—make up approximately 99 percent of the total population, occurring in about 690 kilometers of the Indus River. The remaining three subpopulations are comparatively small (Table 9).

**Table 9:** Abundance estimates for Indus River dolphin subpopulations.

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

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

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

Indus River dolphins inhabit freshwater in the Indus River and its tributaries (Figure 13). They seem to prefer areas of the river with depths between 2.4 and 5.1 meters, and widths of 0.5 to 2 kilometers (NMFS 2016e). Additionally, Indus River dolphins favor confluence areas in the river, with counter-current eddies that help trap fish and provide a resting area where they are not continuously swimming against the downstream current.

#### 5.2.15.3 *Hearing*

We are not aware of any hearing data on Indus river dolphins specifically, but data from other river dolphins indicate they are high frequency specialists, with a likely hearing range between 275 Hz to 160 kHz (NOAA 2016).

#### 5.2.15.4 *Status*

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

#### 5.2.15.5 *Critical Habitat*

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

#### 5.2.15.6 *Recovery Goals*

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

### 5.2.16 Killer Whale (Southern Resident Distinct Population Segment)

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

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

We used information available in the final rule, the Recovery Plan (NMFS 2008a), the 2021 Status Review (NMFS 2021e), the recent stock assessment report (Carretta et al. 2021), and the available literature to summarize the life history, population dynamics and status of this species, as follows.

#### 5.2.16.1 *Life History*

Killer whales show considerable sexual size "dimorphism". Adult males develop larger pectoral flippers, dorsal fins, tail flukes, and girths than females. Male adult killer whales can reach up to 32 feet (9.8 meters) in length and can weigh nearly 22,000 pounds (10,000 kg); females can reach 28 feet (8.5 meters) in length and can weigh up to 16,500 pounds (7,500 kg). Males become sexually mature at ten to 17 years of age. Females reach maturity at 12 to 16 years of age and produce an average of 5.4 surviving calves during a reproductive life span of approximately 25 years. Mothers and offspring maintain highly stable, life-long social bonds, and this natal relationship is the basis for a matrilineal social structure. Life expectancy for wild female killer whales is approximately 50 years, with maximum longevity estimated at 80 to 90 years. Male killer whales typically live for about 30 years, with maximum longevity estimated at 50 to 60 years.

Recent studies have utilized movement variables of subsurface behavior to identify prey capture events in order to explore sex differences in foraging ecology of fish-eating killer whales. Results show that males made more prey capture dives than females, presumably to support the energetic requirements of a larger body size (Tennessen et al. 2019a; Tennessen et al. 2019b). Females were more likely than males to engage in non-foraging behavior, and spent notably more time in surface respiration, intermediate depth or traveling states than males, who spent substantially more time searching for and pursuing prey. Although limited by small sample sizes, these studies suggest that female foraging behavior may be temporally compartmentalized, due to the time demands of caring for calves or other offspring or kin, and due to the potentially increased costs of transport for females with calves.

The Southern Resident killer whales DPS includes three large, stable pods or familial groups (J, K, and L), which occasionally interact (Parsons et al. 2009). Most mating was thought to occur outside natal pods, during temporary associations of pods, or as a result of the temporary dispersal of males (Pilot et al. 2010). However, recent genetic paternity analyses using single nucleotide polymorphisms and microsatellites indicate that mating within Southern Resident killer whale pods is common and inbreeding is occurring in the population (Ford et al. 2018). Four cases of strong inbreeding were detected (two between parent and offspring, one between paternal half-siblings, and one between an uncle and half-niece), and two males (J1 and L41) were inferred to have sired 52 percent of all sampled progeny born since 1990 (Ford et al. 2011; Ford et al. 2018).

Southern Resident killer whale habitat utilization is dynamic, and specific breeding, calving or resting areas are not currently documented (NMFS 2006d). Southern Resident killer whales are highly mobile and can travel up to 160 km in a 24-hour period (Baird and Whitehead 2000), allowing rapid movements between areas. The DPS requires open waterways that are free from obstruction to move between important habitat areas, find prey and fulfill other life history requirements (NMFS 2006d). Individual knowledge of productive feeding areas and other special habitats is probably an important determinant in the selection of locations visited and is likely a learned tradition passed from one generation to the next (Ford et al. 1998).

Southern Resident killer whales are large mammals requiring abundant food sources to sustain metabolic processes throughout the year (NMFS 2019f). Prey availability changes seasonally, and Southern Resident killer whales appear to depend on different prey species/populations and habitats throughout the year. The seasonal timing of salmon returns to different river systems likely influences their movements (NMFS 2019f). Whales may travel significant distances to locate prey aggregations sufficient to support their numbers.

The daily prey energy requirements for individual females and males range from 41,376 to 269,458 kcal/day and 41,376 to 217,775 kcal/day, respectively (Noren 2011). The daily prey energy requirements can be converted to the number of fish required each year if the caloric densities of the fish (kcal/fish) consumed are known. However, caloric density of fish can vary because of multiple factors including differences in species, age and/or size, percent lipid content, geographic region and season (L. Barre, NMFS, personal communication to R. Salz, NMFS, May 27, 2020). Noren (2011) estimated the daily consumption rate of a population with 82 individuals over the age of one that consumes solely Chinook salmon would consume 289,131–347,000 fish/year by assuming the caloric density of Chinook salmon was 16,386 kcal/fish (i.e., the average value for adults from Fraser River). Williams et al. (2011) and Chasco et al. (2017) modeled annual SRKW prey requirements and found that the whole population requires approximately 211,000 to 364,100 and 190,000 to 260,000 Chinook salmon per year, respectively. These estimates provide a general indication of how many Chinook salmon need to be available and consumed to meet the biological needs of the whales. These estimates can vary based on several underlying assumptions including the size of the whale population and the caloric density of the salmon.

#### 5.2.16.2 *Population Dynamics*

The most recent abundance estimate for the Southern Resident DPS is 73 whales[5]. This estimate was previously 73 whales in 2019 (Carretta et al. 2021), 83 whales in 2017 (Carretta et al. 2018) and 81 whales in 2015 (Carretta et al. 2017a). Population abundance has fluctuated over time with a maximum of approximately 100 whales in 1995 (Carretta et al. 2017a), with an increase between 1974 and 1993, from 76 to 93 individuals. As compared to stable or growing populations, the DPS reflects lower fecundity and has demonstrated little to no growth in recent decades (NMFS 2016i). For the period between 1974 and the mid-1990s, when the population increased from 76 to 93 animals, the population growth rate was 1.8 percent (Ford et al. 1994). More recent data indicate the population is now in decline (Carretta et al. 2017a).

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

Southern Resident DPS of 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.

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[5] *https://www.orcanetwork.org/births-and-deaths; accessed 10/3/2022.*

#### 5.2.16.3 *Hearing*

Killer whale hearing is one of the most sensitive of any odontocete, with a hearing range of 600 Hz to 114 kilohertz, with the most sensitive range being between 5 and 81 kilohertz (Branstetter et al. 2017). The most sensitive frequency is 20 kilohertz, which corresponds with the approximate peak energy of the species' echolocation clicks (Szymanski et al. 1999b).

#### 5.2.16.4 *Status*

Current threats to its survival and recovery include contaminants, vessel traffic, and reduction in prey availability. Chinook salmon populations have declined due to degradation of habitat, hydrology issues, harvest, and hatchery introgression; such reductions may require an increase in foraging effort. In addition, these prey contain environmental pollutants. These contaminants become concentrated at higher trophic levels and may lead to immune suppression or reproductive impairment. The inland waters of Washington and British Columbia support a large whale watch industry, commercial shipping, and recreational boating; these activities generate underwater noise, which may mask whales' communication or interrupt foraging. The factors that originally endangered the species persist throughout its habitat: contaminants, vessel traffic, and reduced prey. The DPS's resilience to future perturbation is reduced as a result of its small population size. The recent decline, unstable population status, and population structure (e.g., few reproductive age males and non-calving adult females) continue to be causes for concern. The relatively low number of individuals in this population makes it difficult to resist or recover from natural spikes in mortality, including disease and fluctuations in prey availability.

#### 5.2.16.5 *Critical Habitat*

See Section 5.1.4.6 for a description of Southern Resident killer whale critical habitat.

#### 5.2.16.6 *Recovery Goals*

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

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

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

### 5.2.17 Maui's and South Island Hector's dolphins

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

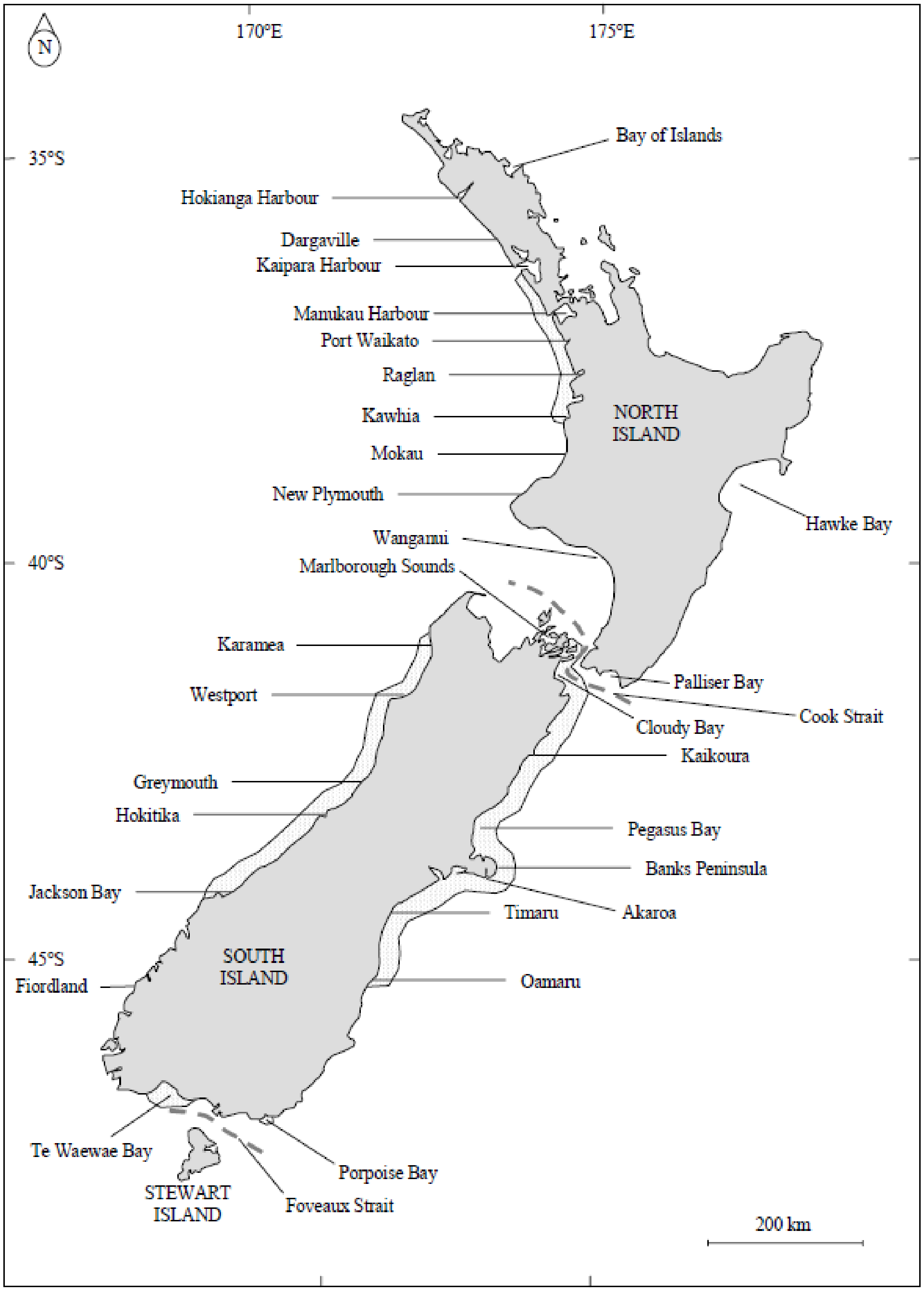


**Figure 14.** Map identifying the ranges (shaded coastlines) of the Maui's dolphin (North Island) and South Island Hector's dolphin (South Island) off the coast of New Zealand. Taken from (Pichler 2002).

Hector's dolphins are small (up to 1.2 meters (four feet)), have a short and stocky body, no external beak, a rounded dorsal fin and rounded pectoral fins, and relatively large flukes (Manning and Grantz. 2017). They have a distinctive and complex black and white coloration pattern. Both the Maui's and South Island subspecies of Hector's dolphin were listed under the ESA on September 19, 2017, with the Maui's dolphin being listed as endangered and the South Island Hector's dolphin being listed as threatened. Information available from the status review

(Manning and Grantz. 2016; Manning and Grantz. 2017), listing documents, and the peer-reviewed literature were used to summarize the life history, population dynamics, and status of the species as follows.

#### 5.2.17.1 *Life History*

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

#### 5.2.17.2 *Population Dynamics*

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

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

The earliest reliable population abundance for South Island Hector's dolphins comes from the same study mentioned above for Maui's dolphins, with an estimated 3,274 South Island Hector's dolphins from 1984/1985 (Dawson and Slooten 1988). Between 1997 and 2001, more advanced methods produced a much larger estimate of 7,270 individuals (95 percent confidence intervals between 5,303 and 9,966) (Slooten et al. 2004), and a more recent study produced an even larger estimate of 14,849 individuals (95 percent confidence intervals between 11,923 and 18,492)

(MacKenzie and Clement 2016). The first population trend estimate for South Island Hector's dolphins comes from data collected from 1984 to 1988 around Banks Peninsula, which resulted in an estimated five percent decline per year (Slooten et al. 1992). Following the establishment of a Marine Mammal Sanctuary around Banks Peninsula in 1988, the population of South Island Hector's dolphins in this area appeared to improve with a six percent increase in population growth rate (Gormley et al. 2012). Despite this, the population in this area still appears to be in decline at a rate of 0.5 percent per year (Gormley et al. 2012). Range-wide, both a stochastic Schaefer (1954) and Bayesian model suggest substantial declines in South Island Hector's dolphins since the 1970s and predict continued declines over the next 50 years (Slooten and Davies 2011).

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

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

#### 5.2.17.3 *Hearing*

Based on the characteristics of their vocalizations, it is thought that South Island Hector's dolphins use sound primarily for foraging, communication, and fine scale navigation but not large-scale navigation (Dawson 1988). We are aware of no information on the hearing range of

South Island Hector's dolphins, but assume they hear best in the frequency range at which they produce sound (112 and 130 kHz) (Dawson 1988; Dawson and Thorpe 1990).

#### 5.2.17.4 *Status*

Both subspecies of Hector's dolphin show evidence of population declines, which is thought to be primarily due to bycatch in commercial and recreational gillnets and trawls (Manning and Grantz. 2017). While changes in the management of New Zealand fisheries appear to have reduced some of the impacts from this threat, both subspecies are expected to continue to decline as a result of bycatch (Manning and Grantz. 2017). Habitat modification and degradation due to development and industrial activities, and disease and tourism also pose a threat to both subspecies (Manning and Grantz. 2017). Given the small size, low genetic diversity, and limited range of Maui's dolphins, the species is at very high risk for extinction and is proposed for listing as endangered under the ESA (Manning and Grantz. 2017). The more abundant and wider ranging South Island Hector's dolphin fairs better but still is at moderate risk of extinction and is proposed for listing as threatened under the ESA (Manning and Grantz. 2017).

#### 5.2.17.5 *Critical Habitat*

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

#### 5.2.17.6 *Recovery Goals*

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

### 5.2.18 North Atlantic Right Whale

The North Atlantic right whale is a narrowly distributed baleen whale found in temperate and sub-polar latitudes in the North Atlantic Ocean (Figure 15). Today they are mainly found in the Western North Atlantic, but have been historically recorded south of Greenland and in the Denmark straight, as well as in Eastern North Atlantic waters (Kraus and Rolland 2007) with possible historic calving grounds being located in the Mediterranean Sea (Rodrigues et al. 2018).

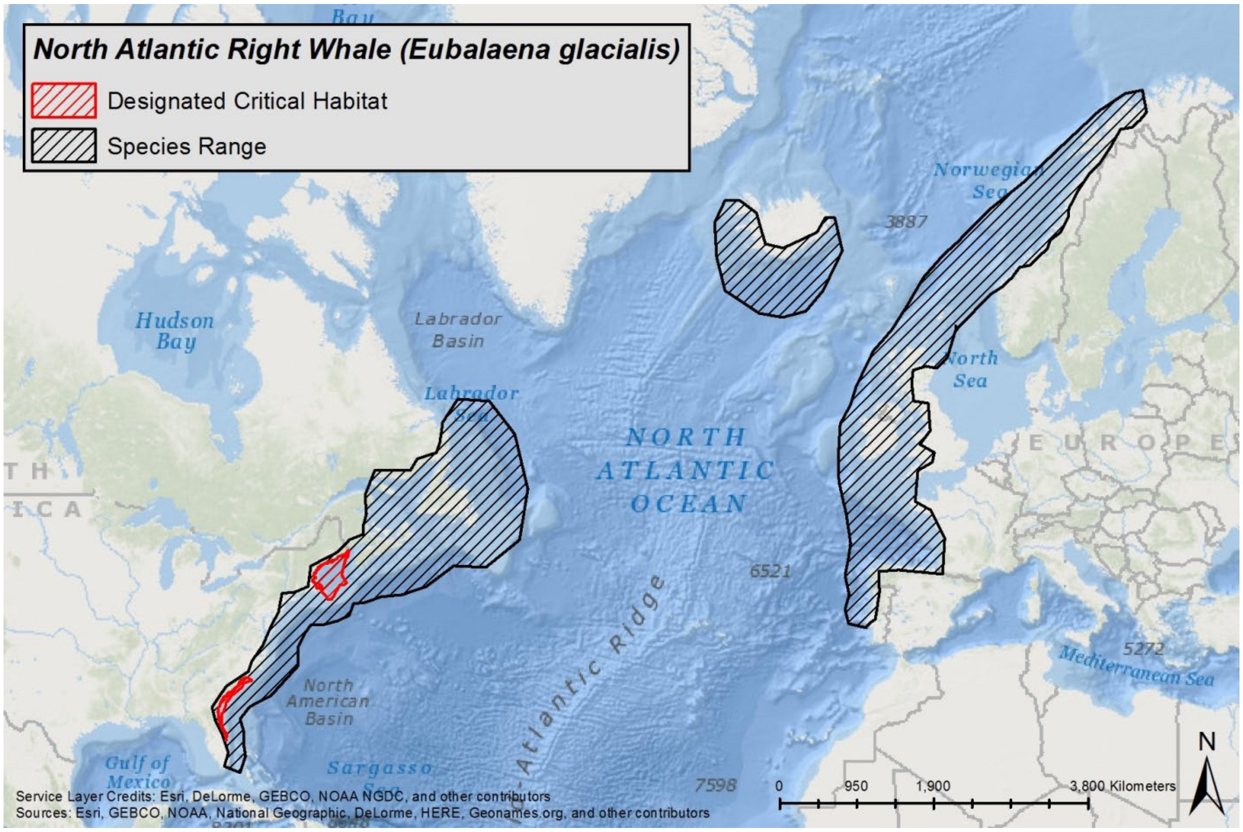


**Figure 15:** Map identifying range and critical habitat of the North Atlantic right whale.

The North Atlantic right whale is distinguished by its stocky body and lack of a dorsal fin. The species was originally listed as endangered on December 2, 1970. The North Atlantic right whale was listed separately as endangered on March 6, 2008. We used information available in the most recent five-year review (NMFS 2017h), the most recent stock assessment report (Hayes et al. 2021), and the scientific literature to summarize the life history, population dynamics, and status of the species as follows.

### 5.2.18.1 *Life history*

The maximum lifespan of North Atlantic right whales is unknown, but one individual is thought to have reached around 70 years of age (Hamilton et al. 1998; Kenney 2009). Previous modelling efforts suggest that in 1980, females had a life expectancy of approximately 52 years of age, which was twice that of males at the time (Fujiwara and Caswell 2001). However, due to reduced survival probability (Caswell et al. 1999), in 1995 female life expectancy was estimated to have declined to approximately 15 years, with males having a slightly higher life expectancy into the 20s (Fujiwara and Caswell 2001). A recent study demonstrated that females have substantially higher mortality than males (Pace et al. 2017a), and as a result, also have substantially shorter life expectancies.

Gestation is approximately one year, after which calves typically nurse for around a year (Kenney 2009; Kraus et al. 2007; Lockyer 1984). After weaning calves, females typically undergo a 'resting' year before becoming pregnant again, presumably because they need time to recover from the energy deficit experienced during lactation (Fortune et al. 2013; Fortune et al. 2012; Pettis et al. 2017b). From 1983 to 2005, annual average calving intervals ranged from three to 5.8 years (overall average of 4.23 years) (Knowlton et al. 1994; Kraus et al. 2007). Between 2006 and 2015, annual average calving intervals continued to vary within this range, but in 2016 and 2017 longer calving intervals were reported (6.3 to 6.6 years in 2016 and 10.2 years in 2017; Hayes et al. 2018a; Pettis and Hamilton 2015; Pettis and Hamilton 2016; Pettis et al. 2017a; Surrey-Marsden et al. 2017). Females have been known to give birth as young as five years old, but the mean age of first partition is about 10 years old (Kraus et al. 2007).

Pregnant North Atlantic right whales migrate south, through the mid-Atlantic region of the United States, to low latitudes during late fall where they overwinter and give birth in shallow, coastal waters (Kenney 2009; Krzystan et al. 2018). During spring, these females migrate back north with their new calves to high latitude foraging grounds where they feed on large concentrations of copepods, primarily *Calanus finmarchicus* (Mayo et al. 2018; NMFS 2017h). Some non-reproductive North Atlantic right whales (males, juveniles, non-reproducing females) also migrate south along the mid-Atlantic region, although at more variable times throughout the winter, while others appear to not migrate south, and instead remain in the northern feeding grounds year round or go elsewhere (Bort et al. 2015; Mayo et al. 2018; Morano et al. 2012; NMFS 2017h; Stone et al. 2017). Nonetheless, calving females arrive to the southern calving grounds earlier and stay in the area more than twice as long as other demographics (Krzystan et al. 2018). Little is known about North Atlantic right whale habitat use in the mid-Atlantic region, but recent acoustic data indicate near year round presence of at least some whales off the coasts of New Jersey, Virginia, and North Carolina (Davis et al. 2017; Hodge et al. 2015; Salisbury et al. 2016; Whitt et al. 2013). While it is generally not known where North Atlantic right whales mate, some evidence suggests that mating may occur in the northern feeding grounds (Cole et al. 2013; Matthews et al. 2014).

#### 5.2.18.2 *Population dynamics*

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

There are currently two recognized populations of North Atlantic right whales, an eastern and a western population. In the eastern North Atlantic Ocean, sightings of right whales are rare and the population may be functionally extinct (Best et al. 2001). In the western North Atlantic Ocean, the best current estimate of the population in the NMFS stock assessment report is 412 individuals ($N_{min}$=408) (Hayes et al. 2021). In the western North Atlantic Ocean, there were estimated to be 458 in November 2015 based on a Bayesian mark–recapture open population model, which accounts for individual differences in the probability of being photographed (95 percent credible intervals 444–471, Pace et al. 2017b). While photographic data for 2016 are still being processed, using this same Bayesian methodology with the available data as of September 1, 2017, gave an estimate of 451 individuals for 2016 (Pettis et al. 2017a). Accurate pre-exploitation abundance estimates are not available for either population of the species. The western population may have numbered fewer than 100 individuals by 1935, when international protection for right whales came into effect (Kenney et al. 1995).

The western North Atlantic population demonstrated overall growth of 2.8 percent per year between 1990 through 2010, despite a decline in 1993 and no growth between 1997 and 2000 (Pace et al. 2017a). However, since 2010 the population has been in decline, with a 99.99 percent probability of a decline of just under one percent per year (Pace et al. 2017a). Between 1990 and 2015, survival rates appeared to be relatively stable, but differed between the sexes, with males having higher survivorship than females (males: 0.985 ± 0.0038; females: 0.968 + 0.0073) leading to a male-biased sex ratio (approximately 1.46 males per female, Pace et al. 2017a). During this same period, calving rates varied substantially, with low calving rates coinciding with all three periods of decline or no growth (Pace et al. 2017a). On average, North Atlantic right whale calving rates are estimated to be roughly one-third to one-half that of Southern right whales (Pace et al. 2017a), which are increasing in abundance (NMFS 2015e).

While data are not yet available to statistically estimate the population's trend beyond 2015, three lines of evidence indicate the population is still in decline. First, calving rates in 2016, 2017, and 2018 were low. Only five new calves were documented in 2017 (Pettis et al. 2017a), well below the number needed to compensate for expected mortalities (Pace et al. 2017a), and for 2018, no new calves were reported (Zoodsma personal communication to E. Patterson on February 26, 2018). Long-term photographic identification data indicate new calves rarely go undetected, so these years likely represent a continuation of the low calving rates that began in 2012 (Kraus et al. 2007; Pace et al. 2017a). Second, as noted above, the preliminary abundance estimate for 2016 is 451 individuals, down approximately 1.5 percent from 458 in 2015. Third, since June 2017, at least 19 North Atlantic right whales have died in what has been declared an Unusual Mortality Event[6] (UME), and at least one calf died prior to this in April 2017 (Meyer-Gutbrod et al. 2018; NMFS 2017h). Twelve whales died in Canada in the Gulf of St. Lawrence area, seven off the New England coast of the United States, and one off the coast of the Virginia-North Carolina border. To date, four mortalities have been attributed to entanglement in fishing gear and five showed signs of blunt force trauma consistent with vessel strikes (Daoust et al. 2017; Hardy personal communication to D. Fauquier on October 5, 2017; Meyer-Gutbrod et al. 2018; Pettis et al. 2017a). The remaining causes of death could not be, or have yet to be, determined.

[6] *https://www.fisheries.noaa.gov/national/marine-life-distress/2017-2018-north-atlantic-right-whale-unusual-mortality-event*

Analysis of mtDNA from North Atlantic right whales has identified seven mtDNA haplotypes in the western North Atlantic Ocean (Malik et al. 1999; McLeod and White 2010). This is significantly less diverse than southern right whales and may indicate inbreeding (Hayes et al. 2018b; Malik et al. 2000; Schaeff et al. 1997). While analysis of historic DNA taken from museum specimens indicates that the eastern and western populations were likely not genetically distinct, the lack of recovery of the eastern North Atlantic Ocean population indicates at least some level of population segregation (Rosenbaum et al. 1997; Rosenbaum et al. 2000b). Overall, the species has low genetic diversity as would be expected based on its low abundance. However, analysis of 16$^{th}$ and 17$^{th}$ century whaling bones indicate this low genetic diversity may pre-date whaling activities (McLeod et al. 2010). Despite this, Frasier et al. (2013) recently identified a post-copulatory mechanism that appears to be slowly increasing genetic diversity among right whale calves.

Today, North Atlantic right whales are primarily found in the western North Atlantic Ocean, from their calving grounds in lower latitudes off the coast of the southeastern United States to their feeding grounds in higher latitudes off the coast of New England and Nova Scotia (Hayes et al. 2018b). In recent years, there has been a shift in distribution in their feeding grounds, with fewer animals being seen in the Great South Channel and the Bay of Fundy and more animals being observed in the Gulf of Saint Lawrence and mid-Atlantic region (Daoust et al. 2017; Davis et al. 2017; Hayes et al. 2018a; Hayes et al. 2018b; Meyer-Gutbrod et al. 2018; Pace et al. 2017a). Very few individuals likely make up the population in the eastern Atlantic Ocean, which is thought to be functionally extinct (Best et al. 2001). However, in recent years, a few known individuals from the western population have been seen in the eastern Atlantic Ocean, suggesting some individuals may have wider ranges than previously thought (Kenney 2009).

#### 5.2.18.3 *Hearing*

There are no direct data on the hearing range of North Atlantic right whales, although they are considered to be part of the low frequency hearing group with a hearing range between 7 Hertz and 35 kiloHertz (NOAA 2018). However, based on anatomical modeling, their hearing range is predicted to be from 10 Hertz to 22 kiloHertz with a functional range probably between 15 Hertz to 18 kiloHertz (Parks et al. 2007b).

#### 5.2.18.4 *Status*

The North Atlantic right whale is listed under the ESA as endangered. Currently, none of its recovery goals (see Section 5.2.18.5 below) have been met (NMFS 2017h). With whaling now prohibited, the two major known human causes of mortality are vessel strikes and entanglement in fishing gear (Hayes et al. 2018a). Progress has been made in mitigating vessel strikes by regulating vessel speeds (78 FR 73726) (Conn and Silber 2013b), but entanglement in fishing gear remains a major threat (Kraus et al. 2016a), which appears to be worsening (Hayes et al. 2018a). From 1990 to 2010, the population experienced overall growth consistent with one of its recovery goals. However, the population is currently experiencing a UME that appears to be related to both vessel strikes and entanglement in fishing gear (Daoust et al. 2017). On top of this, recent modeling efforts indicate that low female survival, a male biased sex ratio, and low calving success are contributing to the population's current decline (Pace et al. 2017a). While there are likely a multitude of factors involved, low calving has been linked to poor female health (Rolland et al. 2016) and reduced prey availability (Devine et al. 2017; Johnson et al. 2017; Meyer-Gutbrod and Greene 2014; Meyer-Gutbrod and Greene 2018; Meyer-Gutbrod et al. 2018). Furthermore, entanglement in fishing gear appears to have substantial health and energetic costs that affect both survival and reproduction (Hayes et al. 2018a; Hunt et al. 2018; Lysiak et al. 2018; Pettis et al. 2017b; Robbins et al. 2015; Rolland et al. 2017; van der Hoop et al. 2017). In fact, there is evidence of a population wide decline in health since the early 1990s, the last time the population experienced a population decline (Rolland et al. 2016). Given this status, the species resilience to future perturbations is considered very low (Hayes et al. 2018a). Using a matrix population projection model, Hayes et al. (2018a) estimates that by 2029 the population will to decline to the 1990 estimate of 123 females if the current rate of decline is not altered. Consistent with this, recent modelling efforts by Meyer-Gutbrod and Greene (2018) indicate that that the species may decline towards extinction if prey conditions worsen, as predicted under future climate scenarios (Grieve et al. 2017), and anthropogenic mortalities are not reduced (Meyer-Gutbrod et al. 2018). In fact, recent data from the Gulf of Maine and Gulf of St. Lawrence indicate prey densities may already be in decline (Devine et al. 2017; Johnson et al. 2017; Meyer-Gutbrod et al. 2018).

#### 5.2.18.5 *Critical Habitat*

See Section 5.1.4.4 for a description of North Atlantic right whale critical habitat.

#### 5.2.18.6 *Recovery Goals*

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

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

### 5.2.19 North Pacific Right Whale

North Pacific right whales are found in temperate and sub-polar waters of the North Pacific Ocean (Figure 16).

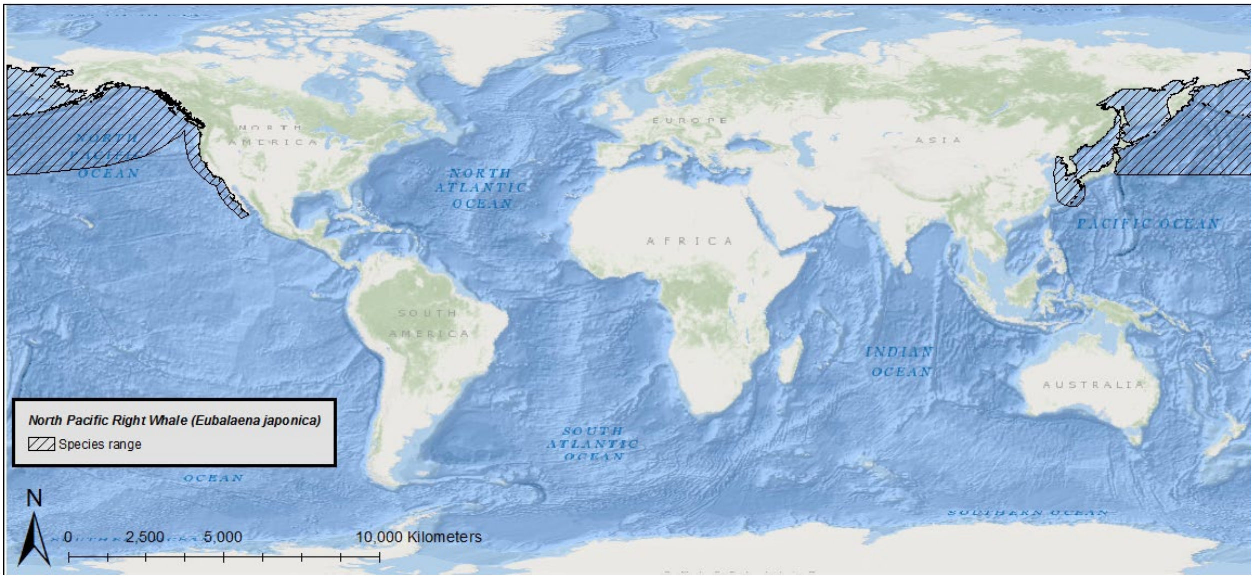


**Figure 16:** Map identifying the range of the North Pacific right whale.

The North Pacific right whale is a baleen whale found only in the North Pacific Ocean and is distinguishable by a stocky body, lack of dorsal fin, generally black coloration, and callosities on the head region. The species was originally listed with the North Atlantic right whale (i.e., "Northern" right whale) as endangered on December 2, 1970. The North Pacific right whale was listed separately as endangered on March 6, 2008. Information available from the recovery plan (NMFS 2013b) recent stock assessment reports (Muto et al. 2021), and status reviews (NMFS 2012a; NMFS 2017i) were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.19.1 *Life History*

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

### 5.2.19.2 *Population Dynamics*

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

The North Pacific right whale remains one of the most endangered whale species in the world. Their abundance likely numbers fewer than 1,000 individuals. There are two currently recognized stocks of North Pacific right whales, a Western North Pacific stock that feeds primarily in the Sea of Okhotsk, and an Eastern North Pacific stock that feeds in eastern north Pacific Ocean waters off Alaska, Canada, and Russia.

The best current estimate of the Eastern North Pacific stock of North Pacific right whales is 31 individuals ($N_{min}$=26) (Muto et al. 2021). Several lines of evidence indicate a total population size of less than 100 for the Eastern North Pacific stock. Based on photo-identification from 1998 through 2013 (Wade et al. 2011) estimated 31 individuals, with a minimum population estimate of 26 individuals (Muto et al. 2017b). Genetic data have identified 23 individuals based on samples collected between 1997 and 2011 (Leduc et al. 2012). The Western North Pacific stock is likely more abundant and was estimated to consist of 922 whales (95 percent confidence intervals 404 to 2,108) based on data collected in 1989, 1990, and 1992 (IWC 2001; Thomas et al. 2016b). The population estimate for the Western North Pacific stock is likely in the low hundreds (Brownell Jr. et al. 2001). While there have been several sightings of Western North Pacific right whales in recent years, with one sighting identifying at least 77 individuals, these data have yet to be compiled to provide a more recent abundance estimate (Thomas et al. 2016b). There is currently no information on the population trend of North Pacific right whales.

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

The North Pacific right whale inhabits the Pacific Ocean, particularly between 20 and 60 degrees North latitude (Figure 16). Prior to exploitation by commercial whalers, concentrations of North Pacific right whales were found in the Gulf of Alaska, Aleutian Islands, south central Bering Sea, Sea of Okhotsk, and Sea of Japan. There has been little recent sighting data of North Pacific right whales occurring in the central North Pacific and Bering Sea. However, since 1996, North

Pacific right whales have been consistently observed in Bristol Bay and the southeastern Bering Sea during summer months. In the Western North Pacific Ocean where the population is thought to be somewhat larger, North Pacific right whales have been sighted in the Sea of Okhotsk and other areas off the coast of Japan, Russia, and South Korea (Thomas et al. 2016b). Although North Pacific right whales are typically found in higher latitudes, they are thought to migrate to more temperate waters during winter to reproduce, and have been sighted as far south as Hawaii and Baja California.

#### 5.2.19.3 *Hearing*

There is no direct data on the hearing range of North Pacific right whales. However, based on anatomical modeling, the hearing range for North Atlantic right whales is predicted to be from 10 Hertz to 22 kiloHertz with functional ranges probably between 15 Hertz to 18 kiloHertz (Parks et al. 2007a) and is used here as a reference for North Pacific right whale hearing.

#### 5.2.19.4 *Status*

Current threats to the survival of this species include hunting, vessel strikes, climate change, and fisheries interactions (including entanglement). The resilience of North Pacific right whales to future perturbations is low due to its small population size and continued threats. Recovery is not anticipated in the foreseeable future (several decades to a century or more) due to small population size and lack of available current information.

#### 5.2.19.5 *Critical Habitat*

See Section 5.1.4.5 for a description of North Pacific right whale critical habitat.

#### 5.2.19.6 *Recovery Goals*

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

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

### 5.2.20 Sei Whale

The sei whale is a widely distributed baleen whale found in all major oceans (Figure 17).

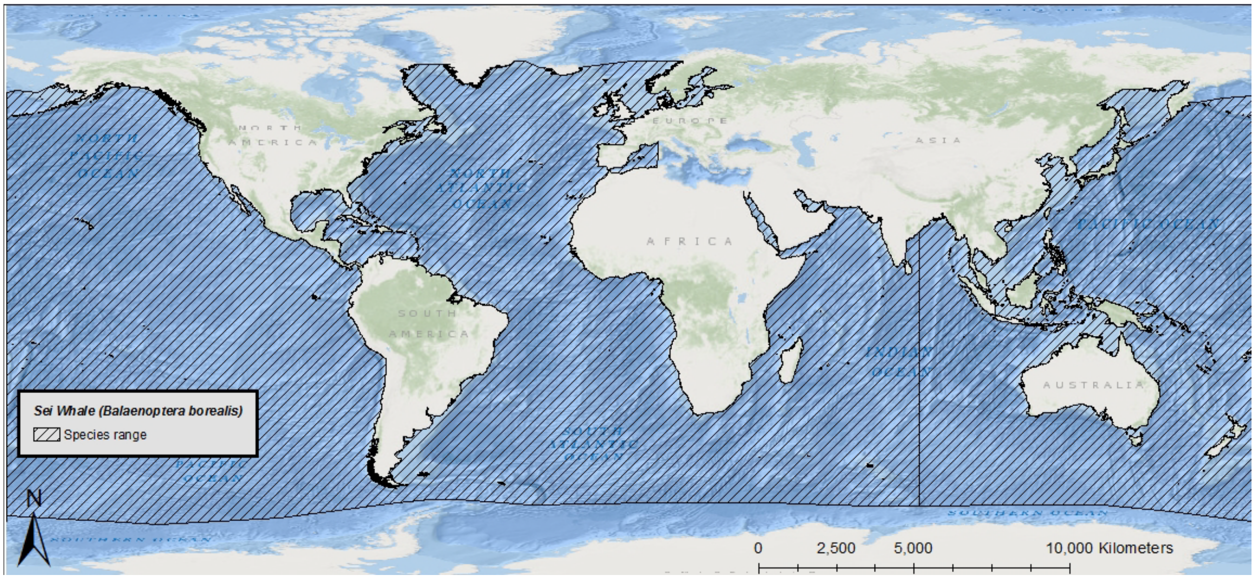


**Figure 17:** Map showing the range of the sei whale.

Sei whales are distinguishable from other whales by a long, sleek body that is dark bluish-gray to black in color and pale underneath, and a single ridge located on their rostrum. The sei whale was originally listed as endangered on December 2, 1970. Information available from the recovery plan (NMFS 2011b), recent stock assessment reports (Carretta et al. 2021; Hayes et al. 2021), and 2021 status review (Austin 2021a) were used to summarize the status of the species as follows.

### 5.2.20.1 *Life History*

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

### 5.2.20.2 *Population Dynamics*

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

Two sub-species of sei whale are recognized, *B. b. borealis* in the Northern Hemisphere and *B. b. schlegellii* in the Southern Hemisphere. There are no estimates of pre-exploitation abundance for the North Atlantic Ocean. Models indicate that total abundance declined from 42,000 to 8,600 individuals between 1963 and 1974 in the North Pacific Ocean. More recently, the North Pacific Ocean population was estimated to be 29,632 (95 percent confidence intervals 18,576 to 47,267) between 2010 and 2012 (IWC 2016; Thomas et al. 2016b). In the Southern Hemisphere, pre-exploitation abundance is estimated at 65,000 whales, with recent abundance estimated at 9,800 to 12,000 whales. Three stocks occur in U.S. waters: Nova Scotia (N=6,292, $N_{min}$=3,098) (Hayes et al. 2021), Hawaii (N=391, $N_{min}$=204) (Carretta et al. 2021), and Eastern North Pacific (N=519, $N_{min}$=374) (Carretta et al. 2021). Population growth rates for sei whales are not available at this time as there are little to no systematic survey efforts to study sei whales.

Based on genetic analyses, there appears to be some differentiation between sei whale populations in different ocean basins. An early study of allozyme variation at 45 loci found some genetic differences between Southern Ocean and the North Pacific sei whales (Wada and Numachi 1991). However, more recent analyses of mtDNA control region variation show no significant differentiation between Southern Ocean and the North Pacific sei whales, though both appear to be genetically distinct from sei whales in the North Atlantic (Baker and Clapham 2004; Huijser et al. 2018). Within ocean basins, there appear to be intermediate to high genetic diversity and little genetic differentiation despite there being different managed stocks (Danielsdottir et al. 1991; Huijser et al. 2018; Kanda et al. 2011; Kanda et al. 2006; Kanda et al. 2015; Kanda et al. 2013).

Sei whales are distributed worldwide, occurring in the North Atlantic Ocean, North Pacific Ocean, and Southern Hemisphere.

#### 5.2.20.3 *Hearing*

Direct studies of sei whale hearing have not been conducted, but it is assumed that they can hear the same frequencies that they produce (low) and are likely most sensitive to this frequency range (Ketten 1997; Richardson et al. 1995b). This suggests sei whales, like other baleen whales, are more likely to have their best hearing capacities at low frequencies, including frequencies lower than those of normal human hearing, rather than mid- to high-frequencies (Ketten 1997). In terms of functional hearing capability, sei whales belong to the low-frequency group, which have a hearing range of 7 Hertz to 35 kiloHertz (NOAA 2018).

#### 5.2.20.4 *Status*

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

#### 5.2.20.5 *Critical Habitat*

No critical habitat has been designated for the sei whale.

#### 5.2.20.6 *Recovery Goals*

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

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

### 5.2.21 Southern Right Whale

Southern right whales are a large baleen whale species distributed in the Southern Hemisphere worldwide from 20 degrees to 60 degrees South.

Southern right whales have a stocky, black body lacking a dorsal fin and a large head covered in callosities. They range in length between 13 to 17 meters (43 to 56 feet), and weigh up to 54,431 kilograms (120,000 pounds). The Southern right whale was listed as endangered under the Endangered Species Preservation Act on June 2, 1970, and this listing was carried over when the ESA was enacted. We used information available in the 2021 Status Review (Austin 2021b) and the International Whaling Commission's 2012 Report on the Assessment of Southern Right Whales (IWC 2012b) to summarize the life history, population dynamics, and status of this species, as follows.

#### 5.2.21.1 *Life History*

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

#### 5.2.21.2 *Population Dynamics*

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

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

The Australia, South Africa and Argentina breeding stocks of Southern right whales are increasing at an estimated seven percent annually. The Brazil breeding population is increasing, while the Peru and Chile breeding population is estimated to contain only 1 to 49 individuals (Cooke and Zerbini 2018; NMFS 2015f). The New Zealand breeding population is showing signs of recovery; recent population modeling estimates the population growth rate at 5.6 percent (Davidson 2016). Juveniles in New Zealand show high apparent annual survival rates, between 0.87 and 0.95 percent (Carroll et al. 2016).

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

Southern right whales are found in the Southern Hemisphere from temperate to polar waters, favoring shallow waters less than 20 meters (65.6 feet) deep. Southern right whales migrate between winter breeding areas in coastal waters of the South Atlantic, Pacific, and Indian Oceans from May to December and offshore summer (January through April) foraging locations in the Subtropical and Antarctic Convergence zones.

#### 5.2.21.3 *Hearing*

There is no direct data on the hearing range of Southern right whales. However, based on anatomical modeling, the hearing range for North Atlantic right whales is predicted to be from 10 Hertz to 22 kiloHertz with functional ranges probably between 15 Hertz to 18 kiloHertz (Parks et al. 2007a) and is used here as a reference for North Pacific right whale hearing.

#### 5.2.21.4 *Status*

Southern right whales are currently subject to many of the same anthropogenic threats other large cetaceans face. In the Southern Hemisphere, Southern right whales are by far the most vessel struck cetacean, with at least 56 reported instances; nearly four-fold higher than the second most struck large whale (Van Waerebeek et al. 2007). Additional threats include declines in water quality, pollutant exposure and near shore habitat degradation from development. Reproductive success is influenced by krill availability on the feeding grounds; therefore, climatic shifts that change krill abundance may hinder the recovery of Southern right whales (Seyboth et al. 2016). Because populations appear to be increasing in size, the species appears to be somewhat resilient to current threats, but it has not recovered to pre-exploitation abundance.

#### 5.2.21.5 *Critical Habitat*

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

#### 5.2.21.6 *Recovery Goals*

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

### 5.2.22 Sperm Whale

The sperm whale is a widely distributed toothed whale found in all major oceans (Figure 18).

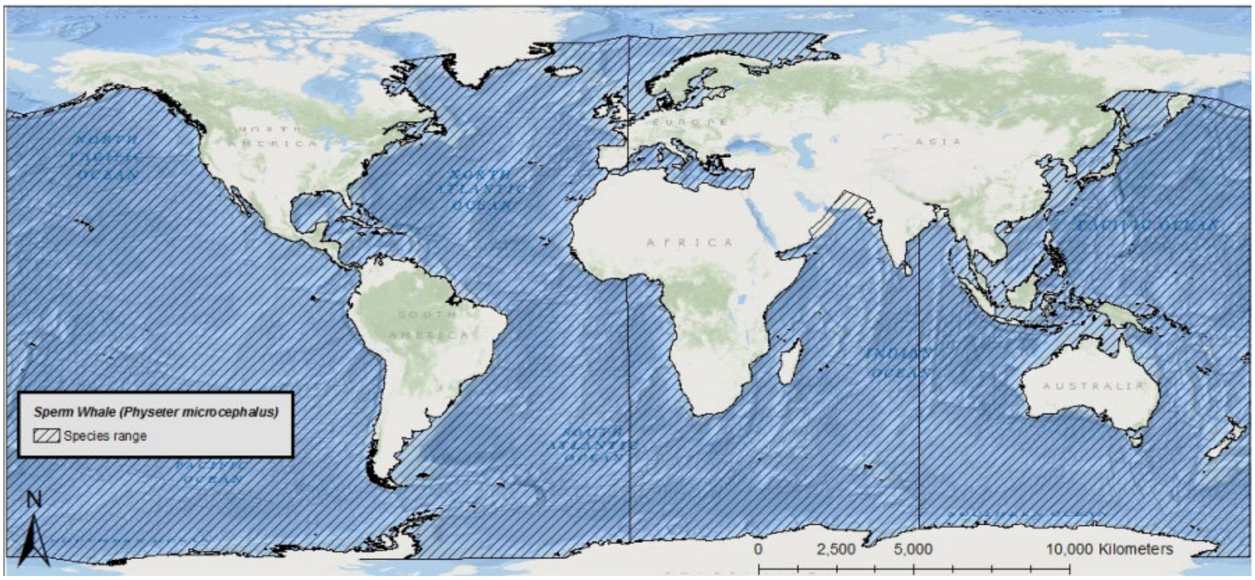


**Figure 18:** Map showing the range of the sperm whale.

The sperm whale is the largest toothed whale and distinguishable from other whales by its extremely large head, which takes up 25 to 35 percent of its total body length, and a single blowhole asymmetrically situated on the left side of the head near the tip. The sperm whale was originally listed as endangered on December 2, 1970. Information available from the recovery plan (NMFS 2010a), recent stock assessment reports (Carretta et al. 2021; Hayes et al. 2020; Hayes et al. 2021; Muto et al. 2021), and status review (NMFS 2015g) were used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.22.1 *Life History*

The average lifespan of sperm whales is estimated to be at least 50 years (Whitehead 2009). They have a gestation period of one to one and a half years, and calves nurse for approximately two years, though they may begin to forage for themselves within the first year of life (Tønnesen et al. 2018). Sexual maturity is reached between seven and 13 years of age for females with an average calving interval of four to six years. Male sperm whales reach full sexual maturity in their 20s. Sperm whales mostly inhabit areas with a water depth of 600 meters (1,968 feet) or more, and are uncommon in waters less than 300 meters (984 feet) deep. They winter at low latitudes, where they calve and nurse, and summer at high latitudes, where they feed primarily on squid; other prey includes octopus and demersal fish (including teleosts and elasmobranchs).

### 5.2.22.2 *Population Dynamics*

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

The sperm whale is the most abundant of the large whale species, with total abundance estimates between 200,000 and 1,500,000. The most recent estimate indicated a global population of between 300,000 and 450,000 individuals (Whitehead 2009). The higher estimates may be approaching population sizes prior to commercial whaling, the reason for ESA listing. There are no reliable estimates for sperm whale abundance across the entire Atlantic Ocean. However, estimates are available for two of three U.S. stocks in the Atlantic Ocean, the Northern Gulf of Mexico stock, estimated to consist of 1,180 individuals ($N_{min}$=983) (Hayes et al. 2021) and the North Atlantic stock, estimated to consist of 4,349 individuals ($N_{min}$=3,451) (Hayes et al. 2020). There are insufficient data to estimate abundance for the Puerto Rico and U.S. Virgin Islands stock. In the northeast Pacific Ocean, the abundance of sperm whales was estimated to be between 26,300 and 32,100 in 1997. In the eastern tropical Pacific Ocean, the abundance of sperm whales was estimated to be 22,700 (95 percent confidence intervals 14,800 to 34,600) in 1993. Population estimates are also available for two of three U.S. stocks that occur in the Pacific Ocean, the California/Oregon/ Washington stock, estimated to consist of 1,997 individuals ($N_{min}$=1,270)(Carretta et al. 2021), and the Hawaii stock, estimated to consist of 5,707 individuals ($N_{min}$=4,486) (Carretta et al. 2021). There are insufficient data to estimate the population abundance of the North Pacific stock (Muto et al. 2021). We are not aware of any reliable abundance estimates specifically for sperm whales in the South Pacific Ocean, and there is insufficient data to evaluate trends in abundance and growth rates of sperm whale populations at this time.

Ocean-wide genetic studies indicate sperm whales have low genetic diversity, suggesting a recent bottleneck, but strong differentiation between matrilineally related groups (Lyrholm and Gyllensten 1998). Consistent with this, two studies of sperm whales in the Pacific Ocean indicate low genetic diversity (Mesnick et al. 2011; Rendell et al. 2012). Furthermore, sperm whales from the Gulf of Mexico, the western North Atlantic Ocean, the North Sea, and the Mediterranean Sea all have been shown to have low levels of genetic diversity (Engelhaupt et al. 2009). As none of the stocks for which data are available have high levels of genetic diversity, the species may be at some risk to inbreeding and 'Allee' effects, although the extent to which is currently unknown. Sperm whales have a global distribution and can be found in relatively deep waters in all ocean basins. While both males and females can be found in latitudes less than 40 degrees, only adult males venture into the higher latitudes near the poles.

#### 5.2.22.3 *Hearing*

Our understanding of sperm whale hearing stems largely from the sounds they produce. The only direct measurement of hearing was from a young stranded individual from which AEP tests were recorded (Carder and Ridgway 1990). From this whale, responses support a hearing range of 2.5 to 60 kiloHertz and highest sensitivity to frequencies between 5 to 20 kiloHertz. Other hearing information consists of indirect data. For example, the anatomy of the sperm whale's inner and middle ear indicates an ability to best hear high-frequency to ultrasonic hearing (Ketten 1992a). The sperm whale may also possess better low-frequency hearing than other odontocetes, although not as low as many baleen whales (Ketten 1992a). Reactions to anthropogenic sounds can provide indirect evidence of hearing capability, and several studies have made note of changes seen in sperm whale behavior in conjunction with these sounds. For example, sperm whales have been observed to frequently stop echolocating in the presence of underwater pulses made by echosounders and submarine sonar (Watkins et al. 1985; Watkins and Schevill 1975). In the Caribbean Sea, Watkins et al. (1985) observed that sperm whales exposed to 3.25 to 8.4 kiloHertz pulses (presumed to be from submarine sonar) interrupted their activities and left the area. Similar reactions were observed from artificial sound generated by banging on a boat hull (Watkins et al. 1985). André et al. (1997) reported that foraging whales exposed to a 10 kiloHertz pulsed signal did not ultimately exhibit any general avoidance reactions: when resting at the surface in a compact group, sperm whales initially reacted strongly, and then ignored the signal completely (André et al. 1997). Aaron et al. (2007) observed that the acoustic signal from the cavitation of a fishing vessel's propeller (110 decibels re: 1 $\mu Pa^2$-second between 250 Hertz and one kiloHertz) interrupted sperm whale acoustic activity and resulted in the animals converging on the vessel. Sperm whales have also been observed to stop vocalizing for brief periods when codas are being produced by other individuals, perhaps because they can hear better when not vocalizing themselves (Goold and Jones 1995). Because they spend large amounts of time at depth and use low frequency sound, sperm whales are likely to be susceptible to low frequency sound in the ocean (Croll et al. 1999). Nonetheless, sperm whales are considered to be part of the mid-frequency marine mammal hearing group, with a hearing range between 150 Hertz and 160 kiloHertz (NOAA 2018).

#### 5.2.22.4 *Status*

Commercial whaling is no longer allowed, however, illegal hunting may occur. Continued threats to sperm whale populations include vessel strikes, entanglement in fishing gear, competition for resources due to overfishing, population, loss of prey and habitat due to climate change, and sound. The species' large population size shows that it is somewhat resilient to current threats.

#### 5.2.22.5 *Critical Habitat*

No critical habitat has been designated for the sperm whale.

#### 5.2.22.6 *Recovery Goals*

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

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

### 5.2.23 Taiwanese Humpback Dolphin

Taiwanese (Indo-Pacific) humpback dolphins are a delphinid species that occurs only off the west coast of Taiwan (Figure 19). They have an extremely coastal range, only occurring out to 5.6 km (3 nmi) from shore (Dares et al. 2017; Dares et al. 2014).

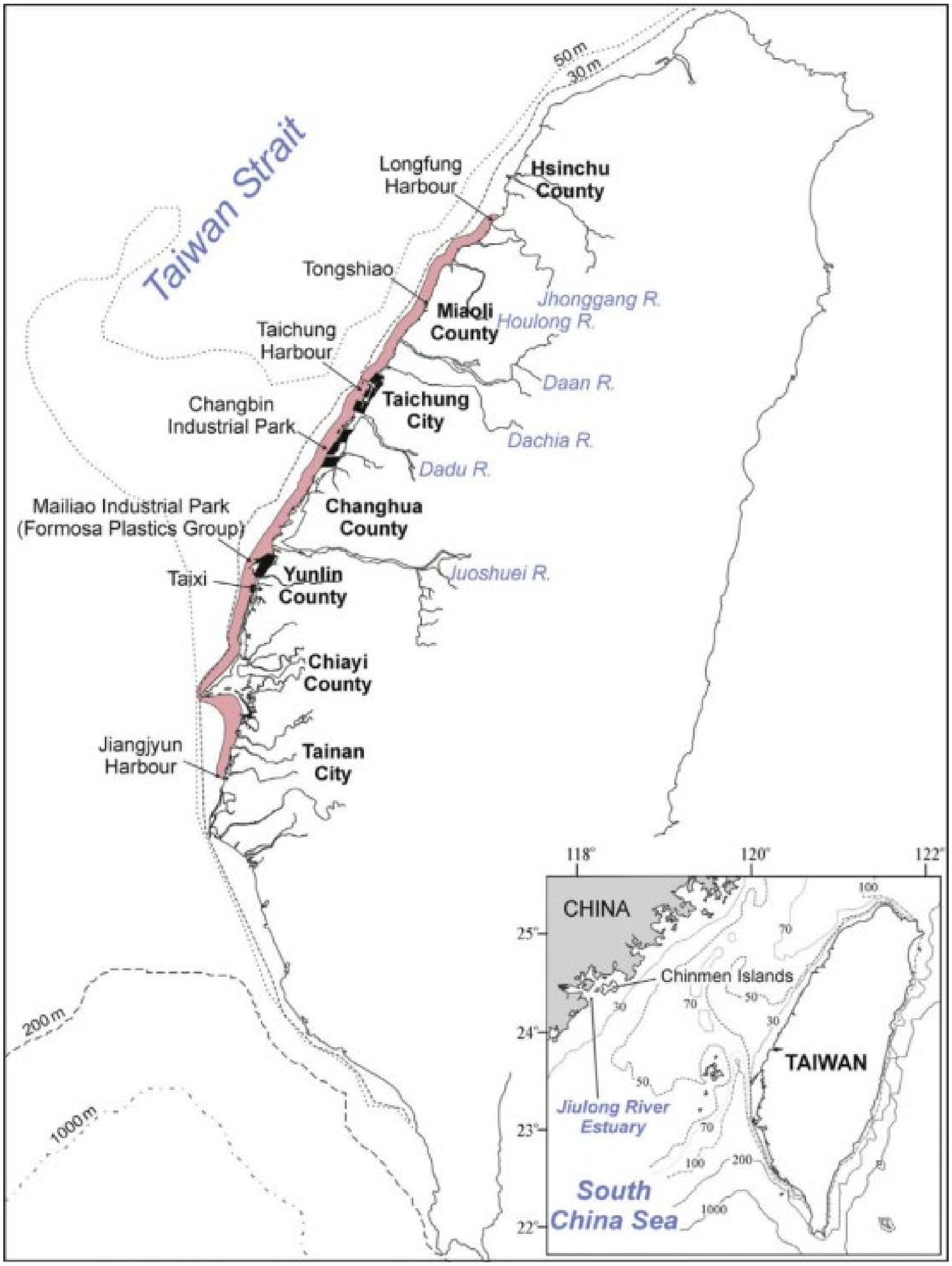


**Figure 19. Map of the distribution of the Taiwanese subspecies of humpback dolphins (pink shaded area). Large-scale industrial development projects over coastal waters are represented by black irregularly shaped polygons (Wang et al. 2016).**

Taiwanese humpback dolphins are characterized by a robust body, long distinct beak, short dorsal fin atop a wide dorsal hump, and round-tipped broad flippers and flukes (Jefferson and Karczmarski 2001). They are medium-sized, up to 2.8 meters (9.2 feet) in length, weighing 250 to 280 kilograms (551 to 617 pounds) (Ross et al. 1994). Taiwanese humpback dolphins were designated as endangered on May 9, 2018 under the ESA. We used information available in the final listing, the status review (Whittaker and Young 2018a), and available literature to summarize the status of the Taiwanese humpback dolphin, as follows.

#### 5.2.23.1 *Life History*

Little is known about the life history and reproduction of the Taiwanese humpback dolphin and estimating life history paramaters for the subspecies has proven difficult due to the lack of carcasses available for study (Wang et al. 2016). However, life history parameters of humpback dolphins in the Pearl River Estuary and South African populations may serve as proxies for those of the Taiwanese humpback dolphin (Whittaker and Young 2018a). Animals belonging to the Pearl River Estuary and South African populations are a length of around one meter at birth, females and males reach sexual maturity around 10 and 12 years of age respectively, can live upwards of 38 years, and reach maximum lengths and weights of just under three meters and 250 kilograms respectively (Jefferson et al. 2012; Jefferson and Karczmarski 2001). The Taiwanese humpback dolphin is considered a generalist and opportunistic piscivore and is believed to prey upon small fish that are generally not valuable to local commercial fisheries (Barros et al. 2004; Sheehy 2009).

#### 5.2.23.2 *Population Dynamics*

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

The most recent population estimates were from a mark-recapture analysis from photo identification data collected from 2007 to 2010, which ranged from 54 to 74 animals (Wang et al. 2012). A previous estimate of 99 animals was calculated from line-transect surveys conducted between 2002 and 2004 (Wang et al. 2007). The Taiwanese humpback dolphin population is most likely comprised of less than 45 mature individuals, and is the smallest known dolphin population of the taxon (Whittaker and Young 2018a). The population is estimated to have a mortality rate of 1.5 percent (Araujo et al. 2014; Wang et al. 2012) and a carrying capacity estimate of 250 animals suggests that the population abundance has been greatly reduced from historical levels (Whittaker and Young 2018a).

#### 5.2.23.3 *Hearing*

The Taiwanese humpback dolphin is a mid-frequency specialist meaning their hearing range falls between 150Hz to 160kHz (NMFS 2018a). They are expected to have a maximum hearing range between frequencies of approximately 500 Hz to 145 kHz (Li et al. 2013; Li et al. 2012; Wang et al. 2014).

#### 5.2.23.4 *Status*

Noise disturbance resulting from development-related activities such as pile-driving, seismic research, and military exercises within its habitat may be threats to the health and well-being of the population (Whittaker and Young 2018b). Industrial activity and coastal development contribute to widespread loss and degradation of Taiwanese humpback dolphin habitat. Over the past three decades, the west coast of Taiwan has undergone large alterations of coastal environments due to embankment, land reclamation, coastal construction, and shoreline development, including the construction of break-walls and dredging activities (Whittaker and Young 2018a).

With over 600 factories located within a kilometer of the shore on the western coast of Taiwan, industrial development is one of the most significant factors contributing heavily to the degradation of vital estuarine and coastal resources upon which the Taiwanese humpback dolphin depends. Offshore wind farm development (now underway) and additional reclamation for industrial parks and municipal activity have recently been proposed, which would result in additional loss of habitat; it is unclear whether these plans will be denied or mitigated for the purpose of conserving the subspecies (Whittaker and Young 2018a). Additional threats to Taiwanese humpback dolphins include freshwater diversion and pollution.

#### 5.2.23.5 *Critical Habitat*

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

#### 5.2.23.6 *Recovery Goals*

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

### 5.2.24 Bearded Seal (Beringia and Okhotsk Distinct Population Segments)

Two subspecies of bearded seals are recognized by NMFS: *Erignathus barbatus nauticus* in the Pacific and *Erignathus barbatus* in the Atlantic (Figure 20). Bearded seals in the Pacific are distributed from 85º N south to Sakhalin Island (45º N), including the Chukchi, Bering and Okhotsk Seas.

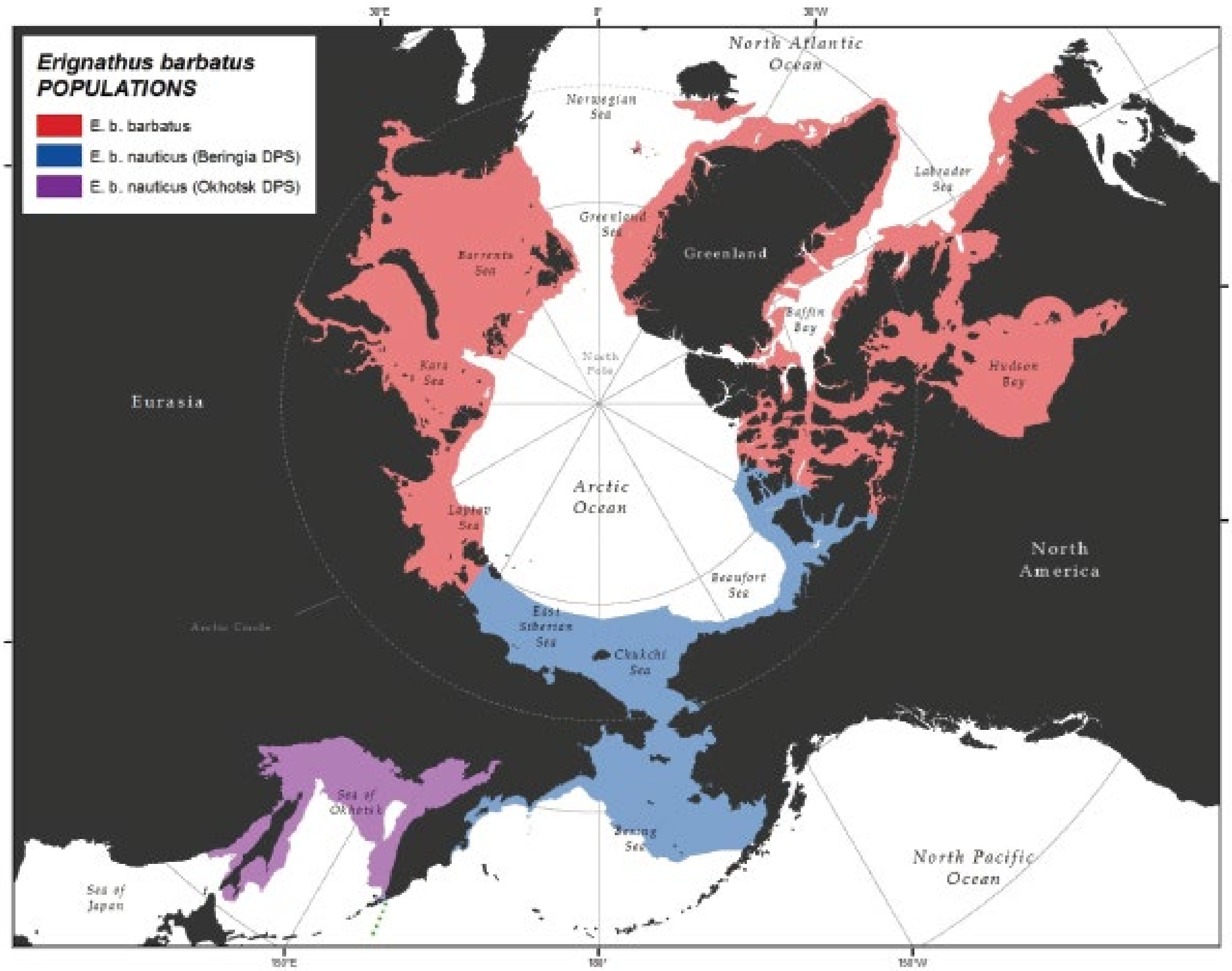


**Figure 20.** Map identifying the range of the two sub-species of bearded seal, *Erignathus barbatus* and *E. b. nauticus*, and the Beringia and Okhotsk distinct population segments. From Cameron et al. (2010).

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

We used information available in the final listing, the status review (Cameron et al. 2010), the 2020 stock assessment report (Muto et al. 2021) and available literature to summarize the status of the bearded seal, as follows.

#### 5.2.24.1 *Life History*

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

#### 5.2.24.2 *Population Dynamics*

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

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

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

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

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

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

Bearded seals are boreoarctic with a circumpolar distribution and are closely associated with sea ice. Most seals move seasonally, following the extent of the sea ice; however some remain near the coasts during the summer and early fall. Bearded seals in the Beringia DPS are found in the continental shelf waters throughout the Eastern Siberian, Chukchi and Beaufort Seas. The Okhotsk DPS includes bearded seals found in the Sea Okhotsk, Russia (Figure 20).

#### 5.2.24.3 *Hearing*

Bearded seals likely have a hearing range spanning the range of their vocalization frequencies, which range from 20 Hz to 11 kHz (Cameron et al. 2010).

#### 5.2.24.4 *Status*

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

#### 5.2.24.5 *Critical Habitat*

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

#### 5.2.24.6 *Recovery Goals*

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

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

### 5.2.25 Guadalupe Fur Seal

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

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

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

#### 5.2.25.1 *Life History*

Guadalupe fur seals prefer rocky habitats and can be found in natural recesses and caves (Fleischer 1978), using sheltered beaches and rocky platforms for breeding (Arias-del-Razo et al. 2016). Breeding occurs in June through August. Adult males return to the colonies in early June. Female Guadalupe fur seals arrive on beaches in June, with births occurring between mid-June to July (Pierson 1978); the pupping season is generally over by late July (Fleischer 1978). Breeding adult males are polygamous, and may mate with up to 12 females during a single breeding season. Females stay with pups for seven to eight days after parturition, and then alternate between foraging trips at sea and lactation on shore; nursing lasts about eight months (Figureroa-Carranza 1994). Guadalupe fur seals feed mainly on squid species (Esperon-Rodriguez and Gallo-Reynoso 2013); the Gulf of Ulloa on the Pacific side of the Baja California peninsula is an important feeding area (Aurioles-Gamboa and Szteren 2019). Based on a stable isotope analysis of male Guadalupe fur seal carcasses, there appears to be some niche segregation between coastal and oceanic males, possibly based on individual age and size (Aurioles-Gamboa and Szteren 2019). Foraging trips can last between four to 24 days (average of 14 days). Tracking data show that adult females spend 75 percent of their time at sea, and 25 percent at rest (Gallo-Reynoso et al. 1995).

#### 5.2.25.2 *Population Dynamics*

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

Commercial sealers in the 19th century decimated the Guadalupe fur seal population, taking as many 8,300 fur seals from San Benito Island (Townsend 1924). Numbers on the total number of fur seals harvested are difficult to ascertain because of the difficulty the hunters had in distinguishing species while hunting (Seagars 1984). These harvests were devastating for the Guadalupe fur seal population, so much so that in 1892, only seven individuals were observed on Guadalupe Island, the location of one of the larger known breeding colonies (Bartholomew Jr. 1950); two years later, a commercial sealer took all 15 remaining individuals that could be found (Townsend 1899).

The species was presumed extinct, until 1926, when a small herd was found on Guadalupe Island by commercial fishermen, who later returned and killed all the seals they could find. In 1928, the Mexican government declared Guadalupe Island as a pinniped sanctuary. In 1954, during a survey of the island, Hubbs (1956) discovered at least 14 individuals. The government of Mexico banned the hunting of Guadalupe fur seals in 1967. Although population surveys occurred on an irregular basis in subsequent years, evidence shows that the Guadalupe fur seal population has been increasing ever since.

The Guadalupe fur seal clearly experienced a precipitous decline due to commercial exploitation, and may have undergone a population bottleneck. Bernardi et al. (1998) compared the genetic divergence in the nuclear fingerprint of samples taken from 29 Guadalupe fur seals, and found an average similarity of 0.59 of the DNA profiles. This average is typical of outbreeding populations. When comparing the amount of unique character fragments found in Guadalupe fur seals to that of other pinnipeds that have experienced bottlenecks (e.g., Hawaiian monk seals), that amount is much higher (0.14 vs. 0.05) in Guadalupe fur seals than Hawaiian monk seals. By using mitochondrial DNA sequence analysis in comparing the genetic diversity of Guadalupe fur seals to northern elephant seals (which did experience a severe bottleneck), Guadalupe fur seals had more haplotypes and a higher number of variable sites. The authors hypothesized that the numbers of Guadalupe fur seals left after harvest may have been underestimated, and the population may not have actually experienced a bottleneck, or the bottleneck may have been of short duration and not severe enough to suppress genetic diversity. Although the relatively high levels of genetic variability are encouraging, it is important to note that commercial harvest still influenced the population. Later studies comparing mt DNA found in the bones of pre-exploitation Guadalupe fur seals against the extant population showed a loss of genotypes, with twenty-five genotypes in pre-harvest fur seals, and seven present today (Weber et al. 2004).

It is difficult to obtain an accurate abundance estimate of Guadalupe fur seals due in part to their tendency to stay in caves and remain at sea for extended lengths of time, making them unavailable for counting. At the time of listing in 1985, the population was estimated at 1,600 individuals, compared to approximately 30,000 before hunting occurred in the 18$^{th}$ and 19$^{th}$ centuries. A population was "rediscovered" in 1928 with the capture of two males on Guadalupe Island; from 1949 on, researchers reported sighting Guadalupe fur seals at Isla Cedros (near the San Benito Archipelago), and Guadalupe Island (Bartholomew Jr. 1950; Peterson et al. 1968). In 1994, the population at Guadalupe Island was estimated at 7,408 individuals (Gallo-Reynoso 1994). There have been other, more recent population abundance estimates for Guadalupe Island, with a considerable amount of variation between them: 20,000 in 2010 (García-Capitanachi et al. 2017), and between 34,000 and 44,000 in 2013 (García-Aguilar et al. 2018). Guadalupe fur seals are also found on San Benito Island, likely immigrants from Guadalupe Island, as there are relatively few pups born on San Benito Island (Aurioles-Gamboa et al. 2010). There were an estimated 2,504 seals on San Benito Island in 2010 (García-Capitanachi et al. 2017). Based on information presented by (García-Aguilar et al. 2018), and using a population size to pup count ratio of 3.5, the minimum population estimate is 31,019 (Carretta et al. 2020).

All Guadalupe fur seals represent a single population, with two known breeding colonies in Mexico, and a purported breeding colony in the United States. Gallo-Reynoso (1994) calculated that the population of Guadalupe fur seals in Mexico from thirty years of population and counts and concluded the population was increasing; with an average annual growth rate of 13.3 percent on Guadalupe Island. The 2000 NMFS SAR for Guadalupe fur seals also indicated the breeding colonies in Mexico were increasing; and more recent evidence indicates that this trend is continuing (Aurioles-Gamboa et al. 2010; Esperon-Rodriguez and Gallo-Reynoso 2012). From 1984 to 2013 at Guadalupe Island, the Guadalupe fur seal population increased at an average annual growth rate of 5.9 percent (range 4.1 to 7.7 percent) (García-Aguilar et al. 2018). Other estimates of the Guadalupe fur seal population of the San Benito Archipelago (from 1997-2007) indicate that it is increasing as well at an annual rate of 21.6 percent (Esperon-Rodriguez and Gallo-Reynoso 2012), and that this population is at a phase of exponential increase (Aurioles-Gamboa et al. 2010). However, these estimates are considered too high, and likely result from immigration at Guadalupe Island (Carretta 2019). The estimated annual population growth rate is 5.9 percent (Carretta et al. 2020).

#### 5.2.25.3 *Hearing*

Underwater hearing in otariid seals is adapted to low frequency sound and less auditory bandwidth than phocid seals. Hearing in otariid seals has been tested in California sea lions (Kastak and Schusterman 1998) and northern fur seals (Babushina et al. 1991; Moore and Schusterman 1987). Based on these studies, Guadalupe fur seals would be expected to hear sounds within the ranges of 50 Hz–75 kHz in air and 50 Hz–50 kHz in water.

#### 5.2.25.4 *Status*

Along with hunting, Guadalupe fur seals been influenced by factors leading to strandings and unusual mortality events (see Section 6.6.1). Of the 169 documented strandings in Washington and Oregon from 2005 through 2016, 139 were yearlings. Strandings were highly seasonal, with most occurring in June consistently throughout the years examined. The three major causes of death could be categorized as emaciation, trauma (fishery-related, blunt force, bullet wounds, and shark attack), and infectious disease from coccidian parasites, including *Toxoplasma gondii* and *Sarcocystis neurona*. These increased strandings may be resulting from increased use of these coastal habitats by a population of Guadalupe fur seals that is reaching a healthy size (D'Agnese et al. 2020).

While some incidental breeding takes place on the San Benito Islands and the Channel Islands, the Guadalupe Island breeding colony supports the population (García-Aguilar et al. 2018). The current abundance of the Guadalupe fur seal represents about one-fifth of the estimated historical population size, and although the population has continued to increase, the species has not expanded its breeding range, potentially affecting its recovery (García-Aguilar et al. 2018). Because that over the last fifty years the population has been increasing since being severely depleted, we believe that the Guadalupe fur seal population is resilient to future perturbations.

#### 5.2.25.5 *Critical Habitat*

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

#### 5.2.25.6 *Recovery Goals*

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

### 5.2.26 Hawaiian Monk Seal

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

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

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

#### 5.2.26.1 *Life History*

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

#### 5.2.26.2 *Population Dynamics*

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

The entire range of the Hawaiian monk seal is located within U.S. waters. In addition to a small but growing population found on the main Hawaiian Islands there are six main breeding subpopulations in the northwestern Hawaiian Islands identified as: Kure Atoll, Midway Islands, Pearl and Hermes Reef, Lisianski Island, Laysan Island, and French Frigate Shoals. The best estimate of the total population of Hawaiian monk seals is 1,437. This estimate is the sum of estimated abundance at the six main northwestern Hawaiian islands subpopulations, an extrapolation of counts at Necker and Nihoa Islands (smaller breeding sub-populations), and an estimate of minimum abundance in the main Hawaiian islands. The minimum population size for the entire species is 1,376. It is currently estimated that the population has grown at an average rate of around two percent per year from 2013 to 2019 (Carretta et al. 2021).

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

#### 5.2.26.3 *Hearing*

The information on the hearing capabilities of endangered Hawaiian monk seals is somewhat limited, but they appear to have their most sensitive hearing at 12 to 28 kHz. Below eight kHz, their hearing is less sensitive than that of other pinnipeds. Their sensitivity to high frequency sound drops off sharply above 30 kHz (Richardson et al. 1995a; Richardson et al. 1995d; Thomas et al. 1990). An underwater audiogram for Hawaiian monk seals, based on a single animal whose hearing may have been affected by disease or age, was best at 12 to 28 kHz and 60 to 70 kHz (Thomas et al. 1990). The hearing showed relatively poor hearing sensitivity, as well as a narrow range of best sensitivity and a relatively low upper frequency limit (Thomas et al. 1990).

#### 5.2.26.4 *Status*

Hawaiian monk seals were once harvested for their meat, oil, and skins, leading to extirpation in the main Hawaiian islands and near-extinction of the species by the twentieth century (Hiruki and Ragen 1992; Ragen 1999). The species partially recovered by 1960, when hundreds of seals were counted on northwestern Hawaiian Islands beaches. Since then, however, the species has declined in abundance. Though the ultimate cause(s) for the decline remain unknown threats include: food limitations in northwestern Hawaiian Islands, entanglement in marine debris, human interactions, loss of haul-out and pupping beaches due to erosion in northwestern Hawaiian Islands, disease outbreaks, shark predation, male aggression towards females, and low genetic diversity. With only approximately 1,437 individuals remaining the species’ resilience to further perturbation is low.

#### 5.2.26.5 *Critical Habitat*

See Section 5.1.4.9 for a description of Hawaiian monk seal critical habitat.

#### 5.2.26.6 *Recovery Goals*

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

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

### 5.2.27 Mediterranean Monk Seal

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

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

Information available from the recent five-year review (NMFS 2017g) and available scientific publications was used to summarize the life history, population dynamics and status of the species as follows.

#### 5.2.27.1 *Life History*

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

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

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

### 5.2.27.2 *Population Dynamics*

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

The current population of Mediterranean monk seals is estimated to be between 600 and 700 individuals. The Cabo Blanco and Madeira subpopulations have shown recent small increases in numbers (NMFS 2017g). Roughly 180 to 200 individuals live in Greek waters, making Greece one of the last strongholds for the species, with about 300 to 350 in the broader eastern Mediterranean Sea (MOm 2014).

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

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

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

#### 5.2.27.3 *Hearing*

While we are aware of no empirical data on the hearing range of Mediterranean monk seals, their expected hearing range is between two and 40 kHz (Kellett et al. 2014; NOAA 2016).

#### 5.2.27.4 *Status*

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

#### 5.2.27.5 *Critical Habitat*

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

#### 5.2.27.6 *Recovery Goals*

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

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

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

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

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

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 appealed that decision, the decision was reversed on February 12, 2018 by the U.S. Court of Appeals for the Ninth Circuit (Alaska Oil and Gas Association v. Ross, 722 F. App'x 666 (9th Cir. 2018), and the listing was reinstated on May 15, 2018.

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

#### 5.2.28.1 *Life History*

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

#### 5.2.28.2 *Population Dynamics*

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

#### 5.2.28.3 *Hearing*

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

#### 5.2.28.4 *Status*

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

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

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

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

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

#### 5.2.28.5 *Critical Habitat*

See Section 5.1.4.8 for a description of Arctic ringed seal critical habitat. There is no designated critical habitat for the Saimaa, Ladoga, Baltic, or Okhotsk ringed seal; NMFS cannot designate critical habitat in foreign waters.

#### 5.2.28.6 *Recovery Goals*

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

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

### 5.2.29 Spotted Seal (Southern Distinct Population Segment)

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

Spotted seals have a silver to light gray coat with dark spots. Adult can be up to 1.5 meters (5 feet) and weigh between 65 to 115 kilograms (140 to 250 pounds). The spotted seal is divided into three DPSs: the Southern DPS, the Bering Sea DPS, and the Sea of Okhotsk DPS. The

Southern DPS is composed of spotted seals breeding in the Liaodong Bay, Yellow Sea, and Peter the Great Bay in the Sea of Japan. On October 22, 2010, the NMFS issued a final determination to list the Southern DPS as threatened under the ESA.

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

#### 5.2.29.1 *Life History*

Spotted seals can live up to 30 to 35 years. Most spotted seals are sexually mature by age four. Spotted seals haul out onto the sea ice to breed; the timing of breeding depends on the region. Breeding in Liaodong Bay occurs from February to mid-March and in March and April in the Peter the Great Bay. The implantation of the fertilized embryo is delayed by two to four months, and gestation lasts seven to nine months. Pups are born between early January to mid-February in Liaodong Bay, and between early February and mid-March in peter the Great Bay. Pups are usually weaned in three to four weeks. Nursing pups do not enter the water until they are weaned and molted. They are dependent on the sea ice until they learn to dive and forage for themselves, which usually occurs ten to 15 days after molting. After breeding and birthing, the herds break up to migrate in spring and summer towards open water for favorable foraging grounds. Adult spotted seals forage on a wide variety of fishes like Pacific herring, Japanese smelt and capelin. Juveniles eat krill and small crustaceans. While foraging, spotted seals generally stay in continental shelf waters up to 200 meters (656.2 feet) deep (Boveng et al. 2009).

#### 5.2.29.2 *Population Dynamics*

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

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

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

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

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

#### 5.2.29.3 *Hearing*

Little is known about the hearing of spotted seals. Recently, Sills et al. (2014) measured the underwater and in-air hearing capabilities of young spotted seals and found that the best hearing sensitivity in air spanned four octaves, ranging from approximately 0.6 to 11 kHz, while the hearing sensitivity underwater ranged from 0.3 and 56 kHz. Sills et al. (2014) concluded that the sound reception capabilities of spotted seals differ from those described previously for ice seals, with capabilities more similar to harbor seals.

#### 5.2.29.4 *Status*

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

#### 5.2.29.5 *Critical Habitat*

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

#### 5.2.29.6 *Recovery Goals*

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

### 5.2.30 Steller Sea Lion (Western Distinct Population Segment)

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

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

We used information available in the final listing, the revised Recovery Plan (NMFS 2008b) and the 2020 stock assessment report (Muto et al. 2021) to summarize the status of the Western DPS, as follows.

#### 5.2.30.1 *Life History*

Within the Western DPS, pupping and breeding occurs at numerous major rookeries from late May to early July. Male Steller sea lions become sexually mature at three to seven years of age. They are polygynous, competing for territories and females by age 10 or 11. Female Steller sea lions become sexually mature at three to six years of age and reproduce into their early 20s. Most females breed annually, giving birth to a single pup. Pups are usually weaned in one to two years. Females and their pups disperse from rookeries by August to October. Juveniles and adults disperse widely, especially males. Their large aquatic ranges are used for foraging, resting, and traveling. Steller sea lions forage on a wide variety of demersal, semi-demersal, and pelagic prey, including fish and cephalopods. Some prey species form large seasonal aggregations, including endangered salmon and eulachon species. Others are available year round.

#### 5.2.30.2 *Population Dynamics*

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

As of 2020, the best estimate of abundance of the western Steller sea lion DPS in Alaska was 12,581 for pups and 40,351 for non-pups (total $N_{min}$ = 52,932) (Muto et al. 2021). This represents a large decline since counts in the 1950s (N = 140,000) and 1970s (N = 110,000).

Steller sea lion Western DPS site counts decreased 40 percent from 1991 to 2000, an average annual decline of 5.4 percent; however, counts increased three percent between 2004 and 2008, the first recorded population increase since the 1970s (NMFS 2008b). However, there are regional differences in population growth rate, with positive trends in the eastern portion of the range, and negative trends west of Samalga Pass (approximately 170 degrees West) (Muto et al. 2016). These trends indicate that overall, the Western DPS may be stable or exhibiting a slight negative trend as a whole.

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

Steller sea lions are distributed mainly around the coasts to the outer continental shelf along the North Pacific Ocean rim from northern Hokkaiddo, Japan through the Kuril Islands and Okhotsk Sea, Aleutian Islands and central Bering Sea, southern coast of Alaska and south to California. The Western DPS includes Steller sea lions that reside in the central and western Gulf of Alaska, Aleutian Islands, as well as those that inhabit the coastal waters and breed in Asia (e.g., Japan and Russia). The Western DPS also includes Steller sea lions that have been born at and west of Cape Suckling, Alaska (144 degrees West) but members of the Eastern (ESA-delisted) and Western DPS are known to cross this boundary (Muto et al. 2018).

#### 5.2.30.3 *Hearing*

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

#### 5.2.30.4 *Status*

The species was listed as threatened in 1990 because of significant declines in population sizes. At the time, the major threat to the species was thought to be reduction in prey availability. To protect and recovery the species, NMFS established the following measures: prohibition of shooting at or near sea lions; prohibition of vessel approach to within three nautical miles of specific rookeries, within 0.5 miles on land, and within sight of other listed rookeries; and restriction of incidental fisheries take to 675 sea lions annually in Alaskan waters. In 1997, the Western DPS was reclassified as endangered because it had continued to decline since its initial listing in 1990. Despite the added protection (and an annual incidental fisheries take of twenty-six individuals), the DPS is likely still in decline (though the decline has slowed or stopped in some portions of the range). The reasons for the continued decline are unknown but may be associated with nutritional stress as a result of environmental change and competition with commercial fisheries. The DPS appears to have little resilience to future perturbations.

#### 5.2.30.5 *Critical Habitat*

See Section 5.1.4.10 for a description of Western DPS Steller sea lion designated critical habitat.

#### 5.2.30.6 *Recovery Goals*

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

1. Baseline population monitoring
2. Insure adequate habitat and range for recovery
3. Protect from over-utilization for commercial, recreational, scientific or educational purposes

4. Protect from diseases, contaminants and predation
5. Protect from other natural or anthropogenic actions and administer the recovery program

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

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

The green sea turtle is the largest of the hardshell marine turtles, growing to a weight of 350 pounds (159 kilograms) and a straight carapace length of greater than 3.3 feet (1 meter). The species was listed under the ESA on July 28, 1978. The species was separated into two listing designations: endangered for breeding populations in Florida and the Pacific coast of Mexico and threatened in all other areas throughout its range. On April 6, 2016, NMFS listed eleven DPSs of green sea turtles as threatened or endangered under the ESA. Eight DPSs are listed as threatened: Central North Pacific, East Indian-West Pacific, East Pacific, North Atlantic, North Indian, South Atlantic, Southwest Indian, and Southwest Pacific. Three DPSs are listed as endangered: Central South Pacific, Central West Pacific, and Mediterranean. Only the North Atlantic, Central North Pacific, Central South Pacific, Central West Pacific, and East Pacific DPSs are considered in this opinion, as all other DPSs fall outside the action area for cetacean net captures.

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

#### 5.2.31.1 *Life history*

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

#### 5.2.31.2 *Population dynamics*

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

Worldwide, nesting data at 464 sites indicate that 563,826 to 564,464 females nest each year (Seminoff et al. 2015). The number of nesting females, nesting sites and the percentage of nesting females in the distinct population nesting at the largest nesting beach are shown in Table 10.

**Table 10.** Green turtle nesting abundance at sites in each distinct population segment (Seminoff et al. 2015).

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

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

Globally, the green turtle is divided into eleven distinct population segments based on genetic analyses. The majority of nesting for the Central North Pacific DPS is centered at one site on French Frigate Shoals, and there is little diversity in nesting areas. Overall, the Central North Pacific DPS has a relatively low level of genetic diversity and stock sub-structuring (Seminoff et al. 2015).There is very limited information available for the Central South Pacific DPS. Mitochondrial DNA studies indicate at least two genetic stocks in the DPS—American Samoa and French Polynesia. Overall, there is a moderate level of diversity for the DPS, and the presence of unique haplotypes (Seminoff et al. 2015). The Central West Pacific DPS is made up of insular rookeries separated by broad geographic distances. Rookeries that are more than 1,000 kilometers apart are significantly differentiated, while rookeries 500 kilometers apart are not (Seminoff et al. 2015). Mitochondrial DNA analyses suggest that there are at least seven independent stocks in the region (Dutton et al. 2014). Rare and unique haplotypes are present in the East Pacific DPS. Genetic sampling has identified four regional stocks in the Eastern Pacific DPS—Revillagigedos Archipelago, Mexico, Michoacán, Mexico, Central America (Costa Rica), and the Galapagos Islands, Ecuador (Seminoff et al. 2015). The North Atlantic DPS has a globally unique haplotype, which was a factor in defining the discreteness of the population for the DPS. Evidence from mtDNA studies indicates that there are at least 4 independent nesting subpopulations in Florida, Cuba, Mexico and Costa Rica (Seminoff et al. 2015). More recent genetic analysis indicates that designating a new western Gulf of Mexico management unit might be appropriate (Shamblin et al. 2016).

The green sea turtle occupies the coastal waters of over 140 countries worldwide; nesting occurs in more than eighty countries. The green sea turtle is distributed in tropical, subtropical, and to a lesser extent, temperate waters (Seminoff et al. 2015). Green turtles in the Central North Pacific DPS are found in the Hawaiian Archipelago and Johnston Atoll. The major nesting site for the DPS is at East Island, French Frigate Shoals, in the Northwestern Hawaiian islands; lesser nesting sites are found throughout the Northwestern Hawaiian Islands and the Main Hawaiian Islands (Seminoff et al. 2015). Green turtles in the Central South Pacific DPS are found in the South Pacific Ocean, from northern New Zealand to Fiji, Tuvalu, and Kiribati and east to include French Polynesia, with nesting occurring sporadically throughout this expansive region (Seminoff et al. 2015). The Central West Pacific DPS is composed of nesting assemblages in the Federated States of Micronesia, the Japanese islands of Chichijima and Hahajima, the Marshall Islands, and Palau. Green turtles in this DPS are found throughout the western Pacific Ocean, in Indonesia, the Philippines, the Marshall Islands and Papua New Guinea (Seminoff et al. 2015). Green turtles in the East Pacific DPS are found from the California/Oregon border south to central Chile. Major nesting sites occur at Michoacán, Mexico, and the Galapagos Islands, Ecuador. Smaller nesting sites are found on the Pacific Coast of Costa Rica, and in the Revillagigedos Archipelago, Mexico. Scattered nesting occurs in Columbia, Ecuador, Guatemala and Peru (Seminoff et al. 2015). Green turtles from the North Atlantic DPS range from the boundary of South and Central America (7.5 degrees North, 77 degrees West) in the south, throughout the Caribbean, the Gulf of Mexico, and the U.S. Atlantic coast to New Brunswick, Canada (48 degrees North, 77 degrees West) in the north. The range of the DPS then extends due east along latitudes 48 degrees North and 19 degrees North to the western coasts of Europe and Africa. Nesting occurs primarily in Costa Rica, Mexico, Florida and Cuba (Seminoff et al. 2015).

#### 5.2.31.3 *Hearing*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956b). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

#### 5.2.31.4 *Status*

Once abundant in tropical and subtropical waters, green sea turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation. Globally, egg harvest, the harvest of females on nesting beaches and directed hunting of turtles in foraging areas remain the three greatest threats to their recovery. In addition, bycatch in drift-net, long-line, set-net, pound-net and trawl fisheries kill thousands of green sea turtles annually. Increasing coastal development (including beach erosion and re-nourishment, construction and artificial lighting) threatens nesting success and hatchling survival. On a regional scale, the different DPSs experience these threats as well, to varying degrees. Differing levels of abundance combined with different intensities of threats and effectiveness of regional regulatory mechanisms make each DPS uniquely susceptible to future perturbations.

Green turtles from the Central North Pacific DPS in the Hawaiian Archipelago were subjected to hunting pressure for subsistence and commercial trade, which was largely responsible for the decline in the region. Though the practice has been banned, there are still anecdotal reports of harvest. Incidental bycatch in fishing gear, ingestion of marine debris, and the loss of nesting habitat due to sea level rise are current threats to the population. Although these threats persist, the increase in annual nesting abundance, continuous scientific monitoring, legal enforcement and conservation programs are all factors that favor the resiliency of the DPS.

Historically, the Central South Pacific DPS declined due to harvest of eggs and females for human consumption or for their shells, a practice that still continues throughout the region.

Incidental bycatch in commercial and artisanal fishing gear, lack of regulatory mechanisms and climate change are significant threats to the long-term viability of the DPS.

The Central West Pacific DPS is impacted by incidental bycatch in fishing gear, predation of eggs by ghost crabs and rats, and directed harvest eggs and nesting females for human consumption. Historically, intentional harvest of eggs from nesting beaches was one of the principal causes for decline, and this practice continues today in many locations. The Central West Pacific DPS has a small number of nesting females and a widespread geographic range. These factors, coupled with the threats facing the DPS and the unknown status of many nesting sites makes the DPS vulnerable to future perturbations.

The population decline for the East Pacific DPS was primarily caused by commercial harvest of green turtles for subsistence and other uses (e.g., sea turtle oil as a cold remedy). Conservation laws are in place in several countries across the range of the DPS, but enforcement is inconsistent, limiting effectiveness. Incidental bycatch in commercial fishing gear, continued harvest, coastal development and beachfront lighting are all continuing threats for the DPS. The observed increases in nesting abundance for the largest nesting aggregation in the region (Michocán, Mexico), a stable trend at Galapagos, and record high numbers at sites in Costa Rica suggest that the population is resilient, particularly in Mexico.

Historically, green turtles in the North Atlantic DPS were hunted for food, which was the principle cause of the population’s decline. Apparent increases in nester abundance for the North Atlantic DPS in recent years are encouraging but must be viewed cautiously, as the datasets represent a fraction of a green sea turtle generation, up to 50 years. While the threats of pollution, habitat loss through coastal development, beachfront lighting, and fisheries bycatch continue, the North Atlantic DPS appears to be somewhat resilient to future perturbations.

#### 5.2.31.5 *Critical Habitat*

See Section 5.1.4.11 for a description of North Atlantic DPS green turtle critical habitat.

#### 5.2.31.6 *Recovery Goals*

See the 1998 and 1991 recovery plans (NMFS 1991b; NMFS 1998c; NMFS 1998d) for the Pacific, East Pacific and Atlantic populations of green turtles for complete down-listing/delisting criteria for recovery goals for the species. Broadly, recovery plan goals emphasize the need to protect and manage nesting and marine habitat, protect and manage populations on nesting beaches and in the marine environment, increase public education, and promote international cooperation on sea turtle conservation topics.

### 5.2.32 Hawksbill Turtle

The hawksbill turtle has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical oceans.

The hawksbill turtle has a sharp, curved, beak-like mouth and a "tortoiseshell" pattern on its carapace, with radiating streaks of brown, black, and amber. The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973.

We used information available in the five-year reviews (NMFS 2013g; NMFS and USFWS 2007a) to summarize the life history, population dynamics and status of the species, as follows.

#### 5.2.32.1 *Life History*

Hawksbill turtles reach sexual maturity at 20 to 40 years of age. Females return to their natal beaches every two to five years to nest and nest an average of three to five times per season. Clutch sizes are large and can be up to 250 eggs. Sex determination is temperature dependent, with warmer incubation producing more females. Hatchlings migrate to, and remain in, pelagic habitats until they reach approximately 22 to 25 centimeters in straight carapace length. As juveniles, they take up residency in coastal waters to forage and grow. As adults, hawksbills use their sharp beak-like mouths to feed on sponges and corals. Hawksbill turtles are highly migratory and use a wide range of habitats during their lifetimes (Musick and Limpus 1997; Plotkin 2003). Satellite tagged turtles have shown significant variation in movement and migration patterns. Distance traveled between nesting and foraging locations ranges from a few hundred to a few thousand kilometers (Horrocks et al. 2001; Miller et al. 1998).

#### 5.2.32.2 *Population Dynamics*

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

Surveys at 88 nesting sites worldwide indicate that 22,004 to 29,035 females nest annually (NMFS 2013g). In general, hawksbills are doing better in the Atlantic and Indian Ocean than in the Pacific Ocean, where despite greater overall abundance, a greater proportion of the nesting sites are declining.

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2013g).

Populations are distinguished generally by ocean basin and more specifically by nesting location. Our understanding of population structure is relatively poor. Genetic analysis of hawksbill turtles foraging off the Cape Verde Islands identified three closely-related haplotypes in a large majority of individuals sampled that did not match those of any known nesting population in the western Atlantic, where the vast majority of nesting has been documented (McClellan et al. 2010; Monzon-Arguello et al. 2010). Hawksbills in the Caribbean seem to have dispersed into separate populations (rookeries) after a bottleneck roughly 100,000 to 300,000 years ago (Leroux et al. 2012).

The hawksbill has a circumglobal distribution throughout tropical and, to a lesser extent, subtropical waters of the Atlantic, Indian, and Pacific Oceans. In their oceanic phase, juvenile hawksbills can be found in *Sargassum* mats; post-oceanic hawksbills may occupy a range of habitats that include coral reefs or other hard-bottom habitats, sea grass, algal beds, mangrove bays and creeks (Bjorndal and Bolten 2010; Musick and Limpus 1997).

### 5.2.32.3 *Hearing*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012) found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956b). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

### 5.2.32.4 *Status*

Long-term data on the hawksbill turtle indicate that 63 sites have declined over the past 20 to one 100 years (historic trends are unknown for the remaining 25 sites). Recently, 28 sites (68 percent) have experienced nesting declines, 10 have experienced increases, three have remained stable, and 47 have unknown trends. The greatest threats to hawksbill turtles are overharvesting of turtles and eggs, degradation of nesting habitat, and fisheries interactions. Adult hawksbills are harvested for their meat and carapace, which is sold as tortoiseshell. Eggs are taken at high levels, especially in southeast Asia where collection approaches 100 percent in some areas. In addition, lights on or adjacent to nesting beaches are often fatal to emerging hatchlings and alters the behavior of nesting adults. The species' resilience to additional perturbation is low.

### 5.2.32.5 *Critical Habitat*

See Section 5.1.4.12 for a description of hawksbill turtle critical habitat.

#### 5.2.32.6 *Recovery Goals*

See the 1993 and 1998 Recovery Plans for the U.S. Caribbean, Atlantic and Gulf of Mexico (NMFS 1993) and U.S. Pacific (NMFS 1998e) populations of hawksbill turtles, respectively, for complete down listing/delisting criteria for each of their respective recovery goals. The following items were the top recovery actions identified to support in the Recovery Plans:

1. Identify important nesting beaches.
2. Ensure long-term protection and management of important nesting beaches.
3. Protect and manage nesting habitat; prevent the degradation of nesting habitat caused by seawalls, revetments, sand bags, other erosion-control measures, jetties and breakwaters.
4. Identify important marine habitats; protect and manage populations in marine habitat.
5. Protect and manage marine habitat; prevent the degradation or destruction of important [marine] habitats caused by upland and coastal erosion.
6. Prevent the degradation of reef habitat caused by sewage and other pollutants.
7. Monitor nesting activity on important nesting beaches with standardized index surveys.
8. Evaluate nest success and implement appropriate nest-protection on important nesting beaches.
9. Ensure that law-enforcement activities prevent the illegal exploitation and harassment of sea turtles and increase law-enforcement efforts to reduce illegal exploitation.
10. Determine nesting beach origins for juveniles and subadult populations.

### 5.2.33 Kemp's Ridley Turtle

The Kemp's ridley turtle is considered the most endangered sea turtle internationally (Groombridge 1982; Zwinenberg 1977). Its range extends from the Gulf of Mexico to the Atlantic coast, with nesting beaches limited to a few sites in Mexico and Texas.

Kemp's ridley turtles the smallest of all sea turtle species, with a nearly circular top shell and a pale yellowish bottom shell. The species was first listed under the Endangered Species Conservation Act and listed as endangered under the ESA since 1973.

We used information available in the revised recovery plan (NMFS 2011a) and the five-year review (NMFS 2015c) to summarize the life history, population dynamics and status of the species, as follows.

#### 5.2.33.1 *Life History*

Females mature at 12 years of age. The average remigration is two years. Nesting occurs from April to July in large arribadas, primarily at Rancho Nuevo, Mexico. Females lay an average of 2.5 clutches per season. The annual average clutch size is 97 to 100 eggs per nest. The nesting location may be particularly important because hatchlings can more easily migrate to foraging grounds in deeper oceanic waters, where they remain for approximately two years before returning to nearshore coastal habitats. Juvenile Kemp's ridley turtles use these nearshore coastal habitats from April through November, but move towards more suitable overwintering habitat in deeper offshore waters (or more southern waters along the Atlantic coast) as water temperature drops. Adult habitat largely consists of sandy and muddy areas in shallow, nearshore waters less than 120 feet (37 meters) deep, although they can also be found in deeper offshore waters. As adults, Kemp's ridleys forage on swimming crabs, fish, jellyfish, mollusks, and tunicates (NMFS 2011a).

#### 5.2.33.2 *Population Dynamics*

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

Of the sea turtles species in the world, the Kemp's ridley has declined to the lowest population level. Nesting aggregations at a single location (Rancho Nuevo, Mexico) were estimated at 40,000 females in 1947. By the mid-1980s, the population had declined to an estimated 300 nesting females. In 2014, there were an estimated 10,987 nests and 519,000 hatchlings released from three primary nesting beaches in Mexico (NMFS 2015c). The number of nests in Padre Island, Texas has increased over the past two decades, with one nest observed in 1985, four in 1995, fifty in 2005, 197 in 2009, and 119 in 2014 (NMFS 2015c).

From 1980 to 2003, the number of nests at three primary nesting beaches (Rancho Nuevo, Tepehuajes, and Playa Dos) increased 15 percent annually (Heppell et al. 2005); however, due to recent declines in nest counts, decreased survival at other life stages, and updated population modeling, this rate is not expected to continue (NMFS 2015c).

Genetic variability in Kemp's ridley turtles is considered to be high, as measured by heterozygosis at microsatellite loci (NMFS 2011a). Additional analysis of the mtDNA taken from samples of Kemp's ridley turtles at Padre Island, Texas, showed six distinct haplotypes, with one found at both Padre Island and Rancho Nuevo (Dutton et al. 2006).

The Kemp's ridley turtle occurs from the Gulf of Mexico and along the Atlantic coast of the United States (TEWG 2000). Kemp's ridley turtles have occasionally been found in the Mediterranean Sea, which may be due to migration expansion or increased hatchling production (Tomas and Raga 2008). The vast majority of individuals stem from breeding beaches at Rancho Nuevo on the Gulf of Mexico coast of Mexico. During spring and summer, juvenile Kemp's ridleys occur in the shallow coastal waters of the northern Gulf of Mexico from south Texas to north Florida. In the fall, most Kemp's ridleys migrate to deeper or more southern, warmer waters and remain there through the winter (Schmid 1998). As adults, many turtles remain in the Gulf of Mexico, with only occasional occurrence in the Atlantic Ocean (NMFS et al. 2010).

#### 5.2.33.3 *Hearing*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2.0 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Moein Bartol and Ketten 2006; Ridgway et al. 1969). Piniak et al. (2012)

found green sea turtle juveniles capable of hearing underwater sounds at frequencies of 50 Hz to 1,600 kHz (maximum sensitivity at 200 to 400 Hz). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Based upon auditory brainstem responses green sea turtles have been measured to hear in the 50 Hz to 1.6 kHz range (Dow et al. 2008), with greatest response at 300 Hz (Yudhana et al. 2010); a value verified by Moein Bartol and Ketten (2006). Other studies have found greatest sensitivities are 200 to 400 Hz for the green sea turtle with a range of 100 to 500 Hz (Moein Bartol and Ketten 2006; Ridgway et al. 1969) and around 250 Hz or below for juveniles (Bartol et al. 1999). However, Dow et al. (2008) found best sensitivity between 50 and 400 Hz.

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956b). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3.0 to 4.0 kHz (Patterson 1966).

#### 5.2.33.4 *Status*

The Kemp's ridley was listed as endangered in response to a severe population decline, primarily the result of egg collection. In 1973, legal ordinances prohibited the harvest of sea turtles from May to August, and in 1990, the harvest of all sea turtles was prohibited by presidential decree. In 2002, Rancho Nuevo was declared a Sanctuary. A successful head-start program has resulted in the reestablishment of nesting at Texan beaches. While fisheries bycatch remains a threat, the use of turtle excluder devices mitigates take. Fishery interactions and strandings, possibly due to forced submergence, appear to be the main threats to the species. It is clear that the species is steadily increasing; however, the species' limited range and low global abundance make it vulnerable to new sources of mortality as well as demographic and environmental randomness, all of which are often difficult to predict with any certainty. Therefore, its resilience to future perturbation is low.

#### 5.2.33.5 *Critical Habitat*

No critical habitat has been designated for Kemp's ridley turtles.

#### 5.2.33.6 *Recovery Goals*

See the 2011 Final Bi-National (United States and Mexico) Revised Recovery Plan (NMFS 2011a) for Kemp's ridley turtles for complete down listing/delisting criteria for each of their respective recovery goals. The following items were identified as priorities to recover Kemp's ridley turtles:

1. Protect and manage nesting and marine habitats.
2. Protect and manage populations on the nesting beaches and in the marine environment.
3. Maintain a stranding network.
4. Manage captive stocks.

5. Sustain education and partnership programs.
6. Maintain, promote awareness of and expand United States and Mexican laws.
7. Implement international agreements.
8. Enforce laws.

### 5.2.34 Leatherback Turtle

Leatherback sea turtles are listed as endangered under the ESA throughout their global range. The leatherback turtle has the most extensive global distribution of any reptile and is distributed throughout the oceans of the world from the equator to subpolar regions in both hemispheres. Leatherback turtles spend the majority of their lives at sea, where they develop, forage, migrate, and mate, nesting on beaches on every continent except Europe and Antarctica, and several islands of the Caribbean and the Indo-Pacific (Eckert et al. 2012a; NMFS and USFWS 2020a). Seven populations are currently recognized: (1) Northwest Atlantic; (2) Southeast Atlantic; (3) Southwest Atlantic; (4) Northeast Indian; (5) Southwest Indian; (6) West Pacific; and (7) East Pacific Ocean populations (NMFS and USFWS 2020a).

The leatherback sea turtle is unique among sea turtles for its large size, lack of scales, ridged carapace, and wide north-south distribution (due to thermoregulatory systems and behavior). Leatherbacks are the largest living turtle, adults weighing an average of 1,000 pounds (453 kg) and over 5 feet (1.52 m) in carapace length (Davenport et al. 2011). Leatherback sea turtles undertake the longest migrations of any sea turtle, migrating long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. During migrations or long distance movements, leatherbacks maximize swimming efficiency by traveling within 15 feet of the surface (Eckert 2002). The leatherback sea turtle is one of the deepest divers in the ocean, with dives as deep as 3,937 feet (1,200 m), although it spends most of its time at depths of less than 328 feet (100 m) (Houghton et al. 2008).

We used information available in the five-year review (NMFS 2013h), status review (NMFS and USFWS 2020a), critical habitat designation, and available scientific literature to summarize the life history, population dynamics and status of the species, as follows.

#### 5.2.34.1 *Life History*

The leatherback life cycle is broken into several stages: (1) egg/hatchling, (2) post-hatchling, (3) juvenile, (4) subadult, and (5) adult. Leatherbacks are a long-lived species that delay age of maturity, have low and variable survival in the egg and juvenile stages, and have relatively high and constant annual survival in the subadult and adult life stages (Chaloupka 2002; Crouse 1999; Heppell et al. 1999; Heppell et al. 2003; Spotila et al. 1996; Spotila et al. 2000). While a robust estimate of the leatherback sea turtle's life span does not exist, the current best estimate for the maximum age is 43 (Avens et al. 2009). It is still unclear when leatherbacks first become sexually mature. Using skeletochronological data, Avens et al. (2009) estimated that leatherbacks in the western North Atlantic may not reach maturity until 29 years of age, which is longer than earlier estimates of 2-3 years by Pritchard and Trebbau (1984), of 3-6 years by Rhodin (1985), of 13-14 years for females by Zug and Parham (1996), and 12-14 years for leatherbacks nesting in the U.S. Virgin Islands by Dutton et al. (2005). A more recent study that examined leatherback growth rates estimated an age at maturity of 16.1 years (Jones et al. 2011).

Female leatherbacks typically nest on sandy, tropical beaches at intervals of 2-4 years (Garcia M. and Sarti 2000; McDonald and Dutton 1996; Spotila et al. 2000). Unlike other sea turtle species, female leatherbacks do not always nest at the same beach year after year; some females may even nest at different beaches during the same year (Dutton et al. 2005; Eckert 1989; Keinath and Musick 1993; Steyermark et al. 1996). Individual female leatherbacks have been observed with fertility spans as long as 25 years (Hughes 1996). Females usually lay up to 10 nests during the 3-6 month nesting season (March through July in the United States), typically 8-12 days apart, with 100 eggs or more per nest (Eckert et al. 2012b; Eckert 1989; Maharaj 2004; Matos 1986; Stewart and Johnson 2006; Tucker 1988). Yet, up to approximately 30% of the eggs may be infertile (Eckert 1989; Eckert et al. 1984; Maharaj 2004; Matos 1986; Stewart and Johnson 2006; Tucker 1988). The number of leatherback hatchlings that make it out of the nest on to the beach (i.e., emergent success) is approximately 50 percent worldwide (Eckert et al. 2012b), which is lower than the greater than 80% reported for other sea turtle species (Miller 1997). In the United States, the emergent success is higher at 54-72 percent (Eckert and Eckert 1990; Stewart and Johnson 2006; Tucker 1988). Thus the number of hatchlings in a given year may be less than the total number of eggs produced in a season. Eggs hatch after 60-65 days, and the hatchlings have white striping along the ridges of their backs and on the edges of the flippers. Leatherback hatchlings weigh approximately 1.5-2 ounces (40-50 grams), and have lengths of approximately 2-3 inches (51-76 milimeters), with fore flippers as long as their bodies. Hatchlings grow rapidly, with reported growth rates for leatherbacks from 2.5-27.6 inches (6-70 centimeters) in length, estimated at 12.6 inches (32 centimeters) per year (Jones et al. 2011).

Avens et al. (2020) estimate a mean age at maturity of 17 years (range of 12 to 28 years) for Pacific leatherbacks (East and West populations combined) and 19 years (range of 13 to 28 years) for Northwest Atlantic leatherbacks. In Indonesia, the mean size of nesting females is 161 cm curved carapace length (CCL) with an observed minimum of 138 cm CCL (Hitipeuw and Maturbongs 2002; Lontoh 2014). Females lay up to seven clutches per season, with more than 65 eggs per clutch and eggs weighing greater than 80 grams (Reina et al. 2002; Wallace et al. 2007). The mean hatchling emergence success (i.e., the number of hatchlings that successfully emerge from the nest onto the beach) is beach and seasonally specific and can range between 25 and 60 percent in the West Pacific and 35 to 52 percent in the East Pacific (summarized in NMFS and USFWS 2020a). Females nest every one to seven years. Natal homing, at least within an ocean basin, results in reproductive isolation between five broad geographic regions: eastern and western Pacific, eastern and western Atlantic, and Indian Ocean. Leatherback turtles migrate long, transoceanic distances between their tropical nesting beaches and the highly productive temperate waters where they forage, primarily on jellyfish and tunicates. These gelatinous prey are relatively nutrient-poor, such that leatherbacks must consume large quantities to support their body weight. Leatherbacks weigh about 33 percent more on their foraging grounds than at nesting, indicating that they probably catabolize fat reserves to fuel migration and subsequent reproduction (James et al. 2005b; Wallace et al. 2006). Leatherback turtles must meet an energy threshold before returning to nesting beaches. Therefore, their remigration intervals (the time between nesting) are dependent upon foraging success and duration (Hays 2000; Price et al. 2004).

In the Atlantic, the sex ratio appears to be skewed toward females. The Turtle Expert Working Group (TEWG) reports that nearshore and onshore strandings data from the U.S. Atlantic and Gulf of Mexico coasts indicate that 60% of strandings were females (TEWG 2007). Those data also show that the proportion of females among adults (57 percent) and juveniles (61 percent) was also skewed toward females in these areas (TEWG 2007). James et al. (2007) collected size and sex data from large subadult and adult leatherbacks off Nova Scotia and also concluded a bias toward females at a rate of 1.86:1.

The survival and mortality rates for leatherbacks are difficult to estimate and vary by location. For example, the annual mortality rate for leatherbacks that nested at Playa Grande, Costa Rica, was estimated to be 34.6 percent in 1993-1994, and 34.0 percent in 1994-1995 (Spotila et al. 2000). In contrast, leatherbacks nesting in French Guiana and St. Croix had estimated annual survival rates of 91 percent (Rivalan et al. 2005) and 89 percent (Dutton et al. 2005), respectively. For the St. Croix population, the average annual juvenile survival rate was estimated to be approximately 63 percent and the total survival rate from hatchling to first year of reproduction for a female was estimated to be between 0.4 percent and 2 percent, assuming age at first reproduction is between 9-13 years (Eguchi et al. 2006). Spotila et al. (1996) estimated first-year survival rates for leatherbacks at 6.25 percent.

Migratory routes of leatherbacks are not entirely known; however, recent information from satellite tags have documented long travels between nesting beaches and foraging areas in the Atlantic and Pacific Ocean basins (Benson et al. 2007a; Benson et al. 2011a; Eckert 2006; Eckert et al. 2006; Ferraroli et al. 2004; Hays et al. 2004; James et al. 2005a). Leatherbacks nesting in Central America and Mexico travel thousands of miles through tropical and temperate waters of the South Pacific (Eckert and Sarti 1997; Shillinger et al. 2008b). Data from satellite tagged leatherbacks suggest that they may be traveling in search of seasonal aggregations of jellyfish (Benson et al. 2007c; Bowlby et al. 1994; Graham 2009; Shenker 1984; Starbird et al. 1993; Suchman and Brodeur 2005).

#### 5.2.34.2 *Population Dynamics*

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

Sea turtles are difficult to study across all life stages due to their extensive distribution, certain cryptic life stages, complex life history, and remote habitats. As a result, status and trends of sea turtle populations are usually based on data collected on nesting beaches (e.g., number of adult females, number of nests, nest success, etc.). The spatial structure of male sea turtles and their fidelity to specific coastal areas is unknown; however, we describe the status of sea turtle populations based on the nesting beaches that females return to when they mature. We make inferences about the growth or decline of leatherback populations based on numbers of nests and trends in numbers of nests.

We define the West Pacific population as leatherback turtles originating from the West Pacific Ocean, with the following boundaries: south of 71 degrees N, north of 47 degrees S latitudes and east of 120 degrees E, and west of 117.124 degrees W longitudes (NMFS and USFWS 2020a). Indonesia, Papua New Guinea and Solomon Islands have been identified as the core nesting areas for this population (Benson et al. 2007b; Benson et al. 2011b; Benson et al. 2018; Benson et al. 2007d). Low levels of nesting are also reported in Vanuatu and the Philippines (NMFS and USFWS 2020a). Recently, a new leatherback turtle nesting area was identified at Buru Island, Maluku province of Indonesia where approximately 200 nests are laid annually (NMFS and USFWS 2020a; WWF 2019). However, long-term monitoring data for this population is geographically limited to the Bird's Head Peninsula in West Papua at Jamursba Medi and Wermon nesting beaches which represent an estimated 50 to 75 percent of all nesting in the West Pacific (NMFS and USFWS 2020)(NMFS and USFWS 2020a).

The West Pacific population exhibits metapopulation dynamics and genetic population structure (NMFS and USFWS 2020a). While mitochondrial DNA analyses of 106 samples from Indonesia, Papua New Guinea, and Solomon Islands did not detect genetic differentiation among nesting aggregations (Dutton et al. 2007), microsatellite DNA analyses indicate fine-scale genetic structure (Dutton et al. 2007; NMFS SWFSC, unpublished data). While we often consider these different nesting aggregations separately, together they comprise the Western Pacific population (NMFS and USFWS 2020a).

Two life history strategies are documented in the West Pacific leatherback population: winter boreal nesters and summer boreal nesters. The most consistent monitoring effort has been at Jamursba-Medi beach, and its nesting females are primarily summer nesters. Wermon beach has a stronger bimodal pattern of nesting, with summer and winter nesters in roughly equal proportions. There is historical evidence to suggest a similar bimodal nesting strategy in other nesting aggregations, but data is lacking to quantify the current extent of summer nesting activity in the Solomon Islands and Papua New Guinea where the majority of nesting activity occurs during winter months (NMFS and USFWS 2020a).

Migration and foraging strategies vary based on these life history strategies, likely due to prevailing offshore currents and, for hatchlings, seasonal monsoon-related effects experienced as hatchlings (Benson et al. 2011b; Gaspar et al. 2012). Summer nesting females forage in Northern Hemisphere foraging habitats in Asia and the North Pacific Ocean, while winter nesting females migrate to tropical waters of the Southern Hemisphere in the South Pacific Ocean (Benson et al. 2011b; Harrison et al. 2018). The lack of crossover among seasonal nesting populations suggests that leatherback turtles develop fidelity for specific foraging regions likely based on juvenile dispersal patterns (Benson et al. 2011b; Gaspar and Lalire 2017; Gaspar et al. 2012). Stable isotopes, linked to particular foraging regions, confirm nesting season fidelity to specific foraging regions (Seminoff et al. 2012).

Using the best available data for the West Pacific leatherback population (Fitry Pakiding, University of Papua, pers. comm. 2020) and a Bayesian steady-state model, (Martin et al. 2020) provided a median estimate of the total number of nesting females (i.e., over one, 3-year, remigration interval) at Jamursba Medi and Wermon beaches of 790 females, with a 95 percent credible interval of 666 to 942 females, as a snapshot of current abundance in 2017. We consider this the best available estimate of total adult female abundance at these two nesting beaches in 2017 (based on data from 2014 through 2017). To estimate the total number of nesting females from all nesting beaches in the West Pacific, we need to consider nesting at unmonitored or irregularly monitored beaches. As noted above, an estimated 50 to 75 percent of West Pacific leatherback nesting occurs at Jamursba-Medi and Wermon beaches (Dutton et al. 2007; NMFS and USFWS 2020a). Applying the conservative estimate of 75 percent to the (Martin et al. 2020) estimate of 790 nesting females at Jamursba Medi and Wermon beaches, the total number of nesting females in the West Pacific population would be 1,054 females with an overall 95 percent credible interval of 888 to 1,256 females. It should be noted that this estimate (i.e., 1,054) of nesting females for the West Pacific population based on more recent available information is an update of the previous estimate (NMFS and USFWS 2020a) (i.e., 1,277) which was based on a simple calculation that did not provide confidence or credible intervals.

Based on the estimates presented in (Jones et al. 2012) for all Pacific populations, NMFS inferred an estimated West Pacific leatherback total population size (i.e., juveniles and adults) of 250,000 (95 percent confidence interval 97,000 to 535,000) in 2004. Based on the relative change in the estimates derived from Jones et al. (2012) and the more recent Martin et al. (2020), NMFS estimates the current juvenile and adult population size of the West Pacific leatherback population is around 100,000 sea turtles (95 percent confidence interval 47,000 to 195,000 individuals).

The Western Pacific population exhibits low hatching success and decreasing nesting population trends due to past and current threats, which are likely to further lower abundance and increase the risk of extinction (NMFS and USFWS 2020a). The low estimated nesting female abundance of the West Pacific population places it at elevated risk for environmental variation, genetic complications, demographic stochasticity, negative ecological feedback, and catastrophes (NMFS and USFWS 2020). These processes, working alone or in concert, place small populations at a greater extinction risk than large populations, which are better able to absorb impacts to habitat or losses in individuals (NMFS and USFWS 2020). Low site fidelity, which is characteristic of the species, results in the dispersal of nests among various beaches (NMFS and USFWS 2020). This may help to reduce population level impacts from threats which may disproportionately affect one area over another, but may also place nests in locations that are likely unmonitored and not protected from human poaching or predation, thereby increasing threats to the population. Due to its small size, this population has restricted capacity to buffer such losses (NMFS and USFWS 2020).

The median trend in annual nest counts estimated for Jamursba Medi nesting beaches from data collected from 2001-2017 was -5.7 percent annually (NMFS and USFWS 2020). The median trend in annual nest counts estimated for Wermon nesting beaches from data collected from 2006 to 2017 (excluding 2013–2015 due to low or insufficient effort) was -2.3 percent annually (NMFS and USFWS 2020). In the absence of population trend data on other leatherback life history stages, we consider these trends in annual nest counts an index of the population's growth rate.

Martin et al. (2020) estimated the mean and median time until the West Pacific population declines to 50 percent, 25 percent, and 12.5 percent of its current estimated abundance. Results of this modeling effort indicate that the adult female portion of West Pacific leatherbacks nesting at Jamursba-Medi and Wermon beaches are predicted to decline to 50 percent of their current abundance in a mean of about 13 years (95 percent CI from 5 to 26 years) and to 25 percent of their current abundance in a mean of about 24 years (95 percent CI from 13 to 42 years).

We define the East Pacific population as leatherback turtles originating from the East Pacific Ocean, north of 47 degrees S and south of 32.531 degrees N latitudes, and east of 117.124 degrees W, and west of the Americas. The East Pacific leatherback population is characterized by somewhat continuous and low density nesting across long stretches of beaches along the coast of Mexico and Central America (NMFS and USFWS 2020). The best available genetic data indicate a high degree of connectivity among nesting aggregations that comprise a single population without population subdivision (NMFS and USFWS 2020). This population generally occupies a marine distribution distinct from the West Pacific population, although there are some pelagic areas where East and West Pacific populations overlap. Genetic analyses of juvenile and adult leatherback sea turtles caught in fisheries off Peru and Chile indicate that a proportion (approximately 16 percent of sampled turtles) are from West Pacific rookeries (Donoso and Dutton 2010; NMFS and USFWS 2013).

The foraging range of the East Pacific leatherback extends into coastal and pelagic waters of the southeastern Pacific Ocean; however, foraging is not as widely separated as compared to the West Pacific DPS (NMFS and USFWS 2020). Tagging studies have shown that East Pacific post-nesting females migrate southward to the south Pacific after nesting in Costa Rica (Shillinger et al. 2008a) and commonly forage offshore in the South Pacific Gyre in upwelling areas of cooler, deeper water and high productivity (Shillinger et al. 2011). During the nesting season, they stay within the shallow, highly productive, continental shelf waters (Shillinger and coauthors. 2010).

Using the best data available for the East Pacific population, NMFS and USFWS (2020) calculated the index of total nesting females to be a minimum of 755 females. We consider this the best available estimate because it is based on a complete compilation of the most recent 4-year remigration interval data for each nesting beach monitored. Model-based estimates of abundance with credible or confidence intervals are unavailable for this population. This index of nesting includes females from known nesting beaches in Costa Rica and Nicaragua, and an estimated 70 to 75 percent of total nesting in Mexico (Gaona and Barragan 2016). It does not include females nesting at inconsistently monitored beaches in Mexico, including: Agua Blanca (40 kilometers in Baja California), Playa Ventura, Playa San Valentín, Piedra de Tlacoyunque, and La Tuza (Martinez et al. 2007). Nesting is rare in other nations (e.g., Ecuador, El Salvador, and Panama) (Sarti et al. 1999).

The East Pacific leatherback population has undergone dramatic declines over the last three generations (NMFS and USFWS 2020a; Wallace et al. 2013), and to date there is no sign of recovery. In Costa Rica, a 15.5 percent annual rate of decline in nesting females has been documented at Las Baulas from 1988/1989 through 2015/2016 (NMFS and USFWS 2020). In Mexico, a positive trend has been recorded at some nesting beaches (i.e., Barra de la Cruz/Playa Grande +9.5 percent annually) but a negative trend has been recorded in other areas (i.e., Cahuitan -4.3 percent annually over the same period). Overall, the current and potential future trend for the population is uncertain and additional years of data are needed to ascertain if recovery is occurring in Mexico.

The greatest genetic divergence within leatherback sea turtles is evident between Atlantic and Indo-Pacific populations (NMFS and USFWS 2020). At least two populations occur within the Pacific Ocean, the West Pacific and the East Pacific, and it has long been considered likely that individuals from the Northeast Indian Ocean population may also occur in the Pacific Ocean. The West Pacific, East Pacific, and Northeast Indian Ocean leatherback populations have all experienced severe and continuing declines. While the West Pacific population is arguably the most robust of the three Pacific populations, our best estimate for the total index of nesting female abundance is only 1,054 females, and at its current rate of decline is predicted to reach half of its current abundance in only 13 years (Martin et al. 2020). The Northeast Indian Ocean has exhibited a drastic population decline with the extirpation of its largest nesting aggregation in Terengganu, Malaysia (Tiwari et al. 2013a). NMFS and FWS (2020) calculated an index of nesting female abundance, defined as the estimated number of nesting females over one (3-year) remigration interval, for each of the Pacific populations. Based on this index, the Northeast Indian Ocean is the smallest of the three populations, with an estimated total index of nesting female abundance of 109 females. The minimum estimated total index of nesting female abundance for the East Pacific population is 755 females. Pacific leatherback recovery is defined, in part, when each population (stock) averages 5,000 females nesting annually over 6 years, and all nesting populations are either stable or increasing over a 25-year monitoring period

(NMFS and USFWS 1998). The Pacific populations are not on a trajectory to meet these, or other relevant recovery criteria.

NMFS and USFWS (2020) found that all seven leatherback populations met the definition of high risk of extinction as a result of reduced nesting female abundance, declining nest trends (for all but the Southwest Atlantic DPS, which exhibits extremely low abundance), and numerous, severe threats. While the estimated total index of nesting female abundance for the Northwest Atlantic population (20,659 females) is relatively high compared to the Pacific populations, this population faces clear and present threats that, along with a declining nest trend, place its continued persistence in question (NMFS and USFWS 2020). The Southeast Atlantic population also faces clear and present threats that, along with a declining nest trend, place its continued persistence in question. The lack of data in many areas limits our ability to quantify threats for more than a small portion of this population.

The conservation biology principles of resiliency, redundancy, and representation (collectively known as the “3Rs”) can be used as a lens for evaluating the current and future status of a species based on an assessment of its reproductive potential, numbers, and distribution. Resiliency describes the ability of the species to withstand stochastic disturbance events, which is associated with population size, growth rate, and habitat quality. Redundancy describes the ability of a species to withstand catastrophic events, which is related to the number, distribution, and resilience of populations. Representation describes the ability of a species to adapt to changing environmental conditions, which is related to distribution within the species’ ecological settings. The spatial distribution of a species’ populations determines, among other things, whether the same natural and anthropogenic stressors affect all of a species’ populations, or whether some populations occur in protected areas or are at least protected from stressors that affect other populations. Changes in the spatial distribution of the populations (or subpopulations) that comprise a globally-listed entity are also important indicators of the species’ status and health, as they provide insight into how the species is responding to long-term changes in its environment (for example, to climate change).

Based on the best available information presented above, the Pacific leatherback population is characterized by low resiliency and redundancy. With low abundance estimates in all countries where the species nests in both the Western Pacific and Eastern Pacific, leatherback sea turtles are at an extremely high risk of being extirpated from the Pacific Ocean. While leatherback abundance estimates are higher for other portions of its global range (e.g., Northwest Atlantic), all seven leatherback populations are currently at a high risk of extinction (NMFS and USFWS 2020). Extirpation of Pacific leatherbacks would significantly contract the species’ range, thus increasing the already high risk of extinction for the globally-listed entity.

We define the Northwest Atlantic DPS as leatherback turtles originating from the northwest Atlantic Ocean, south of 71 degrees N, east of the Americas, and west of Europe and northern

Africa; the southern boundary is a diagonal line between 5.377 degrees S, 35.321 degrees W and 16.063 degrees N, 16.51 degrees W. The northern boundary reflects a straight latitudinal line based on the northern-most occurrence of leatherback turtles (Brongersma 1972; Carriol and Vader 2002; Eckert et al. 2012a; Goff and Lien 1988; McMahon and Hays 2006). The southern boundary is a diagonal line between the elbow of Brazil, where the Brazilian current begins and likely restricts the nesting range of this DPS, and the northern boundary of Senegal. The boundary between Senegal and Mauritania was chosen because the Southeast Atlantic DPS does not appear to nest above this boundary (Fretey et al. 2007b).

The status of the Atlantic leatherback population had been less clear than the Pacific population, which has shown dramatic declines at many nesting sites (Santidrián Tomillo et al. 2007; Sarti Martínez et al. 2007; Spotila et al. 2000). This uncertainty resulted from inconsistent beach and aerial surveys, cycles of erosion, and reformation of nesting beaches in the Guianas (representing the largest nesting area). Leatherbacks also show a lesser degree of nest-site fidelity than occurs with the hardshell sea turtle species. Coordinated efforts of data collection and analyses by the leatherback Turtle Expert Working Group helped to clarify the understanding of the Atlantic population status up through the early 2000's (TEWG 2007). However, additional information for the Northwest Atlantic population has more recently shown declines in that population as well, contrary to what earlier information indicated (Northwest Atlantic Leatherback Working Group 2018). A full status review covering leatherback status and trends for all populations worldwide is being finalized (2020).

The Southern Caribbean/Guianas stock is the largest known Atlantic leatherback nesting aggregation (TEWG 2007). This area includes the Guianas (Guyana, Suriname, and French Guiana), Trinidad, Dominica, and Venezuela, with most of the nesting occurring in the Guianas and Trinidad. The Southern Caribbean/Guianas stock of leatherbacks was designated after genetics studies indicated that animals from the Guianas (and possibly Trinidad) should be viewed as a single population. Using nesting females as a proxy for population, the TEWG (2007) determined that the Southern Caribbean/Guianas stock had demonstrated a long-term, positive population growth rate. TEWG observed positive growth within major nesting areas for the stock, including Trinidad, Guyana, and the combined beaches of Suriname and French Guiana (TEWG 2007). More specifically, Tiwari et al. (2013b) report an estimated three-generation abundance change of +3 percent, +20,800 percent, +1,778 percent, and +6 percent in Trinidad, Guyana, Suriname, and French Guiana, respectively. However, subsequent analysis using data up through 2017 has shown decreases in this stock, with an annual geometric mean decline of 10.43 percent over what they described as the short term (2008-2017) and a long-term (1990-2017) annual geometric mean decline of 5 percent (Northwest Atlantic Leatherback Working Group 2018).

Researchers believe the cyclical pattern of beach erosion and then reformation has affected leatherback nesting patterns in the Guianas. For example, between 1979 and 1986, the number of leatherback nests in French Guiana had increased by about 15 percent annually (NMFS 2001).

This increase was then followed by a nesting decline of about 15 percent annually. This decline corresponded with the erosion of beaches in French Guiana and increased nesting in Suriname. This pattern suggests that the declines observed since 1987 might actually be a part of a nesting cycle that coincides with cyclic beach erosion in Guiana (Schulz 1975). Researchers think that the cycle of erosion and reformation of beaches may have changed where leatherbacks nest throughout this region. The idea of shifting nesting beach locations was supported by increased nesting in Suriname,[7] while the number of nests was declining at beaches in Guiana (Hilterman et al. 2003). This information suggested the long-term trend for the overall Suriname and French Guiana population was increasing. A more recent cycle of nesting declines from 2008-2017, as high at 31 percent annual decline in the Awala-Yalimapo area of French Guiana and almost 20 percent annual declines in Guyana, has changed the long-term nesting trends in the region negative as described above (Northwest Atlantic Leatherback Working Group 2018).

The Western Caribbean stock includes nesting beaches from Honduras to Colombia. Across the Western Caribbean, nesting is most prevalent in Costa Rica, Panama, and the Gulf of Uraba in Colombia (Duque et al. 2000). The Caribbean coastline of Costa Rica and extending through Chiriquí Beach, Panama, represents the fourth largest known leatherback rookery in the world (Troëng et al. 2004). Examination of data from index nesting beaches in Tortuguero, Gandoca, and Pacuaré in Costa Rica indicate that the nesting population likely was not growing over the 1995-2005 time series (TEWG 2007). Other modeling of the nesting data for Tortuguero indicates a possible 67.8 percent decline between 1995 and 2006 (Troëng et al. 2007). Tiwari et al. (2013b) report an estimated three-generation abundance change of -72 percent, -24 percent, and +6 percent for Tortuguero, Gandoca, and Pacuare, respectively. Further decline of almost 6% annual geometric mean from 2008-2017 reflects declines in nesting beaches throughout this stock (Northwest Atlantic Leatherback Working Group 2018).

Nesting data for the Northern Caribbean stock is available from Puerto Rico, St. Croix (U.S. Virgin Islands), and the British Virgin Islands (Tortola). In Puerto Rico, the primary nesting beaches are at Fajardo and on the island of Culebra. Nesting between 1978 and 2005 has ranged between 469-882 nests, and the population has been growing since 1978, with an overall annual growth rate of 1.1 percent (TEWG 2007). Tiwari et al. (2013b) report an estimated three-generation abundance change of -4 percent and +5,583 percent at Culebra and Fajardo, respectively. At the primary nesting beach on St. Croix, the Sandy Point National Wildlife Refuge, nesting has varied from a few hundred nests to a high of 1,008 in 2001, and the average annual growth rate has been approximately 1.1 percent from 1986-2004 (TEWG 2007). From 2006-2010, Tiwari et al. (2013b) report an annual growth rate of +7.5 percent in St. Croix and a three-generation abundance change of +1,058 percent. Nesting in Tortola is limited, but has been increasing from 0-6 nests per year in the late 1980s to 35-65 per year in the 2000s, with an

[7] *Leatherback nesting in Suriname increased by more than 10,000 nests per year since 1999 with a peak of 30,000 nests in 2001.*

annual growth rate of approximately 1.2 percent between 1994 and 2004 (TEWG 2007). The nesting trend reversed course later, with an annual geometric mean decline of 10 percent from 2008-2017 driving the long-term trend (1990-2017) down to a 2 percent annual decline (Northwest Atlantic Leatherback Working Group 2018).

The Florida nesting stock nests primarily along the east coast of Florida. This stock is of growing importance, with total nests between 800-900 per year in the 2000s following nesting totals fewer than 100 nests per year in the 1980s (Florida Fish and Wildlife Conservation Commission, unpublished data). Using data from the index nesting beach surveys, the TEWG (2007) estimated a significant annual nesting growth rate of 1.17 percent between 1989 and 2005. FWC Index Nesting Beach Survey Data generally indicates biennial peaks in nesting abundance beginning in 2007 (Figure 21 and Table 11). A similar pattern was also observed statewide (Table 11). This up-and-down pattern is thought to be a result of the cyclical nature of leatherback nesting, similar to the biennial cycle of green turtle nesting. Overall, the trend showed growth on Florida's east coast beaches. Tiwari et al. (2013b) report an annual growth rate of 9.7 percent and a three-generation abundance change of +1,863 percent. However, in recent years nesting has declined on Florida beaches, with 2017 hitting a decade-low number, with a partial rebound in 2018. The annual geometric mean trend for Florida has been a decline of almost 7 percent from 2008-2017, but the long-term trend (1990-2017) remains positive with an annual geometric mean increase of over 9 percent (Northwest Atlantic Leatherback Working Group 2018).

**Table 11. Number of Leatherback Sea Turtle Nests in Florida.**

| **Leatherback Nests Recorded- Florida** | | |
|---|---|---|
| **Year** | **Index Nesting Beach Survey** | **Statewide Survey** |
| 2011 | 625 | 1,653 |
| 2012 | 515 | 1,712 |
| 2013 | 322 | 896 |
| 2014 | 641 | 1,604 |
| 2015 | 489 | 1,493 |
| 2016 | 319 | 1,054 |
| 2017 | 205 | 663 |
| 2018 | 316 | 949 |
| 2019 | 337 | 1,105 |
| 2020 | 467 | 1,652 |
| 2021 | 435 | |

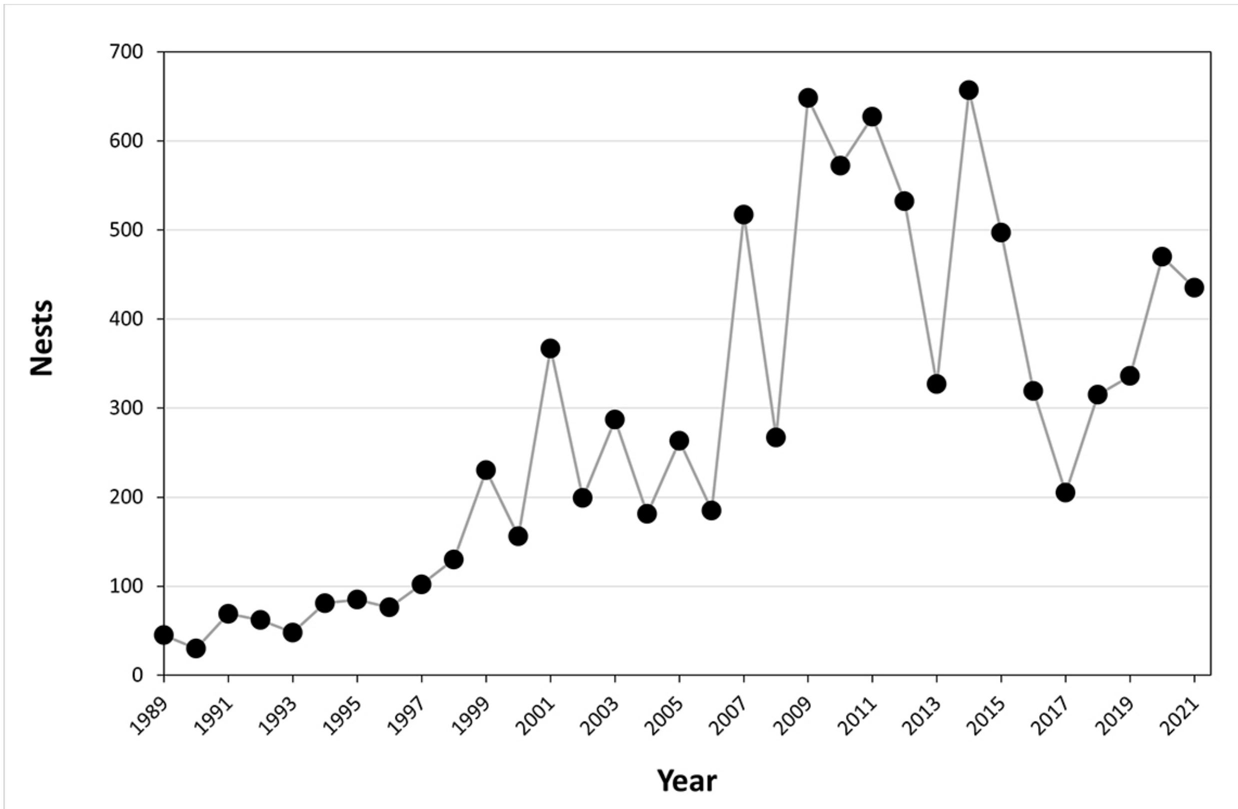


**Figure 21. Leatherback sea turtle nesting at Florida index beaches since 1989.**

The West African nesting stock of leatherbacks is large and important, but it is a mostly unstudied aggregation. Nesting occurs in various countries along Africa's Atlantic coast, but much of the nesting is undocumented and the data are inconsistent. Gabon has a very large amount of leatherback nesting, with at least 30,000 nests laid along its coast in a single season (Fretey et al. 2007a). Fretey et al. (2007a) provide detailed information about other known nesting beaches and survey efforts along the Atlantic African coast. Because of the lack of consistent effort and minimal available data, trend analyses were not possible for this stock (TEWG 2007).

Two other small but growing stocks nest on the beaches of Brazil and South Africa. Based on the data available, TEWG (2007) determined that between 1988 and 2003, there was a positive annual average growth rate between 1.07 percent and 1.08 percent for the Brazilian stock. TEWG (2007) estimated an annual average growth rate between 1.04 percent and 1.06 percent for the South African stock.

Because the available nesting information is inconsistent, it is difficult to estimate the total population size for Atlantic leatherbacks. Spotila et al. (1996) characterized the entire Western Atlantic population as stable at best and estimated a population of 18,800 nesting females. Spotila et al. (1996) further estimated that the adult female leatherback population for the entire Atlantic basin, including all nesting beaches in the Americas, the Caribbean, and West Africa, was about 27,600 (considering both nesting and interesting females), with an estimated range of 20,082-35,133. This is consistent with the estimate of 34,000-95,000 total adults (20,000-56,000 adult females; 10,000-21,000 nesting females) determined by the TEWG (2007). TEWG (2007) also determined that at the time of their publication, leatherback sea turtle populations in the Atlantic were all stable or increasing with the exception of the Western Caribbean and West Africa populations. A later review by NMFS USFWS (2013) suggested the leatherback nesting population was stable in most nesting regions of the Atlantic Ocean. However, as described earlier, the Northwest Atlantic population has experienced declines over the near term (2008-2017), often severe enough to reverse the longer term trends to negative where increases had previously been seen (Northwest Atlantic Leatherback Working Group 2018). Given the relatively large size of the Northwest Atlantic population, it is likely that the overall Atlantic leatherback trend is no longer increasing.

Analyses of mitochondrial DNA from leatherback turtles indicates a low level of genetic diversity, pointing to possible difficulties in the future if current population declines continue (Dutton et al. 1999). Further analysis of samples taken from individuals from rookeries in the Atlantic and Indian oceans suggest that each of the rookeries represent demographically independent populations (NMFS 2013h).

#### 5.2.34.3 *Hearing*

The role of hearing in sea turtles remains unclear, however they likely use sound for navigation, locating prey, avoiding predators, and environmental awareness (Piniak et al. 2016a). Electrophysiological and behavioral studies of sea turtle hearing have documented that most species of sea turtles can detect low-frequency acoustic and/or vibratory stimuli underwater and in air (Bartol and Ketten 2006; Bartol et al. 1999; Dow Piniak et al. 2012; Lavender et al. 2014; Martin et al. 2012; Piniak et al. 2016a; Piniak 2012; Ridgway et al. 1969). Sea turtles generally are most sensitive to underwater and aerial sounds below 1,000 Hz, though variation in sensitivity and frequencies of maximum sensitivity exist between species and age classes (see Piniak (2012) for species comparisons). Dow Piniak et al. (2012) measured hearing of leatherback sea turtle hatchlings in water and in air using an electrophysiological method (i.e., auditory evoked potentials or responses), and determined that hatchlings are able to detect low-frequency sounds between 50 Hz and 1200 Hz in water and 50 Hz and 1600 Hz in air, with best sensitivity between 100 and 400 Hz in water (lowest sound pressure level detected: 84 dB re: 1 μPa-rms at 300 Hz) and 50 and 400 Hz in air (lowest sound pressure level detected: 62 dB re: 20 μPa-rms at 300 Hz).

#### 5.2.34.4 *Status*

The leatherback turtle is an endangered species whose once large nesting populations have experienced steep declines in recent decades. Leatherbacks face many of the same threats as other sea turtle species, including destruction of nesting habitat from storm events, oceanic events such as cold-stunning, pollution (plastics, petroleum products, petrochemicals, etc.), ecosystem alterations (nesting beach development, beach nourishment and shoreline stabilization, vegetation changes, etc.), poaching, global climate change, fisheries interactions, natural predation, and disease.

Of all sea turtle species, leatherbacks seem to be the most vulnerable to entanglement in fishing gear, especially gillnet and pot/trap lines. This vulnerability may be because of their body type (large size, long pectoral flippers, and lack of a hard shell), their attraction to gelatinous organisms and algae that collect on buoys and buoy lines at or near the surface, their method of locomotion, and/or their attraction to the lightsticks used to attract target species in longline fisheries. From 1990-2000, 92 entangled leatherbacks were reported from New York through Maine and many other stranded individuals exhibited evidence of prior entanglement (Dwyer et al. 2003). Zug and Parham (1996) point out that a combination of the loss of long-lived adults in fishery-related mortalities and a lack of recruitment from intense egg harvesting in some areas has caused a sharp decline in leatherback sea turtle populations. This represents a significant threat to survival and recovery of the species worldwide.

Leatherback sea turtles may also be more susceptible to marine debris ingestion than other sea turtle species due to their predominantly pelagic existence and the tendency of floating debris to concentrate in convergence zones that adults and juveniles use for feeding and migratory purposes (Lutcavage et al. 1997a; Shoop and Kenney 1992). The stomach contents of leatherback sea turtles revealed that a substantial percentage (33.8 percent or 138 of 408 cases examined) contained some form of plastic debris (Mrosovsky et al. 2009). Blocking of the gut by plastic to an extent that could have caused death was evident in 8.7 percent of all leatherbacks that ingested plastic (Mrosovsky et al. 2009). Mrosovsky et al. (2009) also note that in a number of cases, the ingestion of plastic may not cause death outright, but could cause the animal to absorb fewer nutrients from food, eat less in general, etc.—factors that could cause other adverse effects. The presence of plastic in the digestive tract suggests that leatherbacks might not be able to distinguish between prey items and forms of debris such a plastic bags (Mrosovsky et al. 2009). Balazs (1985) speculated that the plastic object might resemble a food item by its shape, color, size, or even movement as it drifts about, and therefore induce a feeding response in leatherbacks.

Global climate change can be expected to have various impacts on all sea turtles, including leatherbacks. Global climate change is likely to also influence the distribution and abundance of jellyfish, the primary prey item of leatherbacks (NMFS and USFWS 2007b). Several studies have shown leatherback distribution is influenced by jellyfish abundance (Houghton et al. 2006; Witt et al. 2007; Witt et al. 2006); however, more studies need to be done to monitor how changes to prey items affect distribution and foraging success of leatherbacks so population-level effects can be determined.

Available information indicates leatherback sea turtles (along with hawksbill turtles) were likely directly affected by the Deepwater Horizon (DWH) oil spill. Leatherbacks were documented in the spill area, but the number of affected leatherbacks was not estimated due to a lack of information compared to other species. Given that the northern Gulf of Mexico is important habitat for leatherback migration and foraging (TEWG 2007), and documentation of leatherbacks in the DWH oil spill zone during the spill period, it was concluded that leatherbacks were exposed to DWH oil, and some portion of those exposed leatherbacks likely died. Potential DWH-related impacts to leatherback sea turtles include direct oiling or contact with dispersants from surface and subsurface oil and dispersants, inhalation of volatile compounds, disruption of foraging or migratory movements due to surface or subsurface oil, ingestion of prey species contaminated with oil and/or dispersants, and loss of foraging resources which could lead to compromised growth and/or reproductive potential. There is no information currently available to determine the extent of those impacts, if they occurred. Although adverse impacts likely occurred to leatherbacks, the relative proportion of the population that is expected to have been exposed to and directly impacted by the DWH event may be relatively low. Thus, a population-level impact may not have occurred due to the widespread distribution and nesting location outside of the Gulf of Mexico for this species.

#### 5.2.34.5 *Critical Habitat*

See Section 5.1.4.13 for a discussion of leatherback turtle critical habitat.

#### 5.2.34.6 *Recovery Goals*

The 1998 Recovery Plan for U.S. Pacific Populations of the Leatherback turtle (NMFS and USFWS 1998) identifies the following criteria (all of which must be met) to consider de-listing:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters;
2. Each stock must average 5,000 (or a biologically reasonable estimate based on the goal of maintaining a stable population in perpetuity) females estimated to nest annually over six years;
3. Nesting populations at "source beaches" are either stable or increasing over a 25-year monitoring period;
4. Existing foraging areas are maintained as healthy environments;
5. Foraging populations are exhibiting statistically significant increases at several key foraging grounds within each stock region;
6. All Priority #1 tasks have been implemented (see 1998 Recovery Plan for details); and
7. A management plan designed to maintain sustained populations of turtles is in place.

The primary recovery actions identified in the Pacific Leatherback Species in the Spotlight Five Year Action Plan (NOAA 2021) to support Pacific leatherback recovery include: reduce fisheries bycatch and in-water harvest, improve nesting beach protection and increase reproductive output, support in-water research and monitoring to inform conservation efforts, promote international cooperation, increase monitoring and research efforts, and encourage public engagement

### 5.2.35 Loggerhead Turtle (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean Distinct Population Segments)

Loggerhead sea turtles are circumglobal, and are found in the temperate and tropical regions of the Indian, Pacific and Atlantic Oceans.

The loggerhead sea turtle is distinguished from other turtles by its large head and powerful jaws. The species was first listed as threatened under the Endangered Species Act in 1978. On September 22, 2011, the NMFS designated nine distinct population segments (DPSs) of loggerhead sea turtles: South Atlantic Ocean and Southwest Indian Ocean as threatened as well as Mediterranean Sea, North Indian Ocean, North Pacific Ocean, Northeast Atlantic Ocean, Northwest Atlantic Ocean, South Pacific Ocean, and Southeast Indo-Pacific Ocean as endangered. Ocean-basin scale genetic analysis supports this conclusion, with additional differentiation apparent based upon nesting beaches (Shamblin et al. 2014b). Only the Northwest Atlantic, North Pacific, and South Pacific DPSs are considered in this opinion, as all other DPSs fall outside the action area for cetacean net captures.

We used information available in the North Pacific Ocean DPS the 2020 five-year review (NMFS and USFWS 2020b), 2009 Status Review (Conant et al. 2009b), the final listing rule, and available scientific literature to summarize the life history, population dynamics and status of the species, as follows.

#### 5.2.35.1 *Life History*

Mean age at first reproduction for female loggerhead turtles is 30 years. Females lay an average of three clutches per season. The annual average clutch size is 112 eggs per nest. The average remigration interval is 2.7 years. Nesting occurs on beaches, where warm, humid sand temperatures incubate the eggs. Temperature determines the sex of the sea turtle during the middle of the incubation period. Loggerhead sea 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 loggerhead turtles. Neritic juvenile loggerheads forage on crabs, mollusks, jellyfish and vegetation, whereas adults typically prey on benthic invertebrates such as mollusks and decapods.

#### 5.2.35.2 *Population Dynamics*

The following is a discussion of the species' population and its variance over time. This section includes abundance, population growth rate, genetic diversity, and spatial distribution as it relates to the North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean DPSs of loggerhead sea turtle.

There is general agreement that the number of nesting females provides a useful index of the species' population size and stability at this life stage, even though there are doubts about the ability to estimate the overall population size (Bjorndal et al. 2005). Adult nesting females often account for less than one percent of total population numbers. The global abundance of nesting female loggerhead turtles is estimated at 43,320 to 44,560 (Spotila 2004).

The North Pacific Ocean DPS has a nesting population of about 2,300 nesting females (Matsuzawa 2011). Loggerhead abundance on foraging grounds off the Pacific Coast of the Baja California Peninsula, Mexico, was estimated to be 43,226 individuals (Seminoff et al. 2014).

Overall, Gilman (2009) estimated that the number of loggerheads nesting in the Pacific (thus both North Pacific and South Pacific Ocean DPSs) has declined by eighty percent in the past twenty years. There was a steep (fifty to ninety percent) decline in the annual nesting population in Japan, which would be from the North Pacific Ocean DPS, during the last half of the twentieth century (Kamezaki et al. 2003) Since then, nesting has gradually increased here, but is still considered to be depressed compared to historical numbers, and the population growth rate is negative (-0.032) (Conant et al. 2009b).

Recent mitochondrial DNA analysis using longer sequences has revealed a more complex population sub-structure for the North Pacific Ocean DPS than previously thought. Previously, five haplotypes were present, and now, nine haplotypes have been identified in the North Pacific Ocean DPS. This evidence supports the designation of three management units in the North Pacific Ocean DPS: 1) the Ryukyu management unit (Okinawa, Okinoerabu, and Amami), 2) Yakushima Island management unit and 3) Mainland management unit (Bousou, Enshu-nada, Shikoku, Kii and Eastern Kyushu) (Matsuzawa et al. 2016). Genetic analysis of loggerheads captured on the feeding grounds of Sanriku, Japan, found only haplotypes present in Japanese rookeries (Nishizawa et al. 2014).

All nesting for the North Pacific DPS occurs at sites in Japan (NMFS 2020c). There is no loggerhead nesting on the Pacific coast of Mexico (Chapman and Seminoff 2016). Hatchlings from Japanese nesting beaches use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to foraging grounds. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off Mexico's Baja California Peninsula. Both of these feeding grounds are frequented by individuals from Japanese nesting beaches (Abecassis et al. 2013; Seminoff et al. 2014). Most of the available information seems to indicate that loggerheads are primarily found more north of the action area (Baja California), and South Pacific DPS loggerheads found more south of the action area (in Ecuador, Chile, and Peru). Apparently, loggerheads are not present on the Pacific side of Guatemala. There is anecdotal evidence and reports of loggerheads on the Pacific coast of Panama, but that they are not present on the Pacific coast of Costa Rica (Chapman and Seminoff 2016).

Using a stage/age demographic model, the adult female population size of the Northwest Atlantic Ocean DPS is estimated at 20,000 to 40,000 females, and 53,000 to 92,000 nests annually (NMFS 2009a). In 2010, there were estimated to be approximately 801,000 loggerhead turtles (greater than 30 cm in size, inter-quartile range of approximately 521,000–1,111,000) in northwestern Atlantic continental shelf region based on aerial surveys (NMFS 2011c).

Based on genetic information, the Northwest Atlantic Ocean DPS of loggerhead turtle is further categorized into five recovery units corresponding to nesting beaches. These are the Northern Recovery Unit, Peninsular Florida Recovery Unit, Dry Tortugas Recovery Unit, Northern Gulf of Mexico Recovery Unit, and the Greater Caribbean Recovery Unit. A more recent analysis using expanded mitochondrial DNA sequences revealed that rookeries from the Gulf and Atlantic coasts of Florida are genetically distinct, and that rookeries from Mexico's Caribbean Sea coast express high haplotype diversity (Shamblin et al. 2014a). Furthermore, the results suggest that the Northwest Atlantic Ocean DPS should be considered as 10 management units: (1) South Carolina and Georgia, (2) central eastern Florida, (3) southeastern Florida, (4) Cay Sal, Bahamas, (5) Dry Tortugas, Florida, (6) southwestern Cuba, (7) Quintana Roo, Mexico, (8) southwestern Florida, (9) central western Florida, and (10) northwestern Florida (Shamblin et al. 2012).

A comparison of recent five-year-annual-average loggerhead nest counts with comparable data from other regions reveals that, worldwide, Florida is the most important nesting area for this species, likely hosting more than 40 percent of the nests laid globally (Ceriani et al. 2019). The Peninsular Florida Recovery Unit constitutes the large majority of nesting effort in the Northwest Atlantic Ocean DPS. From 1989 to 2018, this unit averaged an estimated 70,935 nests annually based on the Florida Fish and Wildlife Conservation Commission Statewide Nesting Beach Survey, and 47,433 nest annually based on the Florida Index Nesting Beach Survey (Ceriani et al. 2019). The Northern Recovery Unit, from North Carolina to northeastern Florida, is the second largest nesting aggregation in the Northwest Atlantic Ocean DPS, with an average of 5,215 nests from 1989 through 2008, and approximately 1,272 nesting females during this timeframe (NMFS and USFWS 2008).

Nesting on Florida index beaches showed an increase between 1989 and 1998 but a steep decline between 1998 and 2006 (Witherington et al. 2009). The nesting sub-population in the Florida panhandle has exhibited a significant declining trend from 1995 through 2005 (Conant et al. 2009a; NMFS and USFWS 2007c). Population model estimates predict an overall population decline of 17 percent for the St. Joseph Peninsula, Florida sub-population of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014). However, more recent information about sea turtle nest counts in Florida indicate from 2007-2015 there has been an increase based upon the 26 core index beaches within 2015 (52,647) nests compared to 2013 and 2014; but this was lower than nest count data from 2012. Ceriani et al. (2019) found that annual loggerhead nest counts varied greatly in Florida between 1989 and 2018. While shorter time frames within the time series (e.g., before and after 2007) produced linear trends which may support both pessimistic (Witherington et al. 2009) and optimistic conclusions, the overall 30-yr pattern portrayed a general non-monotonic trend with wide fluctuations. For the Northern Recovery Unit, nest counts at loggerhead turtles nesting beaches in North Carolina, South Carolina, and Georgia declined at 1.9 percent annually from 1983 through 2005 (NMFS and USFWS 2007c).

Nesting for the South Pacific Ocean DPS of loggerhead turtles occurs mostly in eastern Australia and New Caledonia. New Caledonia has about 60 to 70 nesting females annually (Limpus et al. 2006); more recent estimates indicate about 200 nesting females per year (Wabnitz and Andréfouët 2008). Major nesting beaches in Australia occur in the central and south Queensland areas, with some small aggregations in New South Wales (Limpus 2008).

Eastern Australia (South Pacific Ocean DPS) supported one of the major global loggerhead nesting assemblages until recently (Limpus 1985). For many years, the nesting population at Queensland was in decline; there were approximately 3,500 females in the 1976 and 1977 nesting season, and less than 500 in 1999, representing an 86 percent reduction in the size of the annual nesting population in twenty-three years (Limpus and Reimer 1994; Limpus 1985; Limpus and Limpus 2003). From 2000 to 2009, there has been an increasing number of females nesting. Despite that increase, the arithmetic mean of the log -population growth rate calculated for various nesting beaches in eastern Australia range from -0.013 to -0.075 (Conant et al. 2009b). Population modeling focusing on a nesting beach in Queensland, Australia indicates that the loss of only a few hundred adult and sub-adult females would lead to the extinction of the population in eastern Australia in less than one hundred years (Heppell et al. 1996).

The South Pacific Ocean DPS of loggerhead turtles possess three haplotypes, including one dominant haplotype not found elsewhere (Conant et al. 2009b).

Loggerhead turtles hatched on beaches in the southwest Pacific Ocean range widely in the southern portion of the basin, with individuals from nesting beaches in Western Australia found as far east as Peruvian coast foraging areas (Boyle et al. 2009). Loggerhead turtles from Australia and New Caledonia do not appear to go north of the equator. Loggerhead turtles are also present in the waters offshore northern Chile and Peru, where they comprise the majority of sea turtle bycatch in commercial fisheries (Alfaro-Shigueto et al. 2011; Donoso and Dutton 2010).

The population growth rate for each of the four of the recovery units for the Northwest Atlantic DPS (Peninsular Florida, Northern, Northern Gulf of Mexico, and Greater Caribbean) all exhibit negative growth rates (Conant et al. 2009b). Nest counts taken at index beaches in Peninsular Florida show a significant decline in loggerhead nesting from 1989 to 2006, most likely attributed to mortality of oceanic-stage loggerheads caused by fisheries bycatch (Witherington et al. 2009). Loggerhead nesting on the Archie Carr National Wildlife Refuge (representing individuals of the Peninsular Florida subpopulation) has fluctuated over the past few decades. There was an average of 9,300 nests throughout the 1980s, with the number of nests increasing into the 1990s until it reached an all-time high in 1998, with 17,629 nests. From that point, the number of loggerhead nests at the Refuge have declined steeply to a low of 6,405 in 2007, increasing again to 15,539, still a lower number of nests than in 1998 (Bagley et al. 2013). For the Northern recovery unit, nest counts at loggerhead nesting beaches in North Carolina, South Carolina and Georgia declined at 1.9 percent annually from 1983 to 2005 (NMFS and USFWS 2007c). The nesting subpopulation in the Florida panhandle has exhibited a significant declining trend from 1995 to 2005 (Conant et al. 2009b; NMFS and USFWS 2007c). Recent model estimates predict an overall population decline of 17 percent for the St. Joseph Peninsula, Florida subpopulation of the Northern Gulf of Mexico recovery unit (Lamont et al. 2014).There are nine loggerhead DPSs, which are geographically separated and genetically isolated, as indicated by genetic, tagging, and telemetry data. Our understanding of the genetic diversity and population structure of the different loggerhead DPSs is being refined as more studies examine samples from a broader range of specimens using longer mtDNA sequences.

Loggerheads are circumglobal, occurring throughout the temperate and tropical regions of the Atlantic, Pacific, and Indian oceans, returning to their natal region for mating and nesting. Adults and sub-adults occupy nearshore habitat. While in their oceanic phase, loggerheads undergo long migrations using ocean currents. Individuals from multiple nesting colonies can be found on a single feeding ground. Loggerhead hatchlings from the western Atlantic disperse widely, most likely using the Gulf Stream to drift throughout the Atlantic Ocean. Mitochondrial DNA evidence demonstrates that juvenile loggerheads from southern Florida nesting beaches comprise the vast majority (71 to 88 percent) of individuals found in foraging grounds throughout the western and eastern Atlantic: Nicaragua, Panama, Azores and Madiera, Canary Islands and Adalusia, Gulf of Mexico and Brazil (Masuda 2010). Hatchlings from Japanese nesting beaches use the North Pacific Subtropical Gyre and the Kurishio Extension to migrate to foraging grounds. Two major juvenile foraging areas have been identified in the North Pacific Basin: Central North Pacific and off of Mexico's Baja California Peninsula. Both of these feeding grounds are frequented by individuals from Japanese nesting beaches (Abecassis et al. 2013; Seminoff et al. 2014). Loggerheads hatched on beaches in the southwest Pacific range widely in the southern portion of the basin, with individuals from nesting beaches in western Australia found as far east as Peruvian coast foraging areas (Boyle et al. 2009). Loggerhead sea turtles are also present in the waters offshore northern Chile and Peru, where they comprise the majority of sea turtle bycatch in commercial fisheries (Alfaro-Shigueto et al. 2011; Donoso and Dutton 2010).

#### 5.2.35.3 *Hearing*

Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2 kHz, with a range of maximum sensitivity between 100 and 800 Hz (Bartol and Ketten 2006; Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Ridgway et al. 1969). Hearing below 80 Hz is less sensitive but still possible (Lenhardt 1994). Bartol et al. (1999) reported effective hearing range for juvenile loggerhead turtles is from at least 250 to 750 Hz. Both yearling and two-year old loggerhead turtles had the lowest hearing threshold at 500 Hz (yearling: about 81 dB re: 1 μPa and two-year olds: about 86 dB re: 1 μPa), with threshold increasing rapidly above and below that frequency (Bartol and Ketten 2006). Underwater tones elicited behavioral responses to frequencies between 50 and 800 Hz and auditory evoked potential responses between 100 and 1,131 Hz in one adult loggerhead turtle (Martin et al. 2012). The lowest threshold recorded in this study was 98 dB re: 1 μPa at 100 Hz. Lavender et al. (2014) found post-hatchling loggerhead turtles responded to sounds in the range of 50 to 800 Hz while juveniles responded to sounds in the range of 50 Hz to 1 kHz. Post-hatchlings had the greatest sensitivity to sounds at 200 Hz while juveniles had the greatest sensitivity at 800 Hz (Lavender et al. 2014).

These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 and 700 Hz, with slow declines below 100 ha and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956a). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responds beyond 3 or 4 kHz (Patterson 1966).

#### 5.2.35.4 *Status*

Once abundant in tropical and subtropical waters, loggerhead sea turtles worldwide exist at a fraction of their historical abundance, as a result of over-exploitation. Globally, egg harvest, the harvest of females on nesting beaches and directed hunting of turtles in foraging areas remain the greatest threats to their recovery. In addition, bycatch in drift net, long-line, set-net, pound-net and trawl fisheries kill thousands of loggerhead sea turtles annually. Increasing coastal development (including beach erosion and re-nourishment, construction and artificial lighting) threatens nesting success and hatchling survival.

Neritic juveniles and adults in the North Pacific Ocean DPS are at risk of mortality from coastal fisheries in Japan and Baja California, Mexico. Habitat degradation in the form of coastal development and armoring pose a threat to nesting females. Based on these threats and the relatively small population size, the Biological Review Team concluded that the North Pacific Ocean DPS is currently at risk of extinction (Conant et al. 2009c). The 2020 five-year review found that the status of the DPS has not changed since it was listed as endangered in 2011 (NMFS 2020c). The DPS continues to be endangered by intense (fisheries bycatch and climate change) and numerous (habitat loss and modification, overutilization, and predation) threats acting on a small, subdivided population (NMFS 2020c).

Due to declines in nest counts at index beaches in the U.S. and Mexico, and continued mortality of juveniles and adults from fishery bycatch, Conant et al. (2009a) found the Northwest Atlantic Ocean DPS of loggerhead turtle was at risk and likely to decline in the foreseeable future. In the NMFS Fiscal Year 2019-2020 ESA Report to Congress, the population trend for this DPS is shown as stable (NMFS 2022i).

Based on nest count data from the past 30 years, and mortality of juveniles and adults from fishery bycatch, the South Pacific Ocean DPS of loggerhead turtle is at risk, and is likely to decline in the foreseeable future (Conant et al. 2009b; Limpus 2008).

#### 5.2.35.5 *Critical Habitat*

See Section 5.1.4.14 for a description of Northwest Atlantic Ocean DPS loggerhead turtle critical habitat.

#### 5.2.35.6 *Recovery Goals*

Key recovery actions identified in the 1998 Recovery Plan (NMFS 1998f) for U.S. Pacific Populations of the Loggerhead Turtle are:

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

See the 2008 Final Recovery Plan (NMFS and USFWS 2008) for the Northwest Atlantic Population of Loggerheads for complete down listing/delisting criteria for each of the following recovery objectives:

1. Ensure that the number of nests in each recovery unit is increasing and that this increase corresponds to an increase in the number of nesting females.
2. Ensure the in-water abundance of juveniles in both neritic and oceanic habitats is increasing and is increasing at a greater rate than strandings of similar age classes.
3. Manage sufficient nesting beach habitat to ensure successful nesting.
4. Manage sufficient feeding, migratory and internesting marine habitats to ensure successful growth and reproduction.
5. Eliminate legal harvest.
6. Implement scientifically based nest management plans.
7. Minimize nest predation.
8. Recognize and respond to mass/unusual mortality or disease events appropriately.
9. Develop and implement local, state, Federal and international legislation to ensure long-term protection of loggerheads and their terrestrial and marine habitats.
10. Minimize bycatch in domestic and international commercial and artisanal fisheries.
11. Minimize trophic changes from fishery harvest and habitat alteration.
12. Minimize marine debris ingestion and entanglement.
13. Minimize vessel strike mortality.

NMFS has not prepared a Recovery Plan for the South Pacific Ocean DPS of loggerhead turtle. In general, ESA-listed species which occur entirely outside U.S. jurisdiction are not likely to benefit from recovery plans (55 FR 24296).

### 5.2.36 Olive Ridley Turtle (breeding populations on the Pacific Coast of Mexico and all other areas)

The olive ridley turtle is a small, mainly pelagic, sea turtle with a circumtropical distribution. Olive ridley turtles are olive or grayish-green in color, with a heart-shaped carapace. The species was listed under the ESA on July 28, 1978. The species was separated into two listing designations: endangered for breeding populations on the Pacific coast of Mexico, and threatened wherever found except where listed as endangered (i.e., in all other areas throughout its range).

We used information available in the five-year review (NMFS and USFWS 2014) to summarize the life history, population dynamics and status of the olive ridley turtle, as follows.

#### 5.2.36.1 *Life History*

Olive ridley females mature at ten to eighteen years of age. They lay an average of two clutches per season (three to six months in duration). The annual average clutch size is one hundred to 110 eggs per nest. Olive ridleys commonly nest in successive years. Females nest in solitary or in arribadas, where large aggregations coming ashore at the same time and location. There are six arribada nesting beaches and nine solitary nesting beaches in Mexico. At least four of the arribada nesting beaches are in the action area.

Olive ridleys can nest throughout the year, but there tends to be a peak in nesting during the rainy season (Hart et al. 2014a). Pacific coast of Mexico beaches where large-scale synchronized nesting occurs (arribadas) are in the Mexican States of Jalisco, Colima, Michoacán, Guerrero and Oaxaca. In Nayarit, Mexico, nesting occurred from June to November, with a peak from August to October. Peak nesting in Oaxaca for olive ridleys is between August and January (Chaloupka et al. 2004; Vannini and Jaillet 2009). Hatchlings emerge between fifty and sixty days after nesting (NMFS 1998g).

Little information is available for olive ridley habitat use in the western Atlantic Ocean but the post-breeding behavior of olive ridleys in the eastern Pacific Ocean is unique in that they are nomadic, migrating across ocean basins. This contrasts with other sea turtle species, which typically migrate to a particular feeding ground after nesting. As adults, olive ridleys forage on crustaceans, fish, mollusks, and tunicates, primarily in pelagic habitats.

#### 5.2.36.2 *Population Dynamics*

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

Olive ridley sea turtles are thought to be the most abundant species of sea turtle. Shipboard transects along the Mexico and Central American coasts between 1992 and 2006 indicate an estimated 1.39 million adults. There are six primary arribada nesting beaches in Mexico, the largest being La Escobilla, Oaxaca, with about 200,000 nests laid annually (Hernández-

Echeagaray et al. 2012). At Nuevo Vallarta, Nayarit, about 4,900 nests are laid annually (NMFS and USFWS 2014).

Based on the number of olive ridleys nesting in Mexico, populations appear to be increasing in one location (La Escobilla, Oaxaca: from 50,000 nests in 1988 to more than one million in 2000), decreasing at Chacahua, Oaxaca, and stable at all others. At-sea estimates of olive ridleys off Mexico and Central America also support an increasing population trend.

Genetic studies have identified four main lineages for the olive ridley: east India, Indo-Western Pacific, Atlantic, and the eastern Pacific. Rookeries on the Pacific coasts of Costa Rica and Mexico were not genetically distinct, and fine-scale population structure was not found when solitary and arribada nesting beaches were examined. Low levels of genetic diversity among Mexican nesting sites are attributed to a population collapse caused by past overharvest. The range of the endangered Pacific coast breeding population extends as far south as Peru and up to California.

In the western Atlantic, two arribada nesting beaches occur in Suriname and French Guiana. The Cayenne Peninsula in French Guiana hosts about 2,000 nests annually, while the Galibi Nature Reserve in Suriname had 335 nests in 1995. Solitary nesting also occurs elsewhere in Suriname, Guyana and French Guiana, although no abundance estimates are available. In Sergipe, Brazil, solitary nesting amounted to about 2,600 nests in 2002 and 2003.

In the eastern Atlantic, there are no arribada nesting beaches, but solitary nesting occurs in several countries along the western coast of Africa, from Gambia to Angola. For many countries, there are no abundance estimates available. For beaches with data available (Angola, the Republic of Congo, the Democratic Republic of Congo, Equatorial Guinea and Guinea Bissau), nest counts are low, with most monitoring taking place for only a few years. The most abundant nesting beaches are Orango National Park in Guinea Bissau, which had between 170 and 620 nests from 1992 to 1994; and the Republic of Congo, which had between 300 and 600 nests annually from 2003 to 2010 (NMFS and USFWS 2014).

In the Indian Ocean, three arribada nesting beaches are found in India, amounting to 150,000 to 200,000 nesting females annually. Solitary nesting also occurs elsewhere in the region, in eastern Africa, Oman, India, Pakistan, and other southeast Asian countries; for many, there are no estimates available. The largest recorded solitary nesting beach is in Myanmar, when in 1999, 700 nests were counted (NMFS and USFWS 2014).

Population growth rate and trend information for the threatened population of olive ridley sea turtles is difficult to discern, owing to its range over a large geographic area, and a lack of consistent monitoring data in all nesting areas. Below, we present any known population trend information for olive ridley sea turtles by ocean basin (NMFS and USFWS 2014).

Nesting at arribada beaches in French Guiana appears to be increasing, while in Suriname, nesting has declined by more than ninety percent since 1968. Solitary nesting also occurs elsewhere in Suriname, Guyana and French Guiana; no trend data are available. Solitary nesting in Brazil appears to be increasing, with 100 nests recorded in 1989 to 1990, to 2,606 in 2002 to 2003.

In the eastern Atlantic, trend data is not available for most solitary nesting beaches. Nest counts in the Republic of Congo decreased from 600 nests in 2003 and 2004 to less than 300 in 2009 and 2010.

The three arribada nesting beaches in India—Gahirmatha, Rushikulya, and Devi River—are considered stable over three generations. There is no trend data available for several solitary nesting beaches in the Indian Ocean. However, even for the few beaches with short-term monitoring, the nest counts are believed to represent a decline from earlier years.

There are no arribada nesting beaches in the western Pacific. Data are lacking or inconsistent for many solitary nesting beaches in the western Pacific, so it is not possible to assess population trends for these sites. Nest counts at Alas Purwo, Indonesia, appear to be increasing, the nest count at Terengganu, Malaysia, is thought to be a decline from previous years.

Population trends at Nicaraguan arribada nesting beaches are unknown or stable (La Flor). Ostional, Costa Rica arribada nesting beach is increasing, while trends Nancite, Costa Rica, and Isla Cañas, Panama, nesting beaches are declining. For most solitary nesting beaches in the eastern Pacific, population trends are unknown, except for Hawaii Beach, Guatemala, which is decreasing.

Genetic studies have identified four main lineages of olive ridleys: east India, Indo-Western Pacific, Atlantic, and the eastern Pacific. In the eastern Pacific, rookeries on the Pacific coasts of Costa Rica and Mexico were not genetically distinct, and fine-scale population structure was not found when solitary and arribada nesting beaches were examined. There was no population subdivision among olive ridleys along the east India coastline. Low levels of genetic diversity among Mexican, Atlantic French New Guinea, and eastern Pacific Baja California nesting sites are attributed to a population collapse caused by past overharvest (NMFS and USFWS 2014).

#### 5.2.36.3 *Hearing*

We are not aware of hearing information specific to olive ridley sea turtles, so we are presenting information about sea turtle hearing generally. Sea turtles are low frequency hearing specialists, typically hearing frequencies from 30 Hz to 2 kHz, with a range of maximum sensitivity between 100 to 800 Hz (Bartol and Ketten 2006; Bartol et al. 1999; Lenhardt 1994; Lenhardt 2002; Ridgway et al. 1969). These hearing sensitivities are similar to those reported for two terrestrial species: pond and wood turtles. Pond turtles respond best to sounds between 200 to 700 Hz, with slow declines below 100 Hz and rapid declines above 700 Hz, and almost no sensitivity above 3 kHz (Wever and Vernon 1956a). Wood turtles are sensitive up to about 500 Hz, followed by a rapid decline above 1 kHz and almost no responses beyond 3 or 4 kHz (Patterson 1966).

#### 5.2.36.4 *Status*

In the first half of the twentieth century, there was an estimated ten million olive ridleys nesting on the Pacific coast of Mexico. Olive ridleys became targeted in a fishery in Mexico and Ecuador, which severely depleted the population; there was an estimated one million olive ridleys by 1969. Olive ridley breeding populations on the Pacific coast of Mexico were listed as endangered in response to this severe population decline. Legal harvest of olive ridleys has been prohibited, although illegal harvest still occurs. The population is subject to incidental capture in fisheries, exposure to pollutants, and climate change. In spite of the severe population decline, the olive ridley breeding populations on the Pacific coast of Mexico appear to be resilient, evidenced by the increasing population.

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

#### 5.2.36.5 *Critical Habitat*

No critical habitat has been designated for the olive ridley sea turtles of the breeding population of the Pacific coast of Mexico range-wide, nor the range-wide threatened population of olive ridley turtles.

#### 5.2.36.6 *Recovery Goals*

There has not been a Recovery Plan prepared specifically for the range-wide, threatened population of olive ridley turtles. The 1998 Recovery Plan (NMFS 1998g) was prepared for olive ridleys found in the U.S. Pacific. Olive ridley turtles found in the Pacific could originate from the Pacific Coast of Mexico or from another nesting population. As such, the recovery goals in the 1998 Recovery Plan for the U.S Pacific olive ridley turtle can apply to both listed populations. See the 1998 Recovery Plan for the U.S. Pacific olive ridley turtles for complete down listing/delisting criteria for their recovery goals. The following items were the recovery criteria identified to consider delisting:

1. All regional stocks that use U.S. waters have been identified to source beaches based on reasonable geographic parameters.
2. Foraging populations are statistically significantly increasing at several key foraging grounds within each stock region.
3. All females estimated to nest annually at source beaches are either stable or increasing for over ten years.
4. Management plan based on maintaining sustained populations for turtles is in effect.

5. International agreements in place to protect shared stocks.

### 5.2.37 Atlantic Sturgeon (Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic Distinct Population Segments)

The Atlantic sturgeon is a long lived, late maturing, sub-tropical, anadromous species. They occupy ocean waters and associated bays, estuaries, and coastal river systems from Hamilton Inlet, Labrador, Canada, to Cape Canaveral, Florida (ASMFC 2006; Stein et al. 2004).

Atlantic sturgeon attain lengths of up to approximately 14 feet, and weights of more than 800 pounds. They are bluish black or olive brown dorsally with paler sides and a white ventral surface and have five major rows of dermal scutes (Colette and Klein-MacPhee 2002). Five separate DPSs of Atlantic sturgeon were listed under the ESA by NMFS effective April 6, 2012. The New York Bight, Chesapeake Bay, Carolina, and South Atlantic DPSs were listed as endangered and the Gulf of Maine DPS was listed as threatened.

We used information available in the final listing the status review (ASSRT 2007a) and available literature to summarize the status of Atlantic sturgeon as follows.

#### 5.2.37.1 *Life History*

The general life history pattern of Atlantic sturgeon is that of a long lived (approximately 60 years), late maturing, iteroparous, anadromous species (ASSRT 2007a; Dadswell 2006). Atlantic sturgeon spawn in freshwater, but spend most of their subadult and adult life in the marine environment.

Traditionally, it was believed that spawning within all populations occurred during the spring and early summer months (Smith 1985). More recent studies, however, suggest that spawning occurs from late summer to early autumn in three tributaries (James River and York River, Virginia, and Nanticoke River, Maryland) of the Chesapeake Bay (Balazik et al. 2012; Hager et al. 2014; Secor et al. 2021), Roanoke River, North Carolina (Smith et al. 2015), Edisto River, South Carolina (Collins et al. 2000), and in the Altamaha River, Georgia (Ingram and Peterson 2016). Sturgeon eggs are highly adhesive and are deposited on the bottom substrate, usually on hard surfaces (e.g., cobble) (Smith and Clugston 1997). Hatching occurs approximately 94 to 140 hours after egg deposition, and larvae assume a demersal existence (Smith et al. 1980). The yolk sac larval stage is completed in about eight to 12 days, during which time the larvae move downstream to rearing grounds over a six to 12-day period (Kynard and Horgan 2002). During the first half of their migration downstream, movement is limited to nighttime. During the day, larvae use benthic structure (e.g., gravel matrix) as refugia (Kynard and Horgan 2002). During the latter half of migration when larvae are more fully developed, movement to rearing grounds occurs both day and night. The larvae grow rapidly and are 4 to 5.5 inches long at a month old (MSPO 1993).

Juvenile Atlantic sturgeon continue to move downstream into brackish waters, and eventually become residents in estuarine waters. Juvenile Atlantic sturgeon are resident within their natal estuaries for one to six years (Fox and Peterson 2019), depending on their natal river of origin, after which they emigrate as subadults to coastal waters (Dovel 1983) or to other estuaries seasonally (Waldman et al. 2013). Atlantic sturgeon undertake long marine migrations and utilize habitats up and down the East Coast for rearing, feeding, and migrating (Bain 1997; Dovel 1983; Stevenson 1997). Migratory subadults and adults are normally located in shallow (10-50 meter) nearshore areas dominated by gravel and sand substrate (Stein et al. 2004). Tagging and genetic data indicate that subadult and adult Atlantic sturgeon may travel widely once they emigrate from rivers (Bartron 2007; Rothermel et al. 2020; Rulifson et al. 2020; Wippelhauser et al. 2017; Wirgin et al. 2015). Once in marine waters, subadults undergo rapid growth (Dovel 1983; Stevenson 1997). Despite extensive mixing in coastal waters, Atlantic sturgeon display high site fidelity to their natal streams.

Atlantic sturgeon have been aged to 60 years (Mangin 1964), but this should be taken as an approximation because the age validation studies conducted to date show ages cannot be reliably estimated after 15-20 years as annuli become harder to read accurately (Stevenson and Secor 2000). Vital parameters of sturgeon populations generally show clinal variation with faster growth, earlier age at maturation, and shorter life span in more southern systems. Spawning intervals range from one to five years for male Atlantic sturgeon (Collins et al. 2000; Smith 1985) and two to five years for females (Breece et al. 2021; Hager et al. 2020; Schueller and Peterson 2010; Stevenson and Secor 2000). For Atlantic sturgeon from the York River, Virginia, Hager et al. (2020) found that both males and females return to spawn at more frequent intervals than has been reported in the literature (males once every 1.13 years and females once every 2.19 years, on average). Similarly, Breece et al. (2021) reported mean spawning intervals for Hudson River Atlantic sturgeon of 1.66 years for females and 1.28 years for males, Breece et al. (2021) with many fish spawning in consecutive years.

Fecundity of Atlantic sturgeon is correlated with age and body size, ranging from approximately 400,000 to two million eggs (Dadswell 2006; Mitchell et al. 2020; Smith et al. 1982; Van Eenennaam and Doroshov 1998). The average age at which 50 percent of Atlantic sturgeon maximum lifetime egg production is achieved is estimated to be 29 years, approximately 3 to 10 times longer than for most other bony fish species (Boreman 1997).

Atlantic sturgeon feed on mollusks, polychaeta worms, gastropods, shrimps, pea crabs, decapods, amphipods, isopods, and small fishes in the marine environment (Collins et al. 2006; Guilbard et al. 2007; Savoy 2007). The sturgeon "roots" in the sand or mud with its snout, like a pig, to dislodge worms and mollusks that it sucks into its protrusible mouth, along with considerable amounts of mud. The Atlantic sturgeon has a stomach with very thick, muscular walls that resemble the gizzard of a bird. This enables it to grind such food items as mollusks and gastropods (MSPO 1993).

#### 5.2.37.2 *Population Dynamics*

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

Atlantic sturgeon throughout their range exhibit ecological separation during spawning that has resulted in multiple, genetically distinct, interbreeding population segments. Studies have consistently found populations to be genetically diverse and indicate that there are between seven and ten populations that can be statistically differentiated (Grunwald et al. 2008; King et al. 2001; Waldman et al. 2002; Wirgin et al. 2007). However, there is some disagreement among studies, and results do not include samples from all rivers inhabited by Atlantic sturgeon. More recently, White et al. (2021) presented a range-wide microsatellite genetic baseline for Atlantic sturgeon that is comprised of 2510 individuals from 18 genetically distinct groups collected in 13 rivers and one estuary. Recent studies conducted indicate that genetically distinct populations of spring and fall-run Atlantic sturgeon can exist within a given river system (Balazik et al. 2017; Balazik and Musick 2015; Farrae et al. 2017).

The Carolina DPS ranges from the Albemarle Sound to the Santee-Cooper River and consists of seven extant subpopulations; one subpopulation (Sampit) is believed to be extirpated. The current abundance of these subpopulations is likely less than three percent of their historical abundance based on 1890s commercial landings data (ASSRT 2007a; Secor 2002).

Water quality issues represent either a moderate or moderately high risk for most subpopulations within this DPS (ASSRT 2007a). The Pamlico Sound suffers from eutrophication and experiences periodically low dissolved oxygen events and major fish kill events, mainly in the Neuse Estuary of the Sound. The Cape Fear River is a natural blackwater river; however, the low dissolved oxygen concentrations in this river can also be attributed to eutrophication. Water quality is also a problem in Winyah Bay, where portions of the bay have high concentrations of dioxins that can adversely affect sturgeon development (Chambers et al. 2012). Commercial bycatch was a concern for all of the subpopulations examined by the Atlantic Sturgeon Status Review Team. The Cape Fear and Santee-Cooper rivers were found to have a moderately high risk (greater than 50 percent) of becoming endangered within the next 20 years due to impeded habitat from dams. The Cape Fear and Santee-Cooper are the most impeded rivers along the range of the species, where dams are located in the lower coastal plain and impede between 62 to 66 percent of the habitat available between the fall line and mouth of the river (ASSRT 2007a). The Atlantic Sturgeon Status Review Team concluded that the limited habitat in which sturgeon could spawn and utilize for nursery habitat in these rivers likely leads to the instability of these subpopulations and to the entire DPS being at risk of endangerment.

Historically, Atlantic sturgeon were common throughout the Chesapeake Bay and its tributaries (Kahnle et al. 1998). Based on U.S. Fish Commission landings data, approximately 20,000 adult female Atlantic sturgeon inhabited the Chesapeake Bay and its tributaries prior to development of a commercial fishery in 1890 (Secor 2002). At present, the Chesapeake Bay DPS has low abundance and the current numbers of spawning adults are one to two orders of magnitude smaller than historical levels. Despite research efforts, natal juveniles are rarely captured which suggests that the Chesapeake Bay DPS has low reproductive success (NMFS 2022c). Chesapeake Bay rivers once supported at least six historical spawning subpopulations (ASSRT 2007a), but today reproducing populations are only known to occur in the James, York, and Nanticoke rivers. Based on available information for the genetic composition and the estimated abundance of Atlantic sturgeon in marine waters, NMFS (2013d) estimated that subadult and adult abundance of the Chesapeake Bay DPS was 8,811 fish. Atlantic sturgeon belonging to the Chesapeake Bay DPS are still captured and killed as a result of fishery interactions, vessel strikes, and dredging.

The James River supports the largest population of Atlantic sturgeon within the DPS. A total of 373 different adult-sized Atlantic sturgeon (i.e., total count does not include recaptures of the same fish) were captured in the James River from 2009 through spring 2014 (Balazik and Musick 2015). Estimates of James River effective population size from separate studies and based on different age classes are similar, ranging from 32 to 62 sturgeon (NMFS 2022c). Balazik et al. (2012) reported empirical evidence that James River Atlantic sturgeon spawn in the fall, and a more recent study indicates that Atlantic sturgeon also spawn in the spring in the James River (i.e., dual spawning races) (Balazik and Musick 2015). In 2007, the Atlantic Sturgeon Status Review Team concluded that the James River had a moderately high risk (greater than 50 percent chance) of becoming endangered in the next 20 years, due to anticipated impacts from commercial bycatch (ASSRT 2007a).

Kahn et al. (2019) estimated a spawning run size of up to 222 adults (but with yearly variability) in the Pamunkey River, a tributary of the York River in Virginia, based on captures of tagged adults from 2013-2018. The highest ranked stressor for the York River was commercial bycatch, which received a moderate risk rank (ASSRT 2007a). New information for the Nanticoke River system suggests a small adult population based on a small total number of captures (i.e., 26 sturgeon) and the high rate of recapture across several years of study (Secor et al. 2021).

The Gulf of Maine DPS historically supported at least four spawning subpopulations; however, today it is suspected that only two extant subpopulations exist (Penobscot and Kennebec) (ASSRT 2007a). The Kennebec River is the primary spawning and nursery area for Gulf of Maine Atlantic sturgeon. Ripe female Atlantic sturgeon with enlarged, fully mature eggs ready to be fertilized have been found in the Kennebec River from mid-July through early August (MSPO 1993). Prior to any commercial fishing, the Kennebec supported approximately 10,000 to 15,000 spawning adults (ASSRT 2007a; MSPO 1993). The construction of the Edwards Dam in 1837 was believed to have caused the commercial sturgeon catch to decline over 50 percent (MSPO 1993). Severe pollution in the river from the 1930's through the early 1970's is also believed to have been a major factor in the continued decline of the sturgeon population in the Kennebec. It was speculated that the Penobscot subpopulation was extirpated until a fisherman captured an adult Atlantic sturgeon in 2005, and a gillnet survey directed toward Atlantic sturgeon captured seven in 2006 (ASSRT 2007a). There is no current evidence that spawning is occurring in the Penobscot River (NMFS 2022d). Acoustic tag detections suggest that the adults that forage in the Penobscot River travel to the Kennebec River to spawn (Altenritter et al. 2017; Wippelhauser et al. 2017). Within the Penobscot, substrate has been severely degraded by upstream mills, and water quality has been negatively affected by the presence of coal deposits and mercury hot spots.

There are no abundance estimates for the Gulf of Maine DPS or for the Kennebec River spawning population. Another method for assessing the number of spawning adults is through determinations of effective population size, which measures how many adults contributed to producing the next generation based on genetic determinations of parentage from the offspring. The effective population size of the Gulf of Maine DPS was assessed in two studies based on sampling of adult Atlantic sturgeon captured in the Kennebec River in multiple years. The studies yielded very similar results which were an effective population size of: 63.4 (95% CI=47.3-91.1) (ASMFC 2017a) and 67 (95% CI=52.0–89.1) (Waldman et al. 2019). The status of the Gulf of Maine DPS has likely neither improved nor declined from what it was when the DPS was listed as threatened in 2012 (NMFS 2022d).

The New York Bight, ranging from Cape Cod to the Delmarva Peninsula, historically supported four or more spawning subpopulations, but currently this DPS only supports two known spawning subpopulations: Delaware River and Hudson River. The Hudson River currently supports the largest U.S. subpopulation of Atlantic sturgeon spawning adults. Historically, it supported an estimated 6,000 to 8,000 spawning females (Kahnle et al. 2007; Secor 2002). Kazyak et al. (2020) used side scan sonar technology in conjunction with detections of previously tagged Atlantic sturgeon to estimate a Hudson River spawning run size of 466 sturgeon (95% CRI = 310-745) in 2014. The estimates of effective population size for the Hudson River spawning population range from 144 to 198 (NMFS 2022g). Long-term surveys indicate that the Hudson River subpopulation has been stable and/or slightly increasing since 1995 (ASSRT 2007a). Recent analyses suggest that the abundance of juvenile Atlantic sturgeon belonging to the Hudson River spawning population has increased, with double the average catch rate for the period from 2012-2019 compared to the previous eight years, from 2004-2011 (Pendleton and Adams 2021).

The Delaware River estuary once supported large numbers of Atlantic sturgeon, with 3,200 metric tons of commercial fisheries landings in 1888 (ASSRT 2007a; Secor 2002; Secor and Waldman 1999). Population estimates based on juvenile mark and recapture studies and commercial logbook data indicate that the Delaware subpopulation has continued to decline rapidly since 1990. Based on genetic analyses, the majority of subadults captured in the Delaware Bay are thought to be of Hudson River origin (ASSRT 2007a). However, a more recent study by Hale et al. (2016) suggests that a spawning population of Atlantic Sturgeon exists in the Delaware River and that some level of early juvenile recruitment is continuing to persist despite current depressed population levels. They estimated that 3,656 (95 percent confidence interval from 1,935 to 33,041) juveniles (ages 0 to 1) used the Delaware River estuary as a nursery in 2014. These findings suggest that the Delaware River spawning subpopulation contributes more to the New York Bight DPS than was formerly considered. The estimates of effective population size for the Delaware River spawning population range from 40 to 109 (NMFS 2022g). In 2007, the Atlantic Sturgeon Status Review Team found that the Delaware River subpopulation had a moderately high risk (greater than 50 percent chance) of becoming endangered in the next 20 years, due to the loss of adults from vessel strikes. Other stressors contributing to this conclusion that were ranked as moderate risk were dredging, water quality, and commercial bycatch (ASSRT 2007a). Dredging in the upper portions of the river near Philadelphia were considered detrimental to successful Atlantic sturgeon spawning as this is suspected to be the historical spawning grounds of Atlantic sturgeon. Though dredging restrictions are in place during the spawning season, the continued degradation of suspected spawning habitat likely increases the instability of the Delaware subpopulation (ASSRT 2007a).

The New York Bight DPS demographic risk is categorized as “high” due to its low productivity (e.g., relatively few adults compared to historical levels and irregular spawning success), low abundance (e.g., only a few known spawning populations and low DPS abundance, overall), and limited spatial distribution (e.g., limited spawning habitat within each of the few known rivers that support spawning) (NMFS 2022g). The New York Bight DPS’ potential to recover is, however, also high because man-made threats that have a major impact on the species' ability to persist have been identified (e.g., bycatch in federally-managed fisheries, vessel strikes), the DPS’ response to those threats are well understood, management or protective actions to address major threats are primarily under U.S. jurisdiction or authority, and management or protective actions are technically feasible with respect to reducing fisheries bycatch even if they require further testing (e.g., gear modifications to minimize dredge or fishing gear interactions) (NMFS 2022g).

The South Atlantic DPS historically supported eight spawning subpopulations but currently supports five extant spawning populations (ASSRT 2007a). The Altamaha and the Ashepoo, Savannah, Combahee and Edisto Basin subpopulations support the largest number of spawning adults. The current abundance of these subpopulations are suspected to be less than six percent of their historical abundance, extrapolated from the 1890s commercial landings (ASSRT 2007a; Secor and Niklitschek 2002a). Peterson et al. (2008) reported that approximately 324 and 386 adults per year returned to the Altamaha River in 2004 and 2005, respectively. These estimates however, were conducted in the spring. Ingram and Peterson (2016) used acoustic telemetry to show that adults in the Altamaha River display two different spawning migration strategies, those that enter the river in the spring and hold until spawning in the fall and those that enter the river in the fall and move directly to spawning habitat. The abundance of adults in the lower Altamaha River in the spring is approximately 37 percent of the spawning adult population in the fall. Few captures have been documented in subpopulations other than the Altamaha and the Ashepoo, Combahee and Edisto Basin within this DPS, and these smaller systems are suspected to contain less than one percent of their historic abundance (ASSRT 2007a). The Atlantic

Sturgeon Status Review Team found that the South Atlantic DPS of Atlantic sturgeon had a moderate risk (greater than 50 percent) of becoming endangered in the next 20 years due primarily to dredging, degraded water quality, and commercial fisheries bycatch.

#### 5.2.37.3 *Hearing*

While sturgeon have swim bladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon (*Acipenser sturio*) using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon (*Acipenser fulvescens*) and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar (*Astronotus ocellatus*) and goldfish (*Carassius auratus*) and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002). Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish (*Polyodon spathula*) and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of all DPSs of Atlantic sturgeon.

#### 5.2.37.4 *Status*

In 2012, NMFS listed five DPSs of Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina, and South Atlantic) based on low population sizes and the level of continuing threats such as degraded water quality, habitat impacts from dredging, bycatch in state and federally managed fisheries, and vessel strikes. Historically, each of these DPSs likely supported more than 10,000 spawning adults (ASSRT 2007a; MSPO 1993; Secor and Niklitschek 2002a). The best available data indicate that current numbers of spawning adults for each DPS are one to two orders of magnitude smaller than historical levels (ASSRT 2007a; Kahnle et al. 2007). The number of spawning adults in the Hudson River spawning population is only hundreds per year (Kazyak et al. 2020). There are no spawning run estimates for the Delaware River population but the new genetic analyses indicate that the Delaware River spawning population is likely very small and a fraction of the size of the Hudson River spawning population (White et al. 2021) (NMFS 2022g).

An Atlantic sturgeon population abundance estimate was also derived from Northeast Area Monitoring and Assessment Program (NEAMAP) trawl survey data from 2007 to 2012 (Kocik et al. 2013a). The NEAMAP estimates were based on sampling in a large portion of the marine range of the five DPSs (Cape Cod, Massachusetts to Cape Hatteras, North Carolina) in known sturgeon coastal migration areas, and during times of year that sturgeon are expected to be migrating north and south. Kocik et al. (2013b) provided a range of abundance estimates based on alternative catchability rates, defined as the product of the probability of capture given encounter (i.e. net efficiency) and the fraction of the population within the sampling domain (availability) (see Table 16 from Kocik et al. 2013). NMFS (2017e) applied the NEAMAP derived estimate (i.e., 67,776 fish from Kocik et al. 2013) based on a 50 percent catchability rate as a conservative estimated annual abundance of Atlantic sturgeon subadults (that are of a size vulnerable to capture in commercial sink gillnet and otter trawl gear) and adults. While we still consider this to be a reasonable abundance estimate of the subadult and adult population, we recognize its shortcomings including the limited geographic extent of sampling, age of the data (10 to 15 years old), and assumptions regarding gear catchability. We partitioned this estimate across DPSs, using the proportions developed by Kazyak et al. (2021a) to arrive at the following subadult and adult abundance estimates for each DPS: Gulf of Maine and Canada (combined) 2,033 fish; New York Bight 17,283; Chesapeake Bay 6,642; Carolina 15,317; and South Atlantic 25,890.

Kazyak et al. (2021b) performed a mixed-stock analysis of 1704 Atlantic sturgeon encountered across the U.S. Atlantic Coast. Fish sampled north of Cape Cod, MA and south of Cape Hatteras, NC were dominated by individuals from regional stocks; however, extensive stock mixing was found in the mid-Atlantic region, particularly in coastal environments where individuals from all five DPSs were commonly observed. Of the 41 individuals captured north of Cape Cod, 87.8 percent assigned to the Kennebec River population, which is the only population in the Gulf of Maine DPS, with the remainder assigned to Canadian Rivers. In the region sampled between Cape Hatteras and Cape Cod, 37.5 percent of individuals assigned to populations in the New York Bight DPS and 30.7 percent to populations in the Carolina DPS. Individual-based assignment testing indicated that Atlantic sturgeon sampled south of Cape Hatteras were primarily from the South Atlantic (91.2 percent) and Carolina (6.2 percent) DPSs.

#### 5.2.37.5 *Critical Habitat*

See Section 5.1.4.16 for a description of critical habitat for the Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic DPSs of Atlantic sturgeon.

#### 5.2.37.6 *Recovery Plan*

On March 1, 2018, NMFS issued interim guidance (NMFS 2018d) for recovery of the Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic DPSs of Atlantic sturgeon until the development and approval of a full recovery plan. The initial action plan outlined in the interim guidance consists of protecting extant subpopulations and the species' habitat through reduction of threats, gathering information through research and monitoring on current distribution and abundance; vessel strikes; effects of climate change; and bycatch, and seeking fish passage designs that are effective in safely moving sturgeon upstream and downstream of barriers to migration (i.e., dams) where access to historical habitats is blocked.

### 5.2.38 Green Sturgeon (Southern Distinct Population Segment)

The North American green sturgeon is an anadromous fish that occurs in the nearshore Eastern Pacific Ocean from Alaska to Mexico (Moyle 2002). Green sturgeon are long-lived, late-maturing, iteroparous, anadromous species that spawn infrequently in natal streams, and spend substantial portions of their lives in marine waters. Although they are members of the class of bony fishes, the skeleton of sturgeons is composed mostly of cartilage. Sturgeon have five rows of characteristic bony plates on their body (called scutes). Green sturgeon have an olive green to dark green back, a yellowish green-white belly, and a white stripe beneath the lateral scutes (Adams et al. 2002).

NMFS has identified two distinct population segments (DPS) of green sturgeon; northern and southern (Israel et al. 2009). In 2006, NMFS determined that the Southern DPS of green sturgeon warranted listing as a threatened species under the ESA (71 FR 17757). Green sturgeon have been observed in large concentrations in the summer and autumn within coastal bays and estuaries along the west coast of the US, including the Columbia River estuary, Willapa Bay, Grays Harbor, San Francisco Bay and Monterey Bay (Huff et al. 2012; Lindley et al. 2011; Lindley et al. 2008; Moser and Lindley 2007).

We used information available in the final listing, the status review, and available literature to summarize the status of green sturgeon as follows.

#### 5.2.38.1 *Life history*

Green sturgeon can live to be 70 years old. Green sturgeon reach sexual maturity at approximately fifteen years of age (Van Eenennaam et al. 2006), and may spawn every two to four years throughout their long lives (Erickson and Webb 2007). Mora et al. (2018) reported a mean spawning periodicity of 3.69 years based on a tagging study of adult green sturgeon. The Southern DPS of green sturgeon spawn in cool (14-17°C), deep, turbulent areas with clean, hard substrates.

By far, the Sacramento River is the largest known spawning river for the southern DPS. Six discrete spawning sites have been identified in the upper Sacramento River between Gianella Bridge (River Kilometer 320.6) and the Keswick dam (River Kilometer 486) (Poytress et al. 2013). Some minor spawning takes place in the Feather River, with between 21 to 28 sturgeon observed in 2011, and fertilized eggs on egg mats found (Seesholtz et al. 2015). Spawning pairs of green sturgeon were captured on video at the foot of a dam in the Yuba River in 2011 (Bergman et al. 2011). In preparation for spawning, adult Southern DPS green sturgeon enter San Francisco Bay between mid-February and early-May, and migrate rapidly (on the order of a few weeks) up the Sacramento River (Heublein et al. 2009). Spawning occurs from April through early July, with peaks of activity that depend on a variety of factors including water temperature and water flow rates (Poytress et al. 2009; Poytress et al. 2010).

Green sturgeon larvae are different from all other sturgeon because of the absence of a distinct swim-up or post-hatching stage. Larvae grow fast; young fish grow to 74 millimeters 45 days after hatching (Deng 2000). Larvae and juveniles migrate downstream toward the Sacramento-San Joaquin Delta/Estuary, where they rear for one to four years before migrating out to the Pacific Ocean as subadults (Nakamoto et al. 1995).

After spawning, green sturgeon typically congregate and hold for several months in a few deep pools in the upper mainstem Sacramento River near spawning sites and migrate back downstream when river flows increase in fall. Post-spawn fish re-enter the ocean during the winter months (November through January) and begin their seasonal marine migration north along the coast. Green sturgeon spend the majority of their lives in the open ocean where they exhibit migratory behavior not associated with spawning. Lindley et al. (2008) found that green sturgeon migrate annually along the continental shelf from U.S. to Canadian waters in the fall and an apparent return migration in the spring. Green sturgeon in marine habitats are primarily found at depths of 20–60 meters and from 9.5–16.0 degrees C (Huff et al. 2011). Huff et al. (2011) found that green sturgeon, on average, spent a longer duration in areas with high seafloor complexity, especially where a greater proportion of the substrate consists of boulders. During summer and fall, green sturgeon congregate in coastal bays and estuaries of Washington, Oregon, and California. In winter and spring, similar aggregations can be found from Vancouver Island to Hecate Strait, British Columbia, Canada (Lindley et al. 2008).

Adults captured in the Sacramento-San Joaquin Delta are benthic feeders on invertebrates including shrimp, mollusks, amphipods, and even small fish (Houston 1988; Moyle et al. 1992). Juveniles in the Sacramento River delta feed on opossum shrimp, *Neomysis mercedis*, and *Corophium* amphipods (Radtke 1966). Green sturgeon in Willapa Bay, Washington, eat burrowing shrimp (*Neotrypaea californiensis*) (Borin et al. 2017).

#### 5.2.38.2 *Population dynamics*

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

Mora et al. (2018) used dual-frequency identification sonar sampling in the Sacramento River for five years between 2010 and 2015 to estimate spawning run size and population size of the Southern DPS green sturgeon. Southern DPS spawning run size varied across years, from a minimum of 336 to a maximum of 1,236 individuals. The total population size for the Sacramento River was estimated at 17,548 individuals (95 percent confidence interval [CI] = 12,614 to 22,482). The study also estimated the number of juveniles (freshwater stage, less than 60 cm length, and one to three years of age), sub-adults (3-20 years and 60-165 cm length), and adults (greater than 165 cm in length and older than 20 years) in the river. There are an estimated

4,387 juveniles (95 percent CI = 2,595 to 6,179), an estimated 11,055 subadults (95 percent CI = 6,540 to 15,571), and an estimated 2,106 adults (95 percent CI = 1,246 to 2,966) in the Sacramento River (Mora et al. 2018).

Green sturgeon have been observed in large concentrations in the summer and autumn within coastal bays and estuaries along the U.S. west coast, including the Columbia River estuary, Willapa Bay, Grays Harbor, San Francisco Bay and Monterey Bay. Tagged Southern DPS green sturgeon subadults and adults have been detected in coastal marine waters from Monterey Bay, California to Graves Harbor, Alaska, including the Strait of Juan de Fuca and Puget Sound (74 FR 52299; AquaMaps 2016; Lindley et al. 2011), Washington estuaries within the action area for the proposed action. Recent tag detection results indicate that relatively large numbers of green sturgeon are migrating into the Strait of Juan de Fuca. Preliminary data from a hydrophone array (30 hydrophones) positioned across the Strait of Juan de Fuca showed a total of 64 individual green sturgeon detections from October 2012 to October 2014 (Moore 2020). Of the 64 green sturgeon detected at the Strait of Juan de Fuca array, 18 were identified as being part of the ESA-listed Southern DPS, 16 as being part of the Northern DPS, and 30 were of unknown origin (M. Moser, NMFS, pers. comm. to R. Salz, NMFS, February 20, 2020).

Lindley et al. (2011) reported that green sturgeon use the Puget Sound estuary at a low rate, but fish were detected within this estuary in both winter and summer months. Preliminary data from a hydrophone array (30 hydrophones) positioned across Admiralty Inlet, which connects the Strait of Juan de Fuca to Puget Sound, showed two green sturgeon detections from February 2014 through August 2019 (Moore 2020). One of these detections was a Southern DPS female, the other was of unknown origin (M. Moser, NMFS, pers. comm. to R. Salz, NMFS, February 20, 2020). There were no detections of tagged green sturgeon during this time frame at hydrophone arrays across Central Puget Sound or Tacoma Narrows (Moore 2020). NMFS also deployed an array of over 30 hydrophones surrounding the Hood Canal Bridge and four hydrophones spanning the outlet of Hood Canal from March through August of 2017 and March through September of 2018. There were no detections of tagged Southern DPS green sturgeon during this time frame at the Hood Canal array (Moore 2020).

The available genetic data do not change the status of the species or the imminence or magnitude of any threat; data only confirm the DPS structure and add detail to the DPS composition in different estuaries during the sampling periods (NMFS 2015d). Green sturgeon stocks from the DPSs have been found to be genetically differentiated (Israel et al. 2009; Israel et al. 2004).

#### 5.2.38.3 *Hearing*

We are not aware of any hearing studies directly on Green sturgeon (Southern DPS), but data from other species are applicable.

While sturgeon have swimbladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar and goldfish and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of Green sturgeon (Southern DPS).

#### 5.2.38.4 *Status*

Green sturgeon stocks from the two identified DPSs (i.e., Southern and Northern) have been found to be genetically differentiated (Israel et al. 2009; Israel et al. 2004). The available genetic data do not change the status of the species or the imminence or magnitude of any threat; data only confirm the DPS structure and add detail to the DPS composition in different estuaries during the sampling periods (NMFS 2015d). Attempts to evaluate the status of Southern DPS green sturgeon have been met with limited success due to the lack of reliable long-term data. No estimate of intrinsic growth rates are available for Southern DPS green sturgeon. The final rule listing southern DPS green sturgeon indicates that the principle factor for the decline in the DPS is the reduction of spawning to a limited area in the Sacramento River caused primarily by impoundments. The species also faces threats from changes in water temperature, availability, and flow, and commercial and recreational bycatch (Doukakis et al. 2020; 71 FR 17757). Climate change has the potential to impact Southern DPS green sturgeon in the future, but it is unclear how changing oceanic, nearshore and river conditions will affect the Southern DPS overall (NMFS 2015d). Rodgers et al. (2019) used a meta-analytical approach to summarize the mean effects of prominent stressors (elevated temperatures, salinity, low food availability and contaminants) on several physiological traits (growth, thermal tolerance, swimming performance and heat shock protein expression) of Southern DPS green sturgeon. All examined stressors significantly impaired green sturgeon growth, and additional stressor-specific costs were documented (Rodgers et al. 2019).

#### 5.2.38.5 *Critical Habitat*

See Section 5.1.4.19 for a description of Southern DPS green sturgeon critical habitat.

#### 5.2.38.6 *Recovery Goals*

NMFS (2018e) identified de-listing criteria crucial for the recovery of the Southern DPS of green sturgeon. These criteria for recovery are listed below:

- Abundance. The adult Southern DPS of green sturgeon census population remains at or above 3,000 for 3 generations (this equates to a yearly running average of at least 813 spawners for approximately 66 years). In addition, the effective population size must be at least 500 individuals in any given year and each annual spawning run must be comprised of a combined total, from all spawning locations, of at least 500 adult fish in any given year.
- Distribution. The Southern DPS of green sturgeon spawn successfully in at least two rivers within their historical range. Successful spawning will be determined by the annual presence of larvae for at least 20 years.
- Productivity. A net positive trend in juvenile and subadult abundance is observed over the course of at least 20 years. Also, the population is characterized by a broad distribution of size classes representing multiple cohorts that are stable over the long term (20 years or more).
- Diversity. There is no net loss of Southern DPS green sturgeon diversity from current levels.
- Threat-Based Recovery Criteria
    - Access to spawning habitat is improved through barrier removal or modification in the Sacramento, Feather, and/or Yuba rivers such that successful spawning occurs annually in at least two rivers. Successful spawning will be determined by the annual presence of larvae for at least 20 years.
    - Volitional passage is provided for adult green sturgeon through the Yolo and Sutter bypasses.
    - Water temperature and flows are provided in spawning habitat such that juvenile recruitment is documented annually. Recruitment is determined by the annual presence of age-0 juveniles in the lower Sacramento River or San Francisco Bay Delta Estuary. Flow and temperature guidelines have been derived from analysis of inter-annual spawning and recruitment success and are informing this criterion.
    - Adult contaminant levels are below levels that are identified as limiting population maintenance and growth.

Take of adults and subadults through poaching and state, federal, and tribal fisheries is minimal and does not limit population persistence and growth.

### 5.2.39 Gulf Sturgeon

The Gulf sturgeon subspecies of Atlantic sturgeon is a large anadromous fish that resides completely within the Gulf of Mexico.

Gulf sturgeon are nearly cylindrical fish with an extended snout, vertical mouth, five rows of scutes (bony plates surrounding the body), four chin barbels (slender, whisker-like feelers extending from the head used for touch and taste), and a heterocercal (upper lobe is longer than lower) caudal fin. Adults range from six to eight feet in length and weigh up to 200 pounds; females grow larger than males (USFWS 2009).

Gulf sturgeon were listed as threatened effective October 30, 1991 (56 CFR 49653, September 30, 1991), after their stocks were greatly reduced or extirpated throughout much of their historic range by overfishing, dam construction, and habitat degradation. NMFS and the U.S. Fish and Wildlife Service jointly manage Gulf sturgeon. In marine areas, NMFS is responsible for all consultations regarding Gulf sturgeon and critical habitat. In estuarine habitats, responsibility is divided based on the action agency involved. NMFS consults with the Department of Defense, U.S. Army Corps of Engineers, the Bureau of Ocean Energy Management, and any other federal agencies not specifically mentioned at 50 CFR 226.214.

We used information available in the final listing, the status review (USFWS and NMFS 2009), the 2022 five-year review (USFWS and NMFS 2022), and available literature to summarize the status of green sturgeon as follows.

#### 5.2.39.1 *Life History*

Gulf sturgeon are long-lived, with some individuals reaching at least 42 years in age (Huff 1975). Age at sexual maturity ranges from eight to 17 years for females and seven to 21 years for males (Huff 1975). Chapman and Carr (1995) estimated that mature female Gulf sturgeon that weigh between 64 and 112 pounds (29 to 51 kilograms) produce an average of 400,000 eggs. Spawning intervals range from one to five years for males, while females require longer intervals ranging from three to five years (Fox et al. 2000; Huff 1975).

Gulf sturgeon are found in river systems from Louisiana to Florida, in nearshore bays and estuaries, and in the Gulf of Mexico. Gulf sturgeon move from the Gulf of Mexico into coastal rivers in early spring (i.e., March through May). Fox et al. (2000) found water temperatures at time of river entry differed significantly by reproductive stage and sex. Individuals entered the river system when water temperatures ranged anywhere between 11.2 and 27.1 degrees Celsius. Spawning occurs in the upper reaches of rivers in the spring when water temperature is around 15 to 20 degrees Celsius. While Sulak and Clugston (1999) suggest that sturgeon spawning activity is related to moon phase, other researchers have found little evidence of spawning associated with lunar cycles (Fox et al. 2000; Slack et al. 1999). Fertilization is external; females deposit their eggs on the river bottom and males fertilize them. Gulf sturgeon eggs are demersal, adhesive, and vary in color from gray to brown to black (Huff 1975; Vladykov and Greeley 1963). Parauka et al. (1991) reported that hatching time for artificially spawned Gulf sturgeon ranged from 85.5 hours at 18.4 degrees Celsius to 54.4 hours at about 23 degrees Celsius. Published research on the life history of younger Gulf sturgeon is limited. After hatching, young-of-year individuals generally disperse downstream of spawning sites, though some may travel upstream as well (Clugston et al. 1995; Sulak and Clugston 1999), and move into estuarine feeding areas for the winter months.

Tagging studies confirm that Gulf sturgeon exhibit a high degree of river fidelity (Carr 1983). Of 4,100 fish tagged, 21 percent (860 of 4,100 fish) were later recaptured in the river of their initial collection, eight fish (0.2 percent) moved between river systems, and the remaining fish (78.8 percent) have not yet been recaptured (USFWS and GSMFC 1995). There is no information documenting the presence of spawning adults in non-natal rivers. However, there is some evidence of movements by both male and female Gulf sturgeon (n = 22) from natal rivers into non-natal rivers (Carr et al. 1996; Craft et al. 2001; Fox et al. 2002; Ross et al. 2001; Wooley and Crateau 1985).

After spawning, Gulf sturgeon move downstream to areas referred to as "summer resting" or "holding" areas. Adults and subadults are not distributed uniformly throughout the river, but instead show a preference for these discrete holding areas usually located in the lower and middle river reaches (Hightower et al. 2002). While it was suggested these holding areas were sought for cooler water temperatures (Carr et al. 1996; Chapman and Carr 1995), Hightower et al. (2002) found that water temperatures in holding areas where Gulf sturgeon were repeatedly found in the Choctawhatchee River were similar to temperatures where sturgeon were only occasionally found elsewhere in the river.

In the fall, movement from the rivers into the estuaries and associated bays begins in September (at water temperatures around 23 degrees Celsius) and continues through November (Foster and Clugston 1997; Huff 1975; Wooley and Crateau 1985). Because the adult and large subadult sturgeon have spent at least six months fasting or foraging sparingly on detritus in the rivers, it is presumed they immediately begin foraging (Mason and Clugston 1993). Telemetry data indicate Gulf sturgeon are found in high concentrations near the mouths of their natal rivers with individual fish traveling relatively quickly between foraging areas where they spend an extended period of time (Edwards et al. 2007; Edwards et al. 2003).

Most subadult and adult Gulf sturgeon spend the cool winter months (October/November through March/April) in bays, estuaries, and nearshore environments in the Gulf of Mexico (Clugston et al. 1995; Fox et al. 2002; Odenkirk 1989). Tagged fish have been located in well-oxygenated shallow water (less than seven meters) areas that support burrowing macro invertebrates (Craft et al. 2001; Fox and Hightower 1998; Fox et al. 2002; Parauka et al. 2001; Rogillio et al. 2007; Ross et al. 2001; Ross et al. 2009). These areas may include shallow shoals five to seven feet (1.5 to 2.1 meters), deep holes near passes (Craft et al. 2001), unvegetated sand habitats such as sandbars, and intertidal and subtidal energy zones (Abele and Kim 1986; Menzel 1971; Ross et al. 2009). Subadult and adult Gulf sturgeon overwintering in Choctawhatchee Bay (Florida) were generally found to occupy the sandy shoreline habitat at depths of four to six feet (two to three meters) (Fox et al. 2002; Parauka et al. 2001). These shifting, predominantly sandy, areas support a variety of potential prey items including estuarine crustaceans, small bivalve mollusks, ghost shrimp, small crabs, various polychaete worms, and lancelets (Abele and Kim

1986; Menzel 1971; Williams et al. 1989). Preference for sandy habitat is supported by studies in other areas that have correlated Gulf sturgeon presence to sandy substrate (Fox et al. 2002).

Gulf sturgeon are described as opportunistic and indiscriminate benthivores that change their diets and foraging areas during different life stages. Their guts generally contain benthic marine invertebrates including amphiopods, lancelets, polychaetes, gastropods, shrimp, isopods, mollusks, and crustaceans (Carr et al. 1996; Fox et al. 2002; Huff 1975; Mason and Clugston 1993). Generally, Gulf sturgeon prey are burrowing species that feed on detritus and/or suspended particles, and inhabit sandy substrate. In the river, young-of-year sturgeon eat aquatic invertebrates and detritus (Mason and Clugston 1993; Sulak and Clugston 1999) and juveniles forage throughout the river on aquatic insects (e.g., mayflies and caddisflies), worms (oligochaete), and bivalves (Huff 1975; Mason and Clugston 1993). Adults forage sparingly in freshwater and depend almost entirely on estuarine and marine prey for their growth (Gu et al. 2001). Both adult and subadult Gulf sturgeon are known to lose up to 30 percent of their total body weight while in fresh water, and subsequently compensate the loss during winter feeding in marine areas (Carr 1983; Clugston et al. 1995; Heise et al. 1999; Morrow et al. 1998; Sulak and Clugston 1999; Wooley and Crateau 1985).

### 5.2.39.2 *Population Dynamics*

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

Abundance of Gulf sturgeon is measured at the riverine scale. Currently, seven rivers are known to support reproducing populations of Gulf sturgeon: the Pearl, Pascagoula, Escambia, Yellow, Choctawhatchee, Apalachicola, and Suwannee rivers. The number of individuals within each riverine population is variable across their range, but generally over the last decade (USFWS and NMFS 2009) populations in the eastern part of the range (Suwannee, Apalachicola Choctawhatchee) appear to be relatively stable in number or have a slightly increasing population trend. In the western portion of the range, populations in the Pearl and Pascagoula Rivers have never been nearly as abundant as those to the east. Within the last 3 to 5 years, new investigations have been initiated in the Pearl and Pascagoula Rivers but results of those population assessments are not yet available (USFWS and NMFS 2022).

Both acute and episodic events are known to impact individual populations of Gulf sturgeon that in turn, affect overall population numbers. For example, on August 9, 2011, an overflow of "black liquor" (an extremely alkaline waste byproduct of the paper industry) was accidentally released by a paper mill into the Pearl River near Bogalusa, Louisiana, that may have affected the status and abundance of the Pearl River population. While paper mills regularly use acid to balance the black liquor's pH before releasing the material, as permitted by the Louisiana Department of Environmental Quality, this material released was not treated. The untreated waste byproduct created a low oxygen ("hypoxic") environment lethal to aquatic life. These hypoxic conditions moved downstream of the release site killing fish and mussels in the Pearl

River over several days. Within a week after the spill, the dissolved oxygen concentrations returned to normal in all areas of the Pearl River tested by Louisiana Department of Wildlife and Fisheries. The investigation of fish mortality began on August 13, 2011, several days after the spill occurred. Twenty-eight Gulf sturgeon carcasses (38 to 168 centimeters total length) were collected in the Pearl River after the spill (Sanzenbach 2011a; Sanzenbach 2011b) and anecdotal information suggests many other Gulf sturgeon carcasses were not collected. The smaller fish collected represent young-of-year and indicate spawning is likely occurring in the Pearl River. The spill occurred during the time when Gulf sturgeon were still occupying the freshwater habitat. Because the materials moved downriver after the spill, the entire Pearl River population of Gulf sturgeon was likely impacted.

Gene flow is low in Gulf sturgeon stocks, with each stock exchanging less than one mature female per generation (Waldman and Wirgin 1998). Genetic studies confirm that Gulf sturgeon exhibit river-specific fidelity. Stabile et al. (1996) analyzed tissue taken from Gulf sturgeon in eight drainages along the Gulf of Mexico for genetic diversity and noted significant differences among Gulf sturgeon stocks, which suggests region-specific affinities and likely river-specific fidelity. Five regional or river-specific stocks (from west to east) have been identified: (1) Lake Pontchartrain and Pearl River, (2) Pascagoula River, (3) Escambia and Yellow Rivers, (4) Choctawhatchee River, and (5) Apalachicola, Ochlockonee, and Suwannee Rivers (Stabile et al. 1996).

#### 5.2.39.3 *Hearing*

We are not aware of any hearing studies directly on Gulf sturgeon, but data from other species are applicable.

While sturgeon have swimbladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar and goldfish and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz); these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and

300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of Gulf sturgeon.

#### 5.2.39.4 *Status*

The decline in the abundance of Gulf sturgeon has been attributed to targeted fisheries in the late 19th and early 20th centuries, habitat loss associated with dams and sills, habitat degradation associated with dredging, de-snagging, and contamination by pesticides, heavy metals, and other industrial contaminants, and certain life history characteristics (e.g. slow growth and late maturation). Effects of climate change (warmer water, sea level rise and higher salinity levels) could lead to accelerated changes in habitats utilized by Gulf sturgeon. The rate that climate change and corollary impacts are occurring may outpace the ability of the Gulf sturgeon to adapt given its limited geographic distribution and low dispersal rate. In general, Gulf sturgeon populations in the eastern portion of the range appear to be stable or slightly increasing, while populations in the western portion are associated with lower abundances and higher uncertainty (USFWS 2009).

#### 5.2.39.5 *Critical Habitat*

See Section 5.1.4.20 for a description of gulf sturgeon critical habitat.

#### 5.2.39.6 *Recovery Plan*

In 1995, a recovery/management plan (NMFS 1995) was published for the Gulf Sturgeon. In addition, all United States fisheries for the Gulf sturgeon have been closed. The following are priority-one recovery tasks:

1. Develop and implement standardized population sampling and monitoring techniques.
2. Develop and implement regulatory framework to eliminate introductions of nonindigenous stock or other sturgeon species.
3. Reduce or eliminate incidental mortality.
4. Restore the benefits of natural riverine habitats.
5. Utilize existing authorities to protect habitat and where inadequate, recommend new laws and regulations.

### 5.2.40 Shortnose Sturgeon

Shortnose sturgeon occur in estuaries and rivers along the east coast of North America (Vladykov and Greeley 1963). Their northerly distribution extends to the Saint John River, New Brunswick, Canada, and their southerly distribution historically extended to the Indian River, Florida (Evermann and Bean 1898; Scott and Scott 1988a).

The shortnose sturgeon is the smallest of the three sturgeon species that occur in eastern North America. It has an elongate, cylindrical body and its head and snout are fairly small relative to Atlantic sturgeon (Dadswell 1984). Shortnose sturgeon vary in color but are generally dark brown to olive/black on the dorsal surface, lighter along the row of lateral scutes and nearly white on the ventral surface (Gilbert 1989). The shortnose sturgeon was listed as endangered on March 11, 1967. Shortnose sturgeon remained on the endangered species list with enactment of the ESA in 1973.

We used information available in the final listing, the status review (NMFS 2010d), and available literature to summarize the status of green sturgeon as follows.

#### 5.2.40.1 *Life history*

Shortnose sturgeon are relatively slow growing, late maturing and long-lived. Growth rate, maximum age and maximum size vary with latitude; populations in southern areas grow more rapidly and mature at younger ages but attain smaller maximum sizes than those in the north (Dadswell et al. 1984). In general, females reach sexual maturity between ages four and 18, and males between ages two and 11 (NMFS 2010d). Shortnose sturgeon overwinter in the lower portions of rivers and migrate upriver to spawn in the spring. Males spawn every other year while females spawn every three to five years (Dadswell 1979a; Kieffer and Kynard 1996). Spawning females deposit their eggs over gravel, rubble, and/or cobble often in the farthest accessible upstream reach of the river (Kynard 1997). After spawning, adult shortnose sturgeon move rapidly to downstream feeding areas where they forage on benthic insects, crustaceans, mollusks, and polychaetes (Buckley and Kynard 1985; Dadswell 1984; Kieffer and Kynard 1993; O'herron et al. 1993).

Upon hatching, shortnose sturgeon shelter in dark substrate or are found in schools swimming against the current. Around four to 12 days after hatching individuals begin to feed exogenously and are dispersed downstream. These larvae are often found in the deepest water, usually within the channel (Kieffer and Kynard 1993; O'Connor et al. 1981; Parker and Kynard 2014; Taubert and Dadswell 1980). Young of the Year remain in freshwater habitats upstream of the salt wedge for about one year (Dadswell et al. 1984; Kynard 1997). The age at which juveniles begin to utilize habitat associated with the salt/fresh water interface varies with river system from age one to eight (Collins et al. 2002; Dadswell 1979a; Flournoy et al. 1992). Overwintering habitat and behavior of shortnose sturgeon varies with latitude: fish in northern rivers form tight aggregations with little movement and will inhabit either freshwater or saline reaches of the river, while fish in the south are more active and are found predominantly near the fresh/saltwater interface (Collins and Smith 1993; Kynard et al. 2012; Weber et al. 1998).

The general pattern of coastal migration of shortnose sturgeon indicates movement between groups of rivers proximal to each other across the geographic range (Altenritter et al. 2015; Dionne et al. 2013; Quattro et al. 2002b; Wirgin et al. 2005a). However, migration/straying is not necessarily resulting in effective gene exchange as indicated by high degree of genetic differentiation among riverine populations. Based on genetic analyses, the shortnose sturgeon population has been grouped into five regional population clusters: Gulf of Maine, Connecticut/Housatonic rivers, Hudson River, Delaware River/Chesapeake Bay, and Southeast. The shortnose sturgeon status review team recommends, however, that recovery and management actions consider each riverine population as a management/recovery unit (NMFS 2010d).

#### 5.2.40.2 *Population dynamics*

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

Historically, shortnose sturgeon are believed to have inhabited nearly all major rivers and estuaries along the entire east coast of North America. NMFS's Shortnose Sturgeon Recovery Plan identifies 19 populations based on the fish's strong fidelity to natal rivers and the premise that populations in adjacent river systems did not interbreed with any regularity (NMFS 1998b). The Plan recommended that each population be managed separately until further evidence and information allowed for the consideration of potential DPS delineations for shortnose sturgeon. Since the Plan was published in 1998, additional information on straying rates and genetic analysis have been made available. Both mitochondrial deoxyribonucleic acid (DNA) and nuclear DNA analyses indicate effective (with spawning) coastal migrations are occurring between adjacent rivers in some areas, particularly within the GOM and the Southeast (King et al. 2014). The currently available genetic information suggests that shortnose sturgeon can be separated into smaller groupings that form regional clusters across their geographic range (SSSRT 2010). Differences in life history and ecology further support these genetic groupings or clusters. Both regional population and metapopulation structures may exist according to genetic analyses and dispersal and migration patterns (King et al. 2014; Wirgin et al. 2010). The Shortnose Sturgeon Status Review Team (SSSRT) concluded shortnose sturgeon across their geographic range include five genetically distinct groupings each of which have geographic ecological adaptations: 1) GOM; 2) Connecticut and Housatonic Rivers; 3) Hudson River; 4) Delaware River and Chesapeake Bay; and 5) Southeast (SSSRT 2010).

Three of these regional groups appear to be functioning as a metapopulation: GOM, Delaware/Chesapeake Bay, and Southeast. Very few shortnose sturgeon have been captured in the Chesapeake Bay since the species was listed (40 in the Potomac, 1 at mouth of the Rappahonock and 1 in the James river), and those fish moved back and forth to the Delaware estuary, which is why it is grouped with the Delaware population. The other two groups (Connecticut/Housatonic and the Hudson River) are thought to be evolutionarily significant. 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. 2002a; Wirgin et al. 2005b; Wirgin et al. 2010). The SSSRT also recommended that each riverine population be considered as a separate management/recovery unit (SSSRT 2010).

The distribution of shortnose sturgeon is disjointed across their range, with northern populations separated from southern populations by a distance of about 400 kilometers near their geographic center in Virginia. There are no spawning areas in the northern part of North Carolina, and a very small population in the Cape Fear estuary. At the northern end of the species' distribution, the highest rate of gene flow (which suggests migration) occurs between the Kennebec, Penobscot, and Androscoggin Rivers. At the southern end of the species' distribution, populations south of the Pee Dee River appear to exchange between one to ten individuals per generation, with the highest rates of exchange occurring between the Ogeechee and Altamaha Rivers (Wirgin et al. 2005b).

Additionally, these researchers concluded that genetic components of sturgeon in rivers separated by more than 400 kilometers were connected by very little migration, while rivers separated by less than 20 kilometers (such as the rivers flowing into coastal South Carolina) would experience high migration rates (Wirgin et al. 2005b). Shortnose sturgeon are known to occur in the Chesapeake Bay, but these fish may be transients from the Delaware River via the Chesapeake and Delaware Canal (Welsh et al. 2002; Wirgin et al. 2010) or remnants of a population in the Potomac River. Shortnose sturgeon were thought to be extirpated from three southern rivers (St. Johns, St. Mary's, and Satilla) (Collins et al. 2000; Rogers and Weber 1995). However, in 2002 one shortnose sturgeon was captured in the St. Johns River (FFWCC 2007), and from 2008-2011 researchers captured and tagged 11 shortnose sturgeon from the Satilla River and one from the St. Mary's River (Fritts and Peterson 2011). These studies suggest either a small remnant population exists or emigration from other populations. Fritts and Peterson (2011) concluded that growth and survival of juvenile shortnose sturgeon were likely hindered during summer months by hypoxic conditions in critical nursery habitats in these rivers occupying the southern range of this species.

#### 5.2.40.3 *Hearing*

We are not aware of any hearing studies directly on shortnose sturgeon, but data from other species are applicable.

While sturgeon have swimbladders, they are not known to be used for hearing, and thus sturgeon appear to only rely directly on their ears for hearing. Popper (2005) reported that studies measuring responses of the ear of European sturgeon using physiological methods suggest sturgeon are likely capable of detecting sounds from below 100 Hz to about 1 kHz, indicating that sturgeon should be able to localize or determine the direction of origin of sound. Meyer and Popper (2002) recorded auditory evoked potentials of varying frequencies and intensities for lake sturgeon and found that lake sturgeon can detect pure tones from 100 Hz to 2 kHz, with best hearing sensitivity from 100 to 400 Hz. They also compared these sturgeon data with comparable data for Oscar and goldfish and reported that the auditory brainstem responses for the lake sturgeon were more similar to goldfish (which is considered a hearing specialist that can hear up to five kHz) than to the oscar (which is a non-specialist that can only detect sound up to 400 Hz);

these authors, however, felt additional data were necessary before lake sturgeon could be considered specialized for hearing (Meyer and Popper 2002).

Lovell et al. (2005) also studied sound reception and the hearing abilities of paddlefish and lake sturgeon. Using a combination of morphological and physiological techniques, they determined that paddlefish and lake sturgeon were responsive to sounds ranging in frequency from 100 to 500 Hz, with the lowest hearing thresholds from frequencies in a bandwidth of between 200 and 300 Hz and higher thresholds at 100 and 500 Hz; lake sturgeon were not sensitive to sound pressure. We assume that the hearing sensitivities reported for these other species of sturgeon are representative of the hearing sensitivities of shortnose sturgeon.

#### 5.2.40.4 *Status*

The 2010 shortnose sturgeon SRT conducted a three-step risk assessment for shortnose sturgeon at a riverine scale: (1) assess population health, (2) populate a "matrix of stressors" by ranking threats, and (3) review assessment by comparing population health scores to stressor scores. The Hudson River had the highest estimated adult abundance (30,000 to 61,000), followed by the Delaware (12,000), Kennebec Complex (9,000), and Altamaha (6,000) (SSSRT 2010). The SSSRT found evidence of an increasing abundance trend for the Kennebec Complex and ACE Basin populations; a stable trend for the Merrimack, Connecticut, Hudson, Delaware, Winyah Bay Complex, Cooper, Savannah, Ogeechee, and Altamaha populations; and a declining trend only for the Cape Fear population (all other populations had an unknown trend) (SSSRT 2010).

The SSSRT summarized continuing threats to the species in each of the 29 identified populations (SSSRT 2010). Dams represent a major threat to seven shortnose sturgeon populations and a moderate threat to seven additional populations. Dredging represents a major threat to one shortnose sturgeon population (Savannah River), a moderately high threat to three populations, and a moderate threat to seven populations. Fisheries bycatch represents a major threat to one shortnose sturgeon population (Lakes Marion and Moultrie in Santee-Cooper Reservoir System), a moderately high threat to four populations, and a moderate threat to ten populations (SSSRT 2010). Water quality represents a major threat to one shortnose sturgeon population (Potomac River), a moderately high threat to six populations, a moderate threat to 13 populations, and a moderately low threat to one population. Specific sources of water quality degradation affecting shortnose sturgeon include coal tar, wastewater treatment plants, fish hatcheries, industrial waste, pulp mills, sewage outflows, industrial farms, water withdrawals, and non-point sources. These sources contribute to the following conditions that may have adverse effects on shortnose sturgeon: nutrient loading, low DO, algal blooms, increased sedimentation, elevated contaminant levels (mercury, polychlorinated biphenyl [PCBs], dioxin, polycyclic aromatic hydrocarbons [PAHs], endocrine disrupting chemicals, cadmium), and low pH levels (SSSRT 2010). Impingement/entrainment at power plants and treatment plants was rated as a moderate threat to two shortnose sturgeon populations (Delaware and Potomac).

The SSSRT examined the relationship between population health scores and associated stressors/threats for each shortnose sturgeon riverine population and concluded the following: 1) despite relatively high stressor scores, the Hudson and Kennebec River populations appear relatively healthy; 2) shortnose sturgeon in the Savannah River appear moderately healthy, but their status is perilous; 3) shortnose in the ACE system are of moderate health with low stress and may be most able to recover (SSSRT 2010). Climate warming has the potential to reduce abundance or eliminate shortnose sturgeon in many rivers, particularly in the South (Kynard et al. 2016).

The SSSRT reported results of an age-structured population model using the RAMAS software (Akçakaya and Root 2007) to estimate shortnose sturgeon extinction probabilities for three river systems: Hudson, Cooper, and Altamaha. The estimated probability of extinction was zero for all three populations under the default assumptions, despite the long (100-year) horizon and the relatively high year-to-year variability in fertility and survival rates. The estimated probability of a 50 percent decline was relatively high (Hudson 0.65, Cooper 0.32, Altamaha 0.73), whereas the probability of an 80 percent decline was low (Hudson 0.09, Cooper 0.01, Altamaha 0.23) (SSSRT 2010).

Information needed to fully assess population status is lacking for many individual shortnose sturgeon spawning stocks. The largest shortnose sturgeon adult populations are found in the Northeastern rivers: Hudson 56,708 adults (Bain et al. 2007); Delaware 12,047 (ERC 2006); and Saint Johns over 18,000 adults (Dadswell 1979b). Shortnose sturgeon populations in southern rivers are considerably smaller by comparison. Peterson and Bednarski (2013) documented a three-fold variation in adult abundance (707 to 2,122 individuals) over a 7-year period in the Altamaha River. Bahr and Peterson (2017) estimated the adult shortnose population in the Savannah River was 1,865 in 2013, 1,564 in 2014, and 940 in 2015. Their estimates of juvenile shortnose sturgeon ranged from 81-270 age 1 fish and 123-486 age 2 and over fish over the course of the three-year (2013-2015) study period. This study suggests that the Savannah River population is likely the second largest within the South Atlantic (Bahr and Peterson 2017).

Population trend estimates are available for six shortnose sturgeon spawning stocks: St John, Kennebec, Hudson, and Satilla are all decreasing slightly (-1 percent); Delaware and Ogeechee are stable (0 percent). Estimated adult survival rates for shortnose sturgeon are only available for two river populations: Satilla 84 percent and ACE Basin 89 percent. Regular spawning is known to occur in 12 spawning stocks, with intermittent spawning observed in three other river systems. Major threats to shortnose sturgeon, defined as threats that if altered could lead to recovery, are currently identified for four river systems: dams in the Connecticut, Santee, and Cooper Rivers and water quality in the St. Mary's River. One or more minor threats, defined as threats that likely result in a low level of mortality, have been identified for several other river populations. The most prevalent minor threats to shortnose sturgeon are water quality (ten populations), bycatch (eight populations), and impingement/entrainment (six populations).

#### 5.2.40.5 *Critical Habitat*

Critical habitat has not been proposed for shortnose sturgeon.

#### 5.2.40.6 *Recovery Goals*

The Shortnose Sturgeon Recovery Plan was developed in 1998 (NMFS 1998b). The long-term recovery objective, as stated in the Plan, is to recover all 19 discrete populations to levels of abundance at which they no longer require protection under the ESA. To achieve and preserve minimum population sizes for each population segment, essential habitats must be identified and maintained, and mortality must be monitored and minimized. Accordingly, other key recovery tasks discussed in the Plan are to define essential habitat characteristics, assess mortality factors, and protect shortnose sturgeon through applicable federal and state regulations.

### 5.2.41 Smalltooth Sawfish (United States Distinct Population Segment)

The smalltooth sawfish is a tropical marine and estuarine elasmobranch. Within the United States, smalltooth sawfish have been captured in estuarine and coastal waters from New York southward through Texas, although peninsular Florida has historically been the region of the United States with the largest number of recorded captures (NMFS 2010f).

Although they are rays, sawfish physically resemble sharks, with only the trunk and especially the head ventrally flattened. Smalltooth sawfish are characterized by their "saw," a long, narrow, flattened rostral blade with a series of transverse teeth along either edge. The U.S. Distinct Population Segment of smalltooth sawfish was listed as endangered under the ESA effective May 1, 2003.

We used information available in the final listing, the status review (NMFS 2010f), and available literature to summarize the status of green sturgeon as follows.

#### 5.2.41.1 *Life History*

Smalltooth sawfish size at sexual maturity has been reported as 360 centimeters total length by Simpfendorfer (2005b). Carlson and Simpfendorfer (2015) estimated that sexual maturity for females occurs between seven and 11 years of age. As in many elasmobranchs, smalltooth sawfish are viviparous; fertilization is internal. The gestation period for smalltooth sawfish is estimated at five months based on data from the largetooth sawfish (Thorson 1976). Females move into shallow estuarine and nearshore nursery areas to give birth to live young between November and July, with peak parturition occurring between April and May (Poulakis et al. 2011). Litter sizes range between 10 and 20 individuals (Bigalow and Schroeder 1953; Carlson and Simpfendorfer 2015; Simpfendorfer 2005a).

Neonate smalltooth sawfish are born measuring 67 to 81 centimeters in total length and spend the majority of their time in the shallow nearshore edges of sand and mud banks (Poulakis et al. 2011; Simpfendorfer et al. 2010). Once individuals reach 100 to 140 centimeters total length, they begin to expand their foraging range. Capture data suggests smalltooth sawfish in this size class may move throughout rivers and estuaries within a salinity range of 18 and 30 practical salinity units. Individuals in this size class also appear to have the highest affinity to mangrove habitat (Simpfendorfer et al. 2011). Juvenile sawfish spend the first two to three years of their lives in the shallow waters provided in the lower reaches of rivers, estuaries, and coastal bays (Simpfendorfer et al. 2008; Simpfendorfer et al. 2011). As smalltooth sawfish approach 250 centimeters total length they become less sensitive to salinity changes and begin to move out of the protected shallow-water embayments and into the shorelines of barrier islands (Poulakis et al. 2011). Adult sawfish typically occur in more open-water, marine habitats (Poulakis and Seitz 2004).

#### 5.2.41.2 *Population Dynamics*

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

The abundance of smalltooth sawfish in U.S. waters has decreased dramatically over the past century. Efforts are currently underway to provide better estimates of smalltooth sawfish abundance (NMFS 2014e). Current estimates are based on encounter data, genetic sampling, and geographic extent. Carlson and Simpfendorfer (2015) used encounter densities to estimate the female population size to be 600. Chapman et al. (2011) analyzed genetic data from tissue samples (fin clips) to estimate the effective genetic population size as 250 to 350 adults (95 percent confidence intervals 142 to 955). Simpfendorfer (2002) estimated that the U.S. population may number less than five percent of historic levels based on the contraction of the species' range.

The abundance of juveniles encountered in recent studies (Poulakis et al. 2014; Seitz and Poulakis 2002; Simpfendorfer and Wiley 2004a) suggests that the smalltooth sawfish population remains reproductively viable. The overall abundance appears to be stable (Wiley and Simpfendorfer 2010). Data analyzed from the Everglades portion of the smalltooth sawfish range suggests that the population growth rate for that region may be around five percent per year (Carlson and Osborne 2012; Carlson et al. 2007). Intrinsic rates of growth for smalltooth sawfish have been estimated at 1.08 to 1.14 per year and 1.237 to 1.150 per year by Simpfendorfer (2000) and Carlson and Simpfendorfer (2015) respectively. However, these intrinsic rates are uncertain due to the lack of long-term abundance data.

Chapman et al. (2011) investigated the genetic diversity within the smalltooth sawfish population. The study reported that the remnant population exhibits high genetic diversity (allelic richness, alleles per locus, heterozygosity) and that inbreeding is rare. The study also suggested that the protected population will likely retain greater than 90 percent of its current genetic diversity over the next century.

Recent capture and encounter data suggests that the current distribution is focused primarily to south and southwest Florida from Charlotte Harbor through the Dry Tortugas (Poulakis and Seitz 2004; Seitz and Poulakis 2002). Water temperatures (no lower than 16 to 18 degrees Celsius) and the availability of appropriate coastal habitat (shallow, euryhaline waters and red mangroves) are the major environmental constraints limiting the distribution of smalltooth sawfish (Bigalow and Schroeder 1953).

#### 5.2.41.3 *Hearing*

Smalltooth sawfish are elasmobranchs, and like all fish they have an inner ear capable of detecting sound and a lateral line capable of detecting water motion caused by sound (Hastings and Popper 2005; Popper and Schilt 2009). Data for elasmobranchs fishes suggest detection of sounds from 20 Hz to 1.0 kHz with the highest sensitivity to sounds at lower ranges (Casper et al. 2012; Casper et al. 2003; Casper and Mann 2006; Casper and Mann 2009; Ladich and Fay 2013; Myrberg Jr. 2001). However, unlike most teleost fish, elasmobranchs do not have swimbladders, and thus are unable to detect sound pressure (Casper et al. 2012).

#### 5.2.41.4 *Status*

The decline in the abundance of smalltooth sawfish has been attributed to fishing (primarily commercial and recreational bycatch), habitat modification (including changes to freshwater flow regimes as a result of climate change), and life history characteristics (i.e. slow-growing, relatively late-maturing, and long-lived species (NMFS 2009i; Simpfendorfer et al. 2011). These factors continue to threaten the smalltooth sawfish population.

#### 5.2.41.5 *Critical Habitat*

See Section 5.1.4.23 for a description of U.S. DPS smalltooth sawfish critical habitat.

#### 5.2.41.6 *Recovery Goals*

The 2009 Smalltooth Sawfish Recovery Plan contains complete downlisting/delisting criteria for each of the three following recovery goals (NMFS 2009i).

1. Minimize human interactions and associated injury and mortality.
2. Protect and/or restore smalltooth sawfish habitats.
3. Ensure smalltooth sawfish abundance increases substantially and the species reoccupies areas from which it had been previously extirpated.

# 6 ENVIRONMENTAL BASELINE

The “environmental baseline” refers to the condition of the listed species or its designated critical habitat in the action area, without the consequences to the listed species or designated critical habitat caused by the proposed action. 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. The consequences to listed species or designated critical habitat from ongoing agency activities or existing agency facilities that are not within the agency’s discretion to modify are part of the environmental baseline (50 C.F.R. §402.02). The following information summarizes the principal natural and human-caused phenomena in the MMHSRP action area believed to affect the survival and recovery of ESA-listed species (from Section 5.2 above) in the action area.

## 6.1 Climate Change

There is a large and growing body of literature on past, present, and anticipated future impacts of global climate change, exacerbated and accelerated by human activities. Effects of climate change include sea level rise, increased frequency and magnitude of severe weather events, changes in air and water temperatures, and changes in precipitation patterns, all of which are likely to impact ESA resources. NOAA’s climate information portal provides basic background information on these and other measured or anticipated climate change effects (see https://www.climate.gov).

This section provides some examples of impacts to ESA-listed species and their habitats that have occurred or may occur in the action area as the result of climate change. We address climate change as it has affected ESA-listed species and continues to affect species, and we look to the foreseeable future to consider effects that we anticipate will occur as a result of ongoing activities. While it is difficult to accurately predict the consequences of climate change to a particular species or habitat, a range of impacts are expected that are likely to change the status of the species and the condition of their habitats both within and outside of the action area.

In order to evaluate the implications of different climate outcomes and associated impacts throughout the 21st century, many factors have to be considered. The amount of future greenhouse gas emissions is a key variable. Developments in technology, changes in energy generation and land use, global and regional economic circumstances, and population growth must also be considered. A set of four scenarios was developed by the Intergovernmental Panel on Climate Change (IPCC) to ensure that starting conditions, historical data, and projections are employed consistently across the various branches of climate science. The scenarios are referred to as representative concentration pathways (RCPs), which capture a range of potential greenhouse gas emissions pathways and associated atmospheric concentration levels from 2007 through 2100 using the Coupled Model Intercomparison Project (CMIP) five (IPCC 2014a). The RCP scenarios drove climate model projections for temperature, precipitation, sea level, and other variables: RCP2.6 is a stringent mitigation scenario; RCP2.5 and RCP6.0 are intermediate scenarios; and RCP8.5 is a scenario with no mitigation or reduction in the use of fossil fuels. IPCC future global climate predictions (2014 and 2018) and national and regional climate predictions included in the Fourth National Climate Assessment for U.S. states and territories (USGCRP 2018) use the RCP scenarios. CMIP6 was used in the sixth IPCC assessment report (IPCC 2022), which has a starting point of 2014 and uses five scenarios, called shared socioeconomic pathways (SSPs). SSPs look at five different ways in which the world might evolve in the absence of climate policy under different emission scenarios and how different levels of climate change mitigation could be achieved when the mitigation targets are combined with the SSPs.

The increase of global mean surface temperature change by 2100 is projected to be 0.3 to 1.7°C under RCP2.6, 1.1 to 2.6°C under RCP 4.5, 1.4 to 3.1°C under RCP6.0, and 2.6 to 4.8°C under RCP8.5 with the Arctic region warming more rapidly than the global mean under all scenarios (IPCC 2014a). The Paris Agreement aims to limit the future rise in global average temperature to 2°C, but the observed acceleration in carbon emissions over the last 15 to 20 years, even with a lower trend in 2016, has been consistent with higher future scenarios such as RCP8.5 (Hayhoe et al. 2018). The results of runs of CMIP6 indicate that projections of warming are around 0.4oC greater than under CMIP5. The CMIP6 climate models also predict greater end-of-the-century ocean warming because of greater climate sensitivity than in CMIP5 (IPCC 2022).

The globally-averaged combined land and ocean surface temperature data, as calculated by a linear trend, show a warming of approximately 1.0°C from 1901 through 2016 (Hayhoe et al. 2018). The IPCC Special Report on the Impacts of Global Warming (IPCC 2021) projects that human-induced global average warming is likely to reach 1.5 °C between 2030 and 2052 at the current rate of anthropogenic GHG emissions. Warming greater than the global average has already been experienced in many regions and seasons, with most land regions experiencing greater warming than over the ocean (Allen et al. 2018). Annual average temperatures have increased by 1.8°C across the contiguous U.S. since the beginning of the 20th century with Alaska warming faster than any other state and twice as fast as the global average since the mid-20th century (Jay et al. 2018). Global warming has led to more frequent heatwaves in most land regions and an increase in the frequency and duration of marine heatwaves (Allen et al. 2018). Average global warming up to 1.5°C as compared to pre-industrial levels is expected to lead to regional changes in extreme temperatures, and increases in the frequency and intensity of precipitation and drought (Allen et al. 2018).

Additional consequences of climate change include increased ocean stratification, decreased sea-ice extent, altered patterns of ocean circulation, and decreased ocean oxygen levels (Doney et al. 2012). Since the early 1980s, the annual minimum sea ice extent (observed in September each year) in the Arctic Ocean has decreased at a rate of 11 to 16 percent per decade (Jay et al. 2018). Further, ocean acidity has increased by 26 percent since the beginning of the industrial era (IPCC 2014b) and this rise has been linked to climate change. Climate change is also expected to increase the frequency of extreme weather and climate events including, but not limited to, cyclones, tropical storms, heat waves, and droughts (IPCC 2014b).

Climate change has the potential to impact species abundance, geographic distribution, migration patterns, and susceptibility to disease and contaminants, as well as the timing of seasonal activities and community composition and structure (Evans and Bjørge 2013; IPCC 2014b; Kintisch 2006; Learmonth et al. 2006a; MacLeod et al. 2005; McMahon and Hays 2006; Robinson et al. 2005). Though predicting the precise consequences of climate change on highly mobile marine species is difficult (Becker et al. 2018; Silber et al. 2017; Simmonds and Isaac 2007a), recent research has indicated a range of consequences already occurring. For example, in sea turtles, sex is determined by the ambient sand temperature (during the middle third of incubation) with female offspring produced at higher temperatures and males at lower temperatures within a thermal tolerance range of 25 to 35°C (Ackerman 1997). Increases in global temperature could skew future sex ratios toward higher numbers of females (Patrício et al. 2021). Over time, this can reduce genetic diversity, or even population viability, if males become a small proportion of populations (Hulin et al. 2009). Sea surface temperatures on loggerhead foraging grounds has also been linked to the timing of nesting, with higher temperatures leading to earlier nesting (Mazaris et al. 2009; Schofield et al. 2009). Green sea turtles emerging from nests at cooler temperatures likely absorb more yolk that is converted to body tissue than do hatchlings from warmer nests (Ischer et al. 2009). However, warmer temperatures may also decrease the energy needs of a developing embryo (Reid et al. 2009). Impacts on sea turtle nesting from loss of habitat will likely be exacerbated by sea level rise. The loss of leatherback nesting habitat because of climate change could be accelerated due to a combination of other environmental and oceanographic changes such as an increase in the frequency of storms and/or changes in prevailing currents, both of which could lead to increased beach loss via erosion (Antonelis et al. 2006; Baker et al. 2006).

Climate change represents a threat to both the East and West Pacific leatherback populations. The impacts of climate change include: increases in temperatures (air, sand, and sea surface); sea level rise; increased coastal erosion; more frequent and intense storm events; and changes in oceanographic regimes and currents A warming climate and rising sea levels can impact leatherback turtles through changes in beach morphology and sand temperature (Benson et al. 2015). Leatherback sea turtles are probably already beginning to be affected by impacts associated with anthropogenic climate change given low hatch success due to lethal beach temperatures and beach erosion (Bellagio Sea Turtle Conservation Initiative 2008; NMFS 2013h; NMFS and USFWS 2020a; Tapilatu and Tiwari 2007). West Pacific leatherback turtles have evolved to sustain changes in beach habitats given their proclivity to select highly dynamic and typically narrow beach habitats, and therefore at the population level can likely sustain some level of nest loss (NMFS and USFWS 2020a). However, the increasing frequency of storms and high water events, perhaps as a result of climate change, can result in increased and perhaps unnatural loss of nests. In recent years, management and conservation practices have included relocating erosion-prone nests in Indonesia, Papua New Guinea, and the Solomon Islands to bolster hatchling production (NMFS and USFWS 2020a).

Similar to other sea turtles, leatherback hatchling sex is determined by nest incubation temperature, with higher temperatures producing a greater proportion of females (Mrosovsky 1994). Sand temperatures fluctuate between 28.6 and 34.9 °C at Jamursba-Medi and between 27.0 and 32.7 °C at Wermon (Tapilatu and Tiwari 2007). At Wermon, the sand is black, yet beach temperatures are lower perhaps because peak nesting coincides with the monsoon season (Tapilatu and Tiwari 2007). High average sand temperatures are indicative of a female-biased West Pacific leatherback population at Jamursba-Medi nesting beaches (Tapilatu et al. 2013; Tapilatu and Tiwari 2007). A significant female bias was also reported by Binckley et al. (1998) for East Pacific leatherback hatchlings at the Playa Grande nesting beach in Costa Rica (Plotkin

1995). In addition to impacts on Pacific leatherback nesting success and sex ratios, the impacts of a warming ocean may also affect the environmental variables of their pelagic migratory and foraging habitat, which may further exacerbate population declines (NMFS and USFWS 2020a).

Information on current effects of global climate change on Atlantic sturgeon is not available. While it is speculated that future climate change may affect sturgeon, it is difficult to predict the magnitude and scope of those potential impacts. Atlantic sturgeon could be affected by changes in river ecology resulting from increases in precipitation and changes in water temperature which may affect recruitment and distribution in these rivers. The effects of increased water temperature and decreased water availability are likely to have a more immediate effect on Atlantic sturgeon populations that migrate and spawn in river systems with existing water temperatures that are at or near the maximum for the species, including the South Atlantic and Carolina DPSs. Atlantic sturgeon prefer water temperatures up to approximately 27°C (82.4°F) (Niklitschek 2001); these temperatures are experienced naturally in some areas of rivers during the summer months. If river temperatures rise and temperatures above 28°C are experienced in larger areas, sturgeon may be excluded from some habitats. The increased rainfall predicted by some models in some areas may increase runoff and scour spawning areas, while flooding events could cause temporary decreases in water quality. Rising temperatures predicted for all of the U.S. could exacerbate existing water quality problems with changes in dissolved oxygen and temperature.

Changes in the marine ecosystem caused by global climate change (e.g., ocean acidification, salinity, oceanic currents, dissolved oxygen levels, nutrient distribution) could influence the distribution and abundance of lower trophic levels (e.g., phytoplankton, zooplankton, submerged aquatic vegetation, crustaceans, mollusks, forage fish), ultimately affecting primary foraging areas of ESA-listed species including marine mammals, sea turtles, and fish. According to Holsman et al. (2019), in the North Pacific, some fish and crab species in the Bering Sea may move into northern Bering Sea waters where fishing is more limited. As a result, small boat fisheries and shore-based subsistence and recreational fishers in this region are likely vulnerable to climate change. Modeling conducted by Woodworth-Jefcoats et al. (2017) showed that increasing temperatures under RCP8.5 may alter the spatial distribution of tuna and billfish species richness across the North Pacific. The models also projected that zooplankton densities would decline across this region. Such declines would be amplified relative to declines in phytoplankton densities. Marine species ranges are expected to shift as they align their distributions to match their physiological tolerances under changing environmental conditions (Doney et al. 2012). Hazen et al. (2012) examined top predator distribution and diversity in the Pacific Ocean in light of rising sea surface temperatures using a database of electronic tags and output from a global climate model. They predicted up to a 35 percent change in core habitat area for some key marine predators in the Pacific Ocean, with some species predicted to experience gains in available core habitat and some predicted to experience losses. Notably, leatherback turtles were predicted to gain core habitat area, whereas loggerhead turtles and blue whales were predicted to experience losses in available core habitat. McMahon and Hays (2006) predicted increased ocean temperatures will expand the distribution of leatherback turtles into more northern latitudes. The authors noted this is already occurring in the Atlantic Ocean. MacLeod (2009) estimated, based upon expected shifts in water temperature, 88 percent of cetaceans will be affected by climate change, with 47 percent predicted to experience unfavorable conditions (e.g., range contraction).

Similarly, climate-related changes in important prey species populations are likely to affect predator populations. For example, blue whales, as predators that specialize in eating krill, are likely to change their distribution in response to changes in the distribution of krill (Clapham et al. 1999; Payne et al. 1986; Payne et al. 1990). Pecl and Jackson (2008) predicted climate change will likely result in squid that hatch out smaller and earlier, undergo faster growth over shorter life-spans, and mature younger at a smaller size. This could have negative consequences for species such as sperm whales, whose diets can be dominated by cephalopods. For ESA-listed species that undergo long migrations, if either prey availability or habitat suitability is disrupted by changing ocean temperatures regimes, the timing of migration can change or negatively impact population sustainability (Simmonds and Eliott 2009).

Southern Resident killer whales might shift their distribution in response to climate-related changes in their salmon prey (NMFS 2019f). Climatic conditions affect salmonid abundance, productivity, spatial structure, and diversity through direct and indirect impacts at all life stages (e.g., Crozier et al. 2008; Independent Science Advisory Board 2007; Lindley et al. 2007; Moyle et al. 2013; Wainwright and Weitkamp 2013). Studies examining the effects of long-term climate change to salmon populations have identified a number of common mechanisms by which climate variation is likely to influence salmon sustainability. These include direct effects of temperature such as mortality from heat stress, changes in growth and development rates, and disease resistance (NMFS 2019f). Changes in the flow regime (especially flooding and low flow events) also affect survival and behavior. Expected behavioral responses include shifts in seasonal timing of important life history events, such as the adult migration, spawn timing, fry emergence timing, and the juvenile migration. Indirect effects on salmon mortality, growth rates and movement behavior are also expected to follow from changes in the freshwater habitat structure and the invertebrate and vertebrate community, which governs food supply and predation risk (Crozier et al. 2008; Independent Science Advisory Board 2007; Petersen and Kitchell 2001).

Effects of ocean acidification on ESA-listed fish most likely occur through ecological mechanisms mediated by changes to the food web (Busch et al. 2013; Crozier et al. 2019). Taxa directly affected by declining marine pH include invertebrates such as pteropods, crabs, and krill. Physiological effects of acidification may also impair olfaction, which could hinder salmonid homing ability, along with other developmental effects (Crozier et al. 2019).

Hazen et al. (2012) predicted up to 35 percent change in core habitat for some key Pacific species based on climate change scenarios predicated on the rise in average sea surface temperature by 2100. Climate-mediated changes in the distribution and abundance of keystone prey species like krill and in cephalopod populations worldwide will likely affect marine mammal populations as they re-distribute throughout the world's oceans in search of prey. Blue whales, as predators that specialize in eating krill, seem likely to change their distribution in response to changes in the distribution of krill (Payne et al. 1990); if they did not change their distribution or could not find the biomass of krill necessary to sustain their population numbers, their populations seem likely to experience declines similar to those observed in other krill predators, which would cause dramatic declines in their population sizes or would increase the year-to-year variation in population size; either of these outcomes would dramatically increase the extinction probabilities of these whales. Sperm whales, whose diets can be dominated by cephalopods, would have to re-distribute following changes in the distribution and abundance of their prey. This statement assumes that projected changes in global climate would only affect the distribution of cephalopod populations, but would not reduce the number or density of cephalopod populations. If, however, cephalopod populations collapse or decline dramatically, sperm whale populations are likely to collapse or decline dramatically as well.

### 6.2 Oceanic Temperature Regimes

Oceanographic conditions in the Atlantic and Pacific Oceans can be altered due to periodic shifts in atmospheric patterns caused by the Southern oscillation in the Pacific Ocean, which leads to El Niño and La Niña events, the Pacific decadal oscillation, and the North Atlantic oscillation. These climatic events can alter habitat conditions and prey distribution for ESA-listed species in the action areas (Beamish 1993; Hare and Mantua 2001; Mantua et al. 1997); (Benson and Trites 2002; Mundy 2005; Mundy and Cooney 2005; Stabeno et al. 2004). For example, decade-scale climatic regime shifts have been related to changes in zooplankton in the North Atlantic Ocean (Fromentin and Planque 1996), and decadal trends in the North Atlantic oscillation (Hurrell 1995) can affect the position of the Gulf Stream (Taylor et al. 1998) and other circulation patterns in the North Atlantic Ocean that act as migratory pathways for various marine species, especially fish.

The North Atlantic oscillation is a large-scale, dynamic phenomenon that exemplifies the relationship between the atmosphere and the ocean. The North Atlantic oscillation has global significance as it affects sea surface temperatures, wind conditions, and ocean circulation of the North Atlantic Ocean (Stenseth et al. 2002). The North Atlantic oscillation is an alteration in the intensity of the atmospheric pressure difference between the semi-permanent high-pressure center over the Azores Islands and the sub-polar low-pressure center over Iceland (Stenseth et al. 2002). Sea-level atmospheric pressure in the two regions tends to vary in a "see-saw" pattern – when the pressure increases in Iceland it decreases in the Azores and vice-versa (i.e., the two systems tend to intensify or weaken in synchrony). The North Atlantic oscillation is the dominant mode of decadal-scale variability in weather and climate in the North Atlantic Ocean region (Hurrell 1995).

Because ocean circulation is wind and density driven, it is not surprising to find that the North Atlantic oscillation appears to have a direct effect on the position and strength of important

North Atlantic Ocean currents. The North Atlantic oscillation influences the latitude of the Gulf Stream Current and accounts for a great deal of the interannual variability in the location of the current; in years after a positive North Atlantic oscillation index, the north wall of the Gulf Stream (south of New England) is located farther north (Taylor et al. 1998). Not only is the location of the Gulf Stream Current and its end-member, the North Atlantic Current, affected by the North Atlantic oscillation, but the strength of these currents is also affected. During negative North Atlantic oscillation years, the Gulf Stream System (i.e., Loop, Gulf Stream, and North Atlantic Currents) not only shifted southward but weakened, as witnessed during the predominantly negative North Atlantic oscillation phase of the 1960s; during the subsequent 25-year period of predominantly positive North Atlantic oscillation, the currents intensified to a record peak in transport rate, reflecting an increase of 25 to 33 percent (Curry and McCartney 2001). The location and strength of the Gulf Stream System are important, as this major current system is an essential part of the North Atlantic climate system, moderating temperatures and weather from the U.S. to Great Britain and even the Mediterranean Sea region. Pershing et al. (Pershing et al. 2001) also found that the upper slope-water system off the east coast of the U.S. was affected by the North Atlantic oscillation and was driven by variability in temperature and transport of the Labrador Current. During low North Atlantic oscillation periods, especially that seen in the winter of 1996, the Labrador Current intensified, which led to the advance of cold slope water along the continental shelf as far south as the mid-Atlantic Bight in 1998 (Greene and Pershing 2003; Pershing et al. 2001). Variability in the Labrador Current intensity is linked to the effects of winter temperatures in Greenland and its surroundings (e.g., Davis Strait, Denmark Strait), on sea-ice formation, and the relative balance between the formation of deep and intermediate water masses and surface currents.

A strong association has been established between the variability of the North Atlantic oscillation and changes affecting various trophic groups in North Atlantic marine ecosystems on both the eastern and western sides of the basin (Drinkwater et al. 2003; Fromentin and Planque 1996). For example, the temporal and spatial patterns of *Calanus* copepods (zooplankton) were the first to be linked to the phases of the North Atlantic oscillation (Fromentin and Planque 1996; Stenseth et al. 2002). When the North Atlantic oscillation index was positive, the abundance of *Calanus* copepods in the Gulf of Maine increased, with the inverse true in years when the North Atlantic oscillation index was negative (Conversi et al. 2001; Greene et al. 2003b). This pattern is opposite off the European coast (Fromentin and Planque 1996). Such a shift in copepod patterns has a tremendous significance to upper-trophic-level species, including the North Atlantic right whale, which feeds principally on *Calanus finmarchicus*. North Atlantic right whale calving rates are linked to the abundance of *Calanus finmarchicus*; when the abundance is high, the calving rate remains stable but fell in the late 1990s when the abundance of its favored copepod also declined (Greene et al. 2003a). When the North Atlantic oscillation index is low with subsequently warmer water temperatures off Labrador and the Scotian Shelf, recruitment of cod is higher; direct links to the North Atlantic oscillation phase have also been found for recruitment in the North Atlantic of herring, two tuna species, Atlantic salmon, and swordfish (*Xiphias gladius*) (Drinkwater et al. 2003).

The Pacific decadal oscillation is the leading mode of variability in the North Pacific and operates over longer periods than either El Niño or La Niña/Southern Oscillation events and is capable of altering sea surface temperature, surface winds, and sea level pressure (Mantua and Hare 2002; Stabeno et al. 2004). During positive Pacific decadal oscillations, the northeastern Pacific experiences above average sea surface temperatures while the central and western Pacific Ocean undergoes below-normal sea surface temperatures (Royer 2005). Warm Pacific decadal oscillation regimes, as occurs in El Niño events, tends to decrease productivity along the U.S. west coast, as upwelling typically diminishes (Childers et al. 2005; Hare et al. 1999). Sampling of oceanographic conditions just south of Seward, Alaska has revealed anomalously cold conditions in the Gulf of Alaska from 2006 through 2009, suggesting a shift to a colder Pacific decadal oscillation phase. Cartwright et al. (2019) observed a 73 percent decrease in sightings of mother-calf pairs of humpback whales belonging to the Hawaii DPS between 2013 and 2018 during a positive shift in the Pacific decadal oscillation. This coincided with a build up of warm water in the central, north, and eastern Pacific, which may have suppressed coastal upwelling and productivity, and therefore the availability of humpback whale prey, in these regions. However, more research needs to be done to determine what effects these phase shifts have on the dynamics of prey populations important to ESA-listed cetaceans throughout the Pacific action area. A shift to a colder or warmer decadal oscillation phase would be expected to impact prey populations, although the magnitude of this effect is uncertain.

The Indian Ocean Dipole, which is also known as the Indian Niño, is an irregular oscillation of sea surface temperature in which the western Indian Ocean becomes alternately warmer and then colder than the eastern part of the ocean (Saji et al. 1999). The Indian Ocean dipole, only identified recently in 1999, is one aspect of the general cycle of global climate, interacting with similar phenomena like the El Niño Southern Oscillation in the Pacific Ocean. As in the Pacific decadal oscillation and North Atlantic oscillation, the Indian Ocean dipole fluctuates between phases of positive, negative, and neutral conditions. During a positive Indian Ocean dipole, the western Indian Ocean experiences higher than normal sea surface temperature and greater precipitation while cooler sea surface temperature occur in the eastern Indian Ocean, often leading to droughts on land in the region (Saji et al. 1999). The negative phase of the Indian Ocean dipole brings about the opposite conditions, with warmer sea surface temperatures and greater precipitation in the eastern Indian Ocean and cooler and drier conditions in the western Indian Ocean. The Indian Ocean dipole also affects the strength of monsoons over the Indian subcontinent. An average of four positive and negative Indian Ocean dipole events occurs during each 30-year period, with each Indian Ocean dipole event lasting about six months. However, since 1980 there have been 12 positive Indian Ocean dipoles with no negative Indian Ocean dipole events from 1992 until late in 2010, when a strong negative event began (Nakamura et al. 2009). This strong negative Indian Ocean dipole event coupled with a strong La Niña event in the western Pacific Ocean to cause catastrophic flooding in parts of Australia. In 1998, an El

Niño even interacted with a positive Indian Ocean dipole event with devastating effect on Western Indian Ocean corals: 75 to 99 percent of live corals were lost in the western Indian Ocean during this event (Graham et al. 2006).

In addition to period variation in weather and climate patterns that affect oceanographic conditions in the action area, longer-term trends in climate change and/or variability also have the potential to alter habitat conditions suitable for ESA-listed species in the action area on a much longer time scale. For example, from 1906 through 2006, global surface temperatures have risen 0.74 degrees Celsius and this trend is continuing at an accelerating pace. Twelve of the warmest years on record since 1850 have occurred since 1995 (Poloczanska et al. 2009). Possible effects of this trend in climate change and/or variability for ESA-listed marine species in the action area include the alteration of community composition and structure, changes to migration patterns or community structure, changes to species abundance, increased susceptibility to disease and contaminants, altered timing of breeding and nesting, and increased stress levels (Kintisch 2006; Learmonth et al. 2006b; MacLeod et al. 2005; McMahon and Hays 2006; Robinson et al. 2005). Climate change can influence reproductive success by altering prey availability, as evidenced by the low success of Northern elephant seals (*Mirounga angustirostris*) during El Niño periods (McMahon and Burton 2005) as well as data suggesting that sperm whale females have lower rates of conception following periods of unusually warm sear surface temperature (Whitehead et al. 1997). However, gaps in information and the complexity of climatic interactions complicate the ability to predict the effects that climate change and/or variability may have to these species from year to year in the action area (Kintisch 2006; Simmonds and Isaac 2007b).

### 6.3 Aquatic Nuisance Species

Aquatic nuisance species are aquatic and terrestrial organisms, introduced into new habitats throughout the U.S. 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 non-indigenous species. Invasive species are considered one of the four major threats to the world's oceans (Pughiuc 2010; Raaymakers 2003; Raaymakers and Hilliard 2002; Terdalkar et al. 2005). Introduction of these species is cited as a major threat to biodiversity, second only to habitat loss (Wilcove et al. 1998). A variety of vectors are thought to have introduced non-native species including, but not limited to aquarium and pet trades, recreation, and ballast water discharges from ocean-going vessels (Strayer 2010). Common impacts of invasive species are alteration of habitat and nutrient availability, as well as altering species composition and diversity within an ecosystem (Strayer 2010). Shifts in the base of food webs, a common result of the introduction of invasive species, can fundamentally alter predator-prey dynamics up and across food chains (Moncheva and Kamburska 2002), potentially affecting prey availability and habitat suitability for ESA-listed species. Globally, aquatic nuisance species have been estimated to directly affect 11.8 percent of marine ESA-listed species (Gurevitch and Padilla 2004).

## 6.4 Military Activities

Within the action area, multiple stressors associated with military activities pose a threat to the ESA-listed species discussed in Section 5.2, with the exception of those that occur outside U.S. waters (i.e., Chinese River dolphin, Gulf of California harbor porpoise, Arabian Sea and Cape Verde Islands/Northwest Africa humpback whale DPSs, Indus River dolphin, Maui's and South Island Hector's dolphins, southern right whale, and Taiwanese humpback dolphin. Military activities are conducted by the U.S. Air Force, U.S. Coast Guard, and U.S. Navy and are discussed further below.

### 6.4.1 U.S. Air Force

The U.S. Air Force conducts training and testing activities on range complexes on land and in U.S. waters. Aircraft operations and air-to-surface activities may occur in the action area (e.g., off Florida and Hawaii). U.S. Air Force activities generally involve the firing or dropping of munitions (e.g., bombs, missiles, rockets, and gunnery rounds) from aircraft towards targets located on the surface, though U.S. Air Force training exercises may also involve boats. These activities have the potential to impact ESA-listed cetaceans by physical disturbance, vessel strikes, debris, ingestion, and effects from noise and pressure produced by detonations U.S. Air Force training and testing activities constitute a federal action and their effects on ESA-listed species have previously undergone separate section 7 consultations.

### 6.4.2 U.S. Coast Guard

The U.S. Coast Guard's Aids to Navigation (ATON) program includes the establishment, operation, maintenance, and discontinuance of approximately 31,000 federal navigation aids, such as buoys and beacons, in navigable waters of the United States to promote the safety of maritime traffic. The Coast Guard has operated and maintained ATON since the late 1930s, and most existing ATON have been in place for decades.

ESA section 7 and essential fish habitat consultations have been completed previously on some ATON program actions. For example, NMFS completed a formal programmatic consultation in August 2013 for ATON maintenance activities in Coast Guard sectors Miami, Key West, and San Juan (NMFS 2013c). An additional example includes the Coast Guard's 2016 biological evaluation addressing essential fish habitat (BE; Tech 2014). All previous consultations concluded that the specific ATON program actions considered were not likely to jeopardize the survival or recovery of ESA-listed species or destroy or adversely modify critical habitat designated for those species. Through previous consultations, NMFS has also provided guidance to the Coast Guard on how to minimize the effects of some ATON program activities on essential fish habitat (e.g., NMFS 2013e). This consultation supersedes all previous consultations on ATON program activities.

Since 2003, the U.S. Coast Guard has been developing a ballast water management program in cooperation with other federal agencies. The program is described by the U.S. Coast Guard in the October 21, 2011 letter requesting initiation of consultation, the final rule, and the final

Programmatic Environmental Impact Statement and framed by the Nonindigenous Aquatic Nuisance Prevention and Control Act of 1990 and the National Invasive Species Act of 1996. The goal of the U.S. Coast Guard's ballast water management program is to prevent the unintentional introduction and dispersal of non-indigenous species into waters of the U.S. through ballast water treatment and other requirements.

The U.S. Coast Guard has authority over marine events (e.g. marine parades, boat races, etc.) and marine aspects of triggering events if these actions may result in an extra or unusual hazard that could jeopardize human safety on navigable waters. Activities for which a U.S. Coast Guard marine event permit may be required include powerboat races, poker runs, boat parades, regattas, fishing tournaments, fireworks events, and miscellaneous events (e.g., air shows, swimming events).

The U.S. Coast Guard's authority for the use of icebreakers in the Arctic and Antarctic comes from several statutes that govern the execution of the U.S. Coast Guard's mission: 14 U.S.C. 81 (Coast Guard establishment, maintenance, and operation of aids to navigation), 14 U.S.C. 88 (the protection of life and property), 14 U.S.C. 89 (Coast Guard law enforcement), 14 U.S.C. 91 (control of anchorage and movement of vessels), 14 U.S.C. 94 (conduct oceanographic research), and 14 U.S.C. 141 (cooperation with agencies, states, territories, and others). Executive Order 7521, Use of Vessels for Icebreaking in Channels and Harbors, directs the U.S. Coast Guard to assist in keeping channels and harbors open to navigation using icebreaking.

### 6.4.3 U.S. Navy

The U.S. Navy conducts training, testing, and other military readiness activities on range complexes throughout coastal and offshore areas in the U.S. and on the high seas. The U.S. Navy's activities are conducted off the coast of the Atlantic and Pacific Oceans (e.g., Gulf of Alaska, Gulf of Mexico, off the coast of Southern California and Hawaii, Mariana Islands, Puget Sound, off the coasts of Washington, Oregon, and California) and elsewhere throughout the world. The U.S. Navy's Atlantic Fleet Training and Testing, Hawaii-Southern California Training and Testing, Mariana Islands Training and Testing, Northwest Training and Testing range complexes, Point Mugu Sea Range Training and Testing, and Gulf of Alaska temporary maritime activities overlap with 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. The majority of the training and testing activities the U.S. Navy conducts in the action area are similar, if not identical to activities that have been occurring in the same locations for decades. Surveillance Towed Array Sensor System Low Frequency Active (SURTASS LFA) sonar vessels may participate in joint major training events.

The U.S. Navy's activities produce sound and visual disturbance to marine mammals throughout the action area. Anticipated impacts from harassment due to the U.S. Navy's activities include changes from foraging, resting, milling, and other behavioral states that require low energy expenditures to traveling, avoidance, and behavioral states that require higher energy expenditures. Based on the currently available scientific information, behavioral responses that result from stressors associated with these training and testing activities are expected to be temporary and will not affect the reproduction, survival, or recovery of these species. Sound produced during U.S. Navy activities is also expected to result in instances of temporary threshold shift (TTS) and permanent threshold shift (PTS) to marine mammals. The U.S. Navy's activities constitute a federal action and take of ESA-listed marine mammals considered for these activities have previously undergone separate ESA section 7 consultation. Through these consultations with NMFS, the U.S. Navy has implemented monitoring and conservation measures to reduce the potential effects of underwater sound from activities on ESA-listed resources in the Atlantic and Pacific Oceans. Conservation measures include employing visual observers and implementing mitigation zones during activities using active sonar and explosives.

In addition to these testing and training activities, the U.S. Navy operates SURTASS LFA within the action area, which utilizes low frequency sounds to detect and monitor submarines. SURTASS LFA activities have a coherent low-frequency signal with a duty cycle of less than 20 percent, operating for a maximum of only 255 hours per year for each of the four SURTASS LFA sonar system. This equates to a maximum of 1,020 hours for all systems annually or a total of 42.5 days per year for all systems. However, the U.S. Navy published a 2018 Draft Supplement Environmental Impact Statement for proposed SURTASS LFA sonar testing and training activities from August 2019 through August 2026 (Navy 2018), which reduced the number of total transmission hours that were authorized under the 2017 National Defense Exemption. The U.S. Navy (2018) proposed 496 total transmission hours per year (20.6 days) across all SURTASS LFA sonar vessels, while years five and beyond will include an increase in LFA sonar transmit hours to 592 hours across all vessels per year (24.6 days). This compares to an approximate 21.9 million days per year for the world's shipping industry.

The 2017 National Defense Exemption authorized the U.S. Navy to conduct the operation of SURTASS LFA sonar from August 2017 through 2022 in the non-polar region of the world's oceans (including within the action area). However, U.S. Navy (2018) proposed to only conduct SURTASS LFA sonar testing and training activities in the central and western North Pacific and Eastern Indian Oceans from August 2019 through 2026. The ESA section 7 consultation for the U.S. Navy's proposed 2019 through 2026 SURTASS LFA testing and training activities concluded on July 30, 2019 (NMFS 2019d).

## 6.5 Environmental Baseline Specific to Cetaceans

The environmental baseline for cetaceans includes the impacts of oceanic temperature regimes, whaling and subsistence hunting, fisheries, commercial shipping, ocean sound, military activities, pollution, whale watching, and scientific research.

### 6.5.1 Cetacean Unusual Mortality Events

As stated in Section 3.2.1.3, a 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." In the past, an UME was declared for fin and humpback whales in the Pacific Ocean and Gulf of Alaska, from April 23, 2015 to April 16, 2016, where a total of 46 fin and humpback whales were found dead (NMFS 2019a). A primary cause for the UME was not identified but ecological factors, including El Niño (see Section 6.2), were likely contributors (NMFS 2019a).

A UME was declared for North Atlantic right whales in 2017 after numerous mortalities were documented in the U.S. and Canada. From 2017 through 2021, 34 mortalities (21 in Canada, 13 in the U.S.) have been confirmed. The majority of these mortalities resulted from entanglements and vessel strikes. In addition, 20 free-swimming North Atlantic right whales have been documented with serious injuries, also resulting from entanglements or vessel strikes. These 20 animals have been added to the UME, since their injuries are likely serious enough to remove them from the population, bringing the preliminary total number of UME animals to 54 (NMFS 2022b).

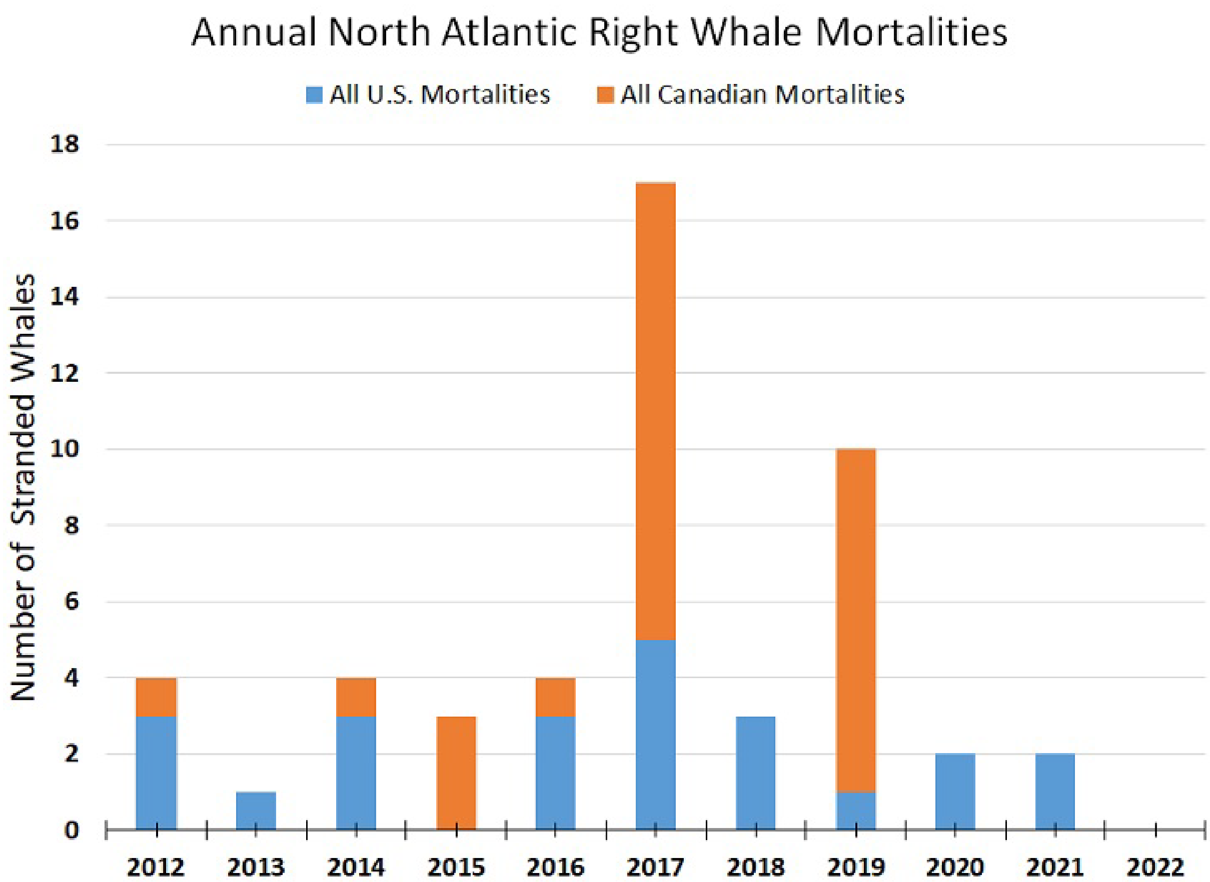


**Figure 22. Annual North Atlantic right whale mortalities in the U.S. and Canada from 2012 through 2021 (NMFS 2022b).**

### 6.5.2 Whaling and Subsistence Harvesting

Large whale population numbers in the action area have historically been impacted by aboriginal hunting and early commercial exploitation, and 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 through 1985, at least 2.4 million mysticetes (excluding minke whales (*Balaenoptera acutorostrata*) and sperm whales) were killed (Gambell 1999). The large number of mysticetes harvested during the 1930s and 1940s has been shown to correspond to increased cortisol levels in earplugs collected from mysticetes, suggesting that anthropogenic activities, such as those associated with whaling, may contribute to increased stress levels in whales (Trumble 2018). Prior to current prohibitions on whaling most large whale species were significantly depleted to the extent it was necessary to list them as endangered under the Endangered Species Preservation Act of 1966. In 1982, the International Whaling Commission issued a moratorium on commercial whaling beginning in 1986. There is currently no legal commercial whaling by International Whaling Commission Member Nations party to the moratorium; however, whales are still killed commercially by countries that field objections to the moratorium (i.e., Iceland and Norway). Presently three types of whaling take place: (1) aboriginal subsistence whaling to support the needs of indigenous people; (2) special permit whaling; and (3) commercial whaling conducted either under objection or reservation to the moratorium. The reported catch and catch limits of large whale species from aboriginal subsistence whaling, special permit whaling, and commercial whaling can be found on the International Whaling Commission's website at: https://iwc.int/whaling. The Japanese whaling fleet left the International Whaling Commission in December 2018 and resumed commercial whaling in July 2019 (Holm 2019).

Norway and Iceland take whales commercially at present, either under objection to the moratorium decision or under reservation to it. These countries establish their own catch limits but must provide information on those catches and associated scientific data to the International Whaling Commission. The Russian Federation has also registered an objection to the moratorium decision but does not exercise it. The moratorium is binding on all other members of the International Whaling Commission. Norway takes minke whales in the North Atlantic Ocean within its EEZ, and Iceland takes minke whales and fin whales in the North Atlantic Ocean, within its EEZ (IWC 2012a).

Under current International Whaling Commission regulations, aboriginal subsistence whaling is permitted for Denmark (Greenland, fin, and minke whales, *Balaenoptera* spp.), the Russian Federation (Siberia, gray, and bowhead whales), St. Vincent and the Grenadines (Bequia, humpback whales) and the U.S. (Alaska, bowhead, and gray whales). It is the responsibility of national governments to provide the International Whaling Commission with evidence of the cultural and subsistence needs of their people. The Scientific Committee provides scientific advice on safe catch limits for such stocks (IWC 2012a). Based on the information on need and scientific advice, the International Whaling Commission then sets catch limits, recently in five-year blocks.

Scientific permit whaling has been conducted by Japan and Iceland. In Iceland, the stated overall objective of the research program was to increase understanding of the biology and feeding ecology of important cetacean species in Icelandic waters for improved management of living and marine resources based on an ecosystem approach. While Iceland states that its program was intended to strengthen the basis for conservation and sustainable use of cetaceans, it noted that it was equally intended to form a contribution to multi-species management of living resources in Icelandic waters. Prior exploitation is likely to have altered population structure and social cohesion of all whale species within the action area, such that effects on abundance and recruitment continued for years after harvesting has ceased. ESA-listed whale mortalities since 1985 resulting from these activities can be seen below in Table 12 (IWC 2022a; IWC 2022b; IWC 2022c). Beluga subsistence number is from (NMFS 2016g) and does not include whales struck and lost. No Cook Inlet DPS beluga harvests have been allowed since 2013 (Muto et al. 2021).

**Table 12. Endangered Species Act-listed cetacean mortalities as the result of commercial, scientific, and subsistence whaling since 1985.**

| Species | Commercial Whaling | Scientific Research | Subsistence |
|---|---|---|---|
| Cook Inlet Beluga Whale | -- -- | -- -- | 235 |
| Blue Whale | -- -- | -- -- | -- -- |
| Bowhead Whale | -- -- | -- -- | 1,894 |
| Chinese River Dolphin | -- -- | -- -- | -- -- |
| False Killer Whale | -- -- | -- -- | -- -- |
| Fin Whale | 852 | 310 | 405 |
| Gray Whale | -- -- | -- -- | 4,415 |
| Gulf of California Harbor Porpoise/Vaquita | -- -- | -- -- | -- -- |
| Humpback Whale | -- -- | -- -- | 146 |
| Indus River Dolphin | -- -- | -- -- | -- -- |
| Killer Whale | -- -- | -- -- | -- -- |
| North Atlantic Right Whale | -- -- | -- -- | -- -- |
| North Pacific Right Whale | -- -- | -- -- | -- -- |
| Rice’s Whale | -- -- | -- -- | -- -- |
| Sei Whale | 75 | 1,698 | 3 |
| Southern Right Whale | -- -- | -- -- | -- -- |
| Sperm Whale | 388 | 56 | -- -- |
| Maui’s and South Island Hector’s Dolphin | -- -- | -- -- | -- -- |
| Taiwanese Humpback Dolphin | -- -- | -- -- | -- -- |

Many of the whaling numbers reported represent minimum catches, as illegal or underreported catches are not included. For example, uncovered Union of Soviet Socialists Republics catch records indicate extensive illegal whaling activity between 1948 and 1979 (Ivashchenko et al. 2014). Additionally, despite the moratorium on large-scale commercial whaling, catch of some of these species still occurs in the Arctic, Atlantic, Pacific, and Southern Oceans whether it be under objection of the International Whaling Commission, for aboriginal subsistence purposes, or under International Whaling Commission scientific permit 1985 through 2013. Some of the whales killed in these fisheries are likely part of the same population of whales occurring within the action area for this consultation.

Historically, commercial whaling caused all of the large whale species to decline to the point where they faced extinction risks high enough to list them as endangered species. Since the end of large-scale commercial whaling, the primary threat to the species has been eliminated. Many whale species have not yet fully recovered from those historic declines. Scientists cannot determine if those initial declines continue to influence current populations of most large whale species in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. For example, the North

Atlantic right whale and North Pacific right whale have not recovered from the effects of commercial whaling and continue to face very high risks of extinction because of their small population sizes and low population growth rates. In contrast, populations of species such as the humpback whale have increased substantially from post-whaling population levels and appear to be recovering despite the impacts of vessel strikes, interactions with fishing gear, and increased levels of ambient sound.

### 6.5.3 Cetacean Vessel Interactions

Vessels have the potential to affect animals through strikes, sound (Section 6.5.6.1), and disturbance associated with their physical presence. Responses to vessel interactions include interruption of vital behaviors and social groups, separation of mothers and young, and abandonment of resting areas (Boren et al. 2001b; Constantine 2001; Mann et al. 2000a; Nowacek 2001; Samuels et al. 2000b). Whale watching, a profitable and rapidly growing business with more than nine million participants in 80 countries and territories, may increase these types of disturbance and negatively affected the species (Hoyt 2001).

#### 6.5.3.1 *Vessel Strikes*

Vessel strikes are considered a serious and widespread threat to ESA-listed cetaceans (especially large cetaceans) and are the most well-documented "marine road" interaction with large cetaceans (Pirotta et al. 2019). 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 vessels become faster and more widespread, an increase in vessel interactions with cetaceans is to be expected. The vast majority of commercial vessel strike mortalities of cetaceans are likely undocumented, as most may not be reported. Most whales killed by vessel strike end up sinking rather than washing up on shore. Kraus et al. (2005) estimated that 17 percent of vessel strikes are actually detected. Of 11 species of cetaceans known to be threatened by vessel strikes, fin whales are the mostly commonly struck species worldwide (Laist et al. 2001; Vanderlaan and Taggart 2007). While any vessel has the potential to hit cetaceans, in most cases, lethal or severe injuries are caused by vessels 80 meters (262.5 feet) in length or greater, traveling 25.9 kilometers per hour (14 knots) or faster (Laist et al. 2001). Vessel traffic within the action area can come from both private (e.g., commercial, recreational) and federal vessel (e.g., military, research), but traffic that is most likely to result in vessel strikes comes from commercial shipping.

The potential lethal effects of vessel strikes are particularly profound on species with low abundance. However, all whale species have the potential to be affected by vessel strikes. The latest five-year average mortalities and serious injuries related to vessel strikes for the ESA-listed cetacean stocks within U.S. waters likely to be found in the action area and experience adverse effects as a result of the proposed action are given in Table 14 below (Carretta et al. 2022; Hayes et al. 2022; Muto et al. 2022). Data are broken down by ocean basin/NMFS stock areas and represent only known mortalities and serious injuries. It is probable that more undocumented mortalities and serious injuries for these and other stocks found within the action area have occurred.

**Table 13. Five-year annual average mortalities and serious injuries related to vessel strikes for Endangered Species Act-listed cetaceans within U.S. waters.**

| Species | Pacific Stocks | Hawaii Stock | Alaska Stocks | Gulf of Mexico Stock | Western North Atlantic Stock |
|---|---|---|---|---|---|
| Beluga Whale | NA | NA | NA | NA | NA |
| Blue Whale | 0.8 | NA | NA | NA | 0 |
| Bowhead Whale | NA | NA | 0 | NA | NA |
| False Killer Whale – Main Hawaiian Islands Insular DPS | NA | 0 | NA | NA | NA |
| Fin Whale | 1.4 | 0 | 0.6 | NA | 0.4 |
| Gray Whale | 0 | NA | NA | NA | NA |
| Humpback Whale– Multiple ESA-listed DPSs | 1.4 | 1.5 | 2.6 | NA | 4.4 |
| Killer Whale | 0.2 | NA | NA | NA | NA |
| North Atlantic Right Whale | NA | NA | NA | NA | 2.0 |
| North Pacific Right Whale | 0 | NA | NA | NA | NA |
| Rice's Whale (formerly Gulf of Mexico Bryde's Whale) | NA | NA | NA | 0 | NA |
| Sei Whale | 0.2 | 0 | NA | NA | 0.2 |
| Sperm Whale | 0 | 0 | 0.2 | 0 | 0 |

DPS=Distinct Population Segment
NA=Not Applicable

### 6.5.3.2 *Whale Watching*

Whale watching is a rapidly-growing industry with more than 3,300 operators worldwide, serving 13 million participants in 119 countries and territories (O'Connor et al. 2009). As of 2010, commercial whale watching was a one billion dollar global industry per year (Lambert et al. 2010). Private vessels may partake in this activity as well. NMFS has issued regulations and guidelines relevant to whale watching. As noted previously, many of the cetaceans considered in this consultation are highly migratory, so may also be exposed to whale watching activity occurring outside of the action area.

Although considered by many to be a non-consumptive use of marine mammals with economic, recreational, educational and scientific benefits, whale watching is not without potential negative impacts (reviewed in Parsons 2012). Whale watching has the potential to harass whales by altering feeding, breeding, and social behavior, or even injure them if the vessel gets too close or strikes the animal. Preferred habitats may be abandoned if disturbance levels are too high.

Animals may also become more vulnerable to vessel strikes if they habituate to vessel traffic (Swingle et al. 1993; Wiley et al. 1995).

Several investigators have studied the effects of whale watch vessels on marine mammals (Amaral and Carlson 2005; Au and Green 2000; Christiansen et al. 2013; Christiansen et al. 2011; Corkeron 1995; Erbe 2002a; Félix 2001; Magalhaes et al. 2002; May-Collado et al. 2014; Richter et al. 2006; Scheidat et al. 2004; Simmonds 2005; Watkins 1986; Williams et al. 2002), including one targeting the response of humpback whales to whale-watching vessels in Juneau, Alaska (Schuler et al. 2019). The whale's behavioral responses to whale-watching vessels depended on the distance of the vessel from the whale, vessel speed, vessel direction, vessel noise, and the number of vessels. Responses changed with these different variables and, in some circumstances, the whales or dolphins did not respond to the vessels, but in other circumstances, whales changed their vocalizations, surface time, swimming speed, swimming angle or direction, respiration rates, dive times, feeding behavior, and social interactions, and dolphins abandoned important habitats due to long-terms disturbance (Bejder et al. 2006).

Although numerous short-term behavioral responses to whale watching vessels were documented, little information is available on whether long-term negative effects result from whale watching (NMFS 2006b). Christiansen et al. (2014) estimated the cumulative time minke whales spent with whale watching vessels in Iceland to assess the biological significance of whale watching disturbances and found that, through some whales were repeatedly exposed to whale watching boats throughout the feeding season, the estimated cumulative time they spent with vessels was very low. Christiansen et al. (2014) suggested that the whale watching industry, in its current state, is likely not having any long-term negative effects on vital rates.

### 6.5.4 Fisheries

Fisheries constitute an important and widespread use of the ocean resources throughout the action area. Fisheries can adversely affect fish populations, other species, and habitats. Direct effects of fisheries interactions on marine mammals include entanglement and entrapment, which can lead to fitness consequences or mortality as a result of injury or drowning. Indirect effects include reduced prey availability, including overfishing of targeted species, and destruction of habitat. Use of mobile fishing gear, such as bottom trawls, disturbs the seafloor and reduces structural complexity. Indirect impacts of trawls include increased turbidity, alteration of surface sediment, removal of prey (leading to declines in predator abundance), removal of predators, ghost fishing (i.e., lost fishing gear continuing to ensnare fish and other marine animals), and generation of marine debris. Lost gill nets, purse seines, and long-lines may foul and disrupt bottom habitats and have the potential to entangle or be ingested by marine mammals.

Fisheries can have a profound influence on fish populations. In a study of retrospective data, Jackson et al. (2001) concluded that ecological extinction caused by overfishing precedes all other pervasive human disturbance of coastal ecosystems, including pollution and anthropogenic climatic change. Marine mammals are 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.

#### 6.5.4.1 *Fisheries Interactions*

Globally, 6.4 million tons of fishing gear is lost in the oceans every year (Wilcox et al. 2015). Entrapment and entanglement in fishing gear is a frequently documented source of human-caused mortality in cetaceans (see Dietrich et al. 2007); in an extensive analysis of global risks to marine mammals, incidental catch was identified as the most common threat category (Avila 2018). 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 vessel 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. 2010a). As with vessel strikes, entanglement or entrapment in fishing gear likely has the greatest impact on populations of ESA-listed species with the lowest abundance (e.g., Kraus et al. 2016b). Nevertheless, all species of cetaceans may face threats from derelict fishing gear.

The latest five-year average mortalities and serious injuries related to fisheries interactions for the ESA-listed cetacean stocks within U.S. waters are given in Table 14 below (Carretta et al. 2022; Hayes et al. 2022; Muto et al. 2022). Data represent only known mortalities and serious injuries; more, undocumented moralities and serious injuries for these and other stocks found within the action area have likely occurred.

**Table 14. Five-year mortalities and serious injuries related to fisheries interactions for Endangered Species Act-listed cetaceans within U.S. waters.**

| Species | Pacific Stock | Hawaii Stock | Alaska Stock | Gulf of Mexico Stock | Western North Atlantic Stock |
|---|---|---|---|---|---|
| Beluga Whale | NA | NA | 0 | NA | NA |
| Blue Whale | 1.54 | 0 | NA | NA | NA |
| Bowhead Whale | NA | NA | 0.8 | NA | NA |
| False Killer Whale – Main Hawaiian Islands Insular DPS | NA | 0.03 | NA | NA | NA |
| Fin Whale | 0.64 | 0 | 0 | NA | 1.45 |
| Gray Whale | Unk | NA | NA | NA | NA |

| | | | | | |
|---|---|---|---|---|---|
| Humpback Whale – Multiple ESA-listed DPSs | 24.9 | NA | 6.8 | NA | 7.75 |
| Killer Whale | 0 | NA | NA | NA | NA |
| North Atlantic Right Whale | NA | NA | NA | NA | 5.7 |
| North Pacific Right Whale | 0.2 | NA | NA | NA | NA |
| Rice's Whale | NA | NA | NA | 0 | NA |
| Sei Whale | 0 | 0.2 | NA | NA | 0.4 |
| Sperm Whale | 0.64 | 0 | 3.3 | 0.2 | 0 |

DPS=Distinct Population Segment
NA=Not Applicable
Unk=unknown

In addition to these direct impacts, cetaceans may also be subject to indirect impacts from fisheries. Marine mammals probably consume at least as much fish as is harvested by humans (Kenney et al. 1985). Many cetacean species (particularly fin and humpback whales) are known to feed on species of fish that are harvested by humans (Carretta et al. 2016). 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 ESA-listed cetacean populations. Even species that do not directly compete with human fisheries could be indirectly affected by fishing activities through changes in ecosystem dynamics. However, in general the effects of fisheries on cetaceans through changes in prey abundance remain unknown.

#### 6.5.4.2 *Aquaculture*

Aquaculture has the potential to impact protected species via entanglement and/or other interaction with aquaculture gear (i.e., buoys, nets, and lines), introduction or transfer of pathogens, increased vessel traffic and noise, impacts to habitat and benthic organisms, and water quality (Clement 2013; Lloyd 2003; Price et al. 2017; Price and Morris 2013). Current data suggest that interactions and entanglements of ESA-listed marine mammals with aquaculture gear are rare (Price et al. 2017). This may be because worldwide the number and density of aquaculture farms are low, and thus there is a low probability of interactions, or because they pose little risk of ESA-listed marine mammals. Nonetheless, given that in some aquaculture gear, such as that used in longline mussel farming, is similar to gear used in commercial fisheries, aquaculture may impact similar to fisheries and bycatch. There are very few reports of marine mammal interactions with aquaculture gear, although it is not always possible to determine if the gear animals become entangled in are from aquaculture or commercial fisheries (Price et al. 2017).

Also, some aquaculture gear has the potential for behavioral effects on marine mammals. For example, aquaculture gear may act as a "fish aggregating device" which may attract marine mammals seeking prey for food, or depredation may occur (Callier et al. 2018). Bottlenose dolphins have been showsn to aggregate around fish cages in Italy and change their social structure by modifying hunting strategies to account for increased prey densitieis around fish farms (reviewed in (Callier et al. 2018). Aquaculture gear may also block migration routes (MPI 2013) or at least cause animals to have to circumnavigate the aquaculture gear, as is the case with bottlenose and Dusky dolphins (*Lagenorhynchus obscurus*) avoiding areas with mussel culture longlines (MPI 2013; reviewed in (Callier et al. 2018).

### 6.5.5 Pollution

Within the action area, pollution poses a threat to ESA-listed cetaceans. Pollution can come in the form of marine debris, pesticides, contaminants, and hydrocarbons and is discussed further below.

#### 6.5.5.1 *Marine Debris*

Marine debris is an ecological threat that is introduced into the marine environment through ocean dumping, littering, or hydrologic transport of these materials from land-based sources (Gallo et al. 2018). Even natural phenomena, such as tsunamis and continental flooding, can cause large amounts of debris to enter the ocean environment (Watters et al. 2010). Marine debris has been discovered to be accumulating in gyres throughout the oceans. Marine mammals often become entangled in marine debris, including fishing gear (Baird et al. 2015). Despite debris removal and outreach to heighten public awareness, marine debris in the environment has not been reduced (NRC 2008) and continues to accumulate in the ocean and along shorelines within the action area.

Marine debris affects marine habitats and marine life worldwide, primarily by entangling or choking individuals that encounter it (Gall and Thompson 2015). Entanglement in marine debris can lead to injury, infection, reduced mobility, increased susceptibility to predation, decreased feeding ability, fitness consequences, and mortality for ESA-listed species in the action area. Entanglement can also result in drowning for air breathing marine species including cetaceans. 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). Data on marine debris in some locations of the action area is largely lacking; therefore, it is difficult to draw conclusions as to the extent of the problem and its impacts on populations of ESA-listed cetaceans.

Cetaceans are also impacted by marine debris, which includes: plastics, glass, metal, polystyrene foam, rubber, and derelict fishing gear (Baulch and Perry 2014b; Li et al. 2016). More than 80 percent of all marine debris consists of plastics (reviewed in (Poeta et al. 2017). Over half of cetacean species (including fin, sei, and sperm whales) are known to ingest marine debris (mostly plastic), with up to 31 percent of individuals in some populations containing marine debris in their guts and being the cause of death for up to 22 percent of individuals found stranded on shorelines (Baulch and Perry 2014a). (Burkhardt-Holm and N'Guyen 2019) concluded that sei whales, particularly those in the coastal Northwest Pacific Ocean, had a high potential for ingesting microplastics via their fish prey species, including Scombridae, Clupeidae, and Engraulidae.

Plastic debris is a major concern because it degrades slowly and many plastics float. The floating debris is transported by currents throughout the oceans and has been discovered accumulating in oceanic gyres (Law et al. 2010). Plastic waste in the ocean can leach chemical additives into the water or these additives, such as brominated flame retardants, stabilizers, phthalate esters, bisphenol A, and nonylphenols (Panti et al. 2019). Additionally, plastic waste chemically attracts hydrocarbon pollutants such as polychlorinated biphenyl and dichlorodiphenyltrichloroethane. Marine mammals can mistakenly consume these wastes containing elevated levels of toxins instead of their prey. Once consumed, plastics can act as nutritional diluents in the gut, making the animal feel satiated before it has acquired the necessary amount of nutrients required for general fitness (reviewed in (Machovsky-Capuska et al. 2019). Plastics may therefore influence the nutritional niches of animals in higher trophic levels, such as cetaceans (Machovsky-Capuska et al. 2019). It is expected that cetaceans may be exposed to marine debris over the course of the action although the risk of ingestion or entanglement and the resulting impacts are uncertain at the time of this consultation.

Given the limited knowledge about the impacts of marine debris on cetaceans, it is difficult to determine the extent of the threats that marine debris poses to cetaceans. However, marine debris is consistently present and has been found in cetaceans in the action area. Fin whales in the Mediterranean Sea are exposed to high densities of microplastics on their feeding grounds, and in turn exposed to a higher oxidative stress because of the presence of plasticizers, an additive in plastics (Fossi et al. 2016). In 2008, two sperm whales were found stranded along the California coast, with an assortment of fishing related debris (e.g., net scraps, rope) and other plastics inside their stomachs (Jacobsen et al. 2010b). One whale was emaciated, and the other had a ruptured stomach. It is suspected that gastric impactions was the cause of both deaths. Jacobsen et al. (2010b) speculated the debris likely accumulated over many years, possibly in the North Pacific gyre, that carries derelict Asian fishing gear into eastern Pacific Ocean waters. In January and February 2016, 30 sperm whales were stranded along the coast of the North Sea (in Germany, the Netherlands, Denmark, France, and Great Britain); of the 22 dissected specimens, nine had marine debris in their gastro-intestinal tracts. Most (78 percent) were fishing-related debris (e.g., nets, monofilament line) and the remainder (22 percent) were general debris (plastic bags, plastic buckets, agricultural foils) (Unger et al. 2016).

#### 6.5.5.2 *Pesticides and Contaminants*

Exposure to pollution and contaminants have the potential to cause adverse health effects in marine species. Marine ecosystems receive pollutants from a variety of local, regional, and international sources, and their levels and sources are therefore difficult to identify and monitor (Grant and Ross 2002). Marine pollutants come from multiple municipal, industrial, and household as well as from atmospheric transport (Garrett 2004; Grant and Ross 2002; Hartwell 2004; Iwata 1993). Contaminants may be introduced by rivers, coastal runoff, wind, ocean dumping, dumping of raw sewage by boats and various industrial activities, including offshore oil and gas or mineral exploitation (Garrett 2004; Grant and Ross 2002; Hartwell 2004).

The accumulation of persistent organic pollutants, including polychlorinated-biphenyls, dibenzo-p-dioxins, dibenzofurans and related compounds, through trophic transfer may cause mortality and sub-lethal effects in long-lived higher trophic level animals (Waring et al. 2016), 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). Recent efforts have led to improvements in regional water quality and monitored pesticide levels have declined, although the more persistent chemicals are still detected and are expected to endure for years (Grant and Ross 2002; Mearns 2001).

Numerous factors can affect concentrations of persistent pollutants in marine mammals, such as age, sex and birth order, diet, and habitat use (Mongillo et al. 2012). In marine mammals, pollutant contaminant load for males increases with age, whereas females pass on contaminants to offspring during pregnancy and lactation (Addison and Brodie 1987; Borrell et al. 1995). Pollutants can be transferred from mothers to juveniles at a time when their bodies are undergoing rapid development, putting juveniles at risk of immune and endocrine system dysfunction later in life (Krahn et al. 2009).

#### 6.5.5.3 *Hydrocarbons*

Numerous small-scale vessel spills likely occur in the action area. A nationwide study examining vessel oil spills from 2002 through 2006 found that over 1.8 million gallons of oil were spilled from vessels in all U.S. waters (Dalton and Jin 2010). In this study, "vessel" included numerous types of vessels, including barges, tankers, tugboats, and recreational and commercial vessels, demonstrating that the threat of an oil spill can come from a variety of boat types. Below we review the effects of oil spills on cetaceans more generally. Much of what is known comes from studies of large oil spills such as the *Deepwater Horizon* oil spill since no information exists on the effects of small-scale oil spills within the action area.

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to marine species. Marine mammals 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). Acute exposure of marine mammals to petroleum products causes changes in behavior and may directly injure animals (Geraci 1990). The *Deepwater Horizon* oil spill in the Gulf of Mexico in 2010 led to the exposure of tens of thousands of marine mammals to oil, causing reproductive failure, adrenal disease, lung disease, and poor body condition.

Cetaceans have a thickened epidermis that greatly reduces the likelihood of petroleum toxicity from skin contact with oils (Geraci 1990), but they nonetheless may inhale these compounds at the water's surface and ingest them while feeding (Matkin and Saulitis 1997). For example, as a result of the *Deepwater Horizon* oil spill, sperm whales may have been exposed to toxic oil components through inhalation, aspiration, ingestion, and dermal exposure. There were 19 observations of 33 sperm whales swimming in *Deepwater Horizon* surface oil or that had oil on their bodies (Diaz 2015 as cited in Deepwater Horizon NRDA Trustees 2016). The effects of oil exposure likely included physical and toxicological damage to organ systems and tissues, reproductive failure, and death. Cetaceans may have experienced multiple routes of exposure at the same time, over intermittent timeframes and at varying rates, doses, and chemical compositions of oil based on observed impacts to bottlenose dolphins. Hydrocarbons also have the potential to impact prey populations, and therefore may affect ESA-listed cetaceans indirectly by reducing food availability.

### 6.5.6 Sound

The ESA-listed cetaceans (see Section 5.2) that occur in the action area are regularly exposed to several sources of anthropogenic sounds. These include, but are not limited to maritime activities, aircraft, seismic surveys (exploration and research), and marine construction (dredging). Cetaceans generate and rely on sound to navigate, hunt, and communicate with other individuals and anthropogenic sound can interfere with these important activities (Nowacek et al. 2007). The ESA-listed cetaceans in Section 5.2 have the potential to be impacted by either increased levels of anthropogenic-induced background sound or high intensity, short-term anthropogenic sounds.

Anthropogenic sound in the action area may be generated by commercial and recreational vessels, sonar, aircraft, seismic surveys, in-water construction activities, wind farms, military activities, and other human activities. These activities occur to varying degrees throughout the year. The scientific community recognizes the addition of anthropogenic sound to the marine environment as a stressor that can possibly harm marine animals or significantly interfere with their normal activities (NRC 2005). The species considered in this consultation may be impacted by anthropogenic sound in various ways. Once detected, some sounds may produce a behavioral response, including but not limited to, changes in habitat to avoid areas of higher sound levels, changes in diving behavior, or changes in vocalization (MMC 2007).

Many researchers have described behavioral responses of marine mammals to sounds produced by boats and vessels, as well as other sound sources such as helicopters and fixed-wing aircraft, and dredging and construction (reviewed in Gomez et al. 2016; and Nowacek et al. 2007). Most observations have been limited to short-term behavioral responses, which included avoidance behavior and temporary cessation of feeding, resting, or social interactions; however, in terrestrial species habitat abandonment can lead to more long-term effects, which may have implications at the population level (Barber et al. 2010). Masking may also occur, in which an animal may not be able to detect, interpret, and/or respond to biologically relevant sounds.

Masking can reduce the range of communication, particularly long-range communication, such as that for blue and fin whales. This can have a variety of implications for an animal's fitness including, but not limited to, predator avoidance and the ability to reproduce successfully (MMC 2007). Recent scientific evidence suggests that marine mammals, including several mysticetes, compensate for masking by changing the frequency, source level, redundancy, or timing of their signals, but the long-term implications of these adjustments are currently unknown (Mcdonald et al. 2006; Parks 2003; Parks 2009).

Despite the potential for these impacts to affect individual ESA-listed cetaceans, information is still lacking. For example, we currently lack empirical data on how sound impacts growth, survival, reproduction, and vital rates, nor do we understand the relative influence of such effects on the population being considered. As a result, the consequences of anthropogenic sound on ESA-listed cetaceans at the population or species scale remain uncertain, although recent efforts have made progress establishing frameworks to consider such effects (NAS 2017).

#### 6.5.6.1 *Vessel Sound and Commercial Shipping*

Much of the increase in sound in the ocean environment is due to increased shipping, as vessels become more numerous and of larger tonnage (Hildebrand 2009b; McKenna et al. 2012; NRC 2003b). Commercial shipping continues a major source of low-frequency sound in the ocean, particularly in the Northern Hemisphere where the majority of vessel traffic occurs. Although large vessels emit predominantly low frequency sound, studies report broadband sound from large cargo vessels above 2 kiloHertz. The low frequency sounds from large vessels overlap with many mysticetes' predicted hearing ranges (7 Hertz to 35 kiloHertz) (NOAA 2018) and may mask their vocalizations and cause stress (Rolland et al. 2012). The broadband sounds from large vessels may interfere with important biological functions of odontocetes, including foraging (Blair et al. 2016; Holt 2008). At frequencies below 300 Hertz, ambient sound levels are elevated by 15 to 20 decibels when exposed to sounds from vessels at a distance (McKenna et al. 2013). Analysis of sound from vessels revealed that their propulsion systems are a dominant source of radiated underwater sound at frequencies less than 200 Hertz (Ross 1976). Additional sources of vessel sound include rotational and reciprocating machinery that produces tones and pulses at a constant rate. Other commercial and recreational vessels also operate within the action area and may produce similar sounds, although to a lesser extent given their much smaller size.

Individual vessels produce unique acoustic signatures, although these signatures may change with vessel speed, vessel load, and activities that may be taking place on the vessel. Peak spectral levels for individual commercial vessels are in the frequency band of 10 to 50 Hertz and range from 195 decibels re: $\mu Pa^2$-s at 1 meter for fast-moving (greater than 37 kilometers per hour [20 knots]) supertankers to 140 decibels re: $\mu Pa^2$-s at 1 meter for small fishing vessels (NRC 2003b). Small boats with outboard or inboard engines produce sound that is generally highest in the mid-frequency (1 to 5 kiloHertz) range and at moderate (150 to 180 decibels re: 1 μPa at 1 meter) source levels (Erbe 2002b; Gabriele et al. 2003; Kipple and Gabriele 2004). On average, sound levels are higher for the larger vessels, and increased vessel speeds result in higher sound levels.

Measurements made over the period 1950 through 1970 indicated low frequency (50 Hertz) vessel traffic sound in the eastern North Pacific Ocean and western North Atlantic Ocean was increasing by 0.55 decibels per year (Ross 1976; Ross 1993; Ross 2005). Whether such trends continue today is unclear. Most data indicate vessel sound is likely still increasing (Hildebrand 2009a). However, the rate of increase appears to have slowed in some areas (Chapman and Price 2011), and in some places, ambient sound including that produced by vessels appears to be decreasing (Miksis-Olds and Nichols 2016). (Pirotta et al. 2019) acknowledged that while it is impractical to limit the use of current vessel shipping routes, the development of new routes should be limited in certain areas, particularly in the Arctic, where cetaceans are being exposed to increasing levels of vessel traffic and noise as a result of climate change. Efforts are underway to better document changes in ambient sound (Haver et al. 2018), which will help provide a better understanding of current and future impacts of vessel sound on ESA-listed species.

Sonar systems are used on commercial, recreational, and military vessels and may also affect cetaceans (NRC 2003a). Although little information is available on potential effects of multiple commercial and recreational sonars to cetaceans, 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 (Nowacek et al. 2007). However, military sonar, particularly low frequency active sonar, often produces intense sounds at high source levels, and these may impact cetacean behavior (Southall et al. 2016).

#### 6.5.6.2 *Aircraft*

Aircraft within the action area may consist of small commercial or recreational airplanes, helicopters, or large commercial airliners. These aircraft produce a variety of sounds that could potentially enter the water and impact cetaceans. While it is difficult to assess these impacts, several studies have documented what appear to be minor behavioral disturbances in response to aircraft presence (Nowacek et al. 2007). Erbe et al. (2018) recorded underwater noise from commercial airplanes reaching as high as 36 decibels above ambient noise. Sound pressure levels received at depth were comparable to cargo and container ships traveling at distances of 1 to 3 kilometers (0.5 to 1.6 nautical miles) away, although the airplane noises ceased as soon as the planes left the area, which was relatively quickly compared to a cargo vessel. While such noise levels are relatively low and brief in duration, they still have the potential to be heard by cetaceans at certain frequencies.

#### 6.5.6.3 *Seismic Surveys*

There are seismic survey activities involving towed airgun arrays that may occur within the action area. They are the primary exploration technique to locate oil and gas deposits, fault structure, and other geological hazards. These activities may produce noise that could impact ESA-listed cetaceans within the action area. These airgun arrays generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of ten to 20 seconds for extended periods (NRC 2003b). Most of the energy from the airguns is directed vertically downward, but significant sound emission also extends horizontally. Peak sound pressure levels from airguns usually reach 235 to 240 decibels re: 1 μPa (rms) at dominant frequencies of five to 300 Hertz (NRC 2003a). Most of the sound energy is at frequencies below 500 Hertz, which is within the hearing range of mysticetes (Nowacek et al. 2007). In the U.S., all seismic surveys involving the use of airguns with the potential to take marine mammals are covered by incidental take authorizations under the MMPA, and if they involve ESA-listed species, undergo formal ESA section 7 consultation. In addition, the Bureau of Ocean Energy Management authorizes oil and gas activities in domestic waters as well as the National Science Foundation and U.S. Geological Survey funds and/or conducts these activities in domestic, international, and foreign waters, and in doing so, consults with NMFS to ensure their actions do not jeopardize the continued existence of ESA-listed species or adversely modify or destroy designated critical habitat. More information on the effects of these activities on ESA-listed species, including authorized takes, can be found in recent biological opinions.

There are five known high-energy and low-energy seismic surveys (Western Gulf of Alaska, Northeastern Pacific Ocean, Argentine Basin, Walvis Ridge off Namibia, and Admunsen Sea off Antarctica) for scientific research purposes that occurred in the Atlantic, Pacific, and Southern Oceans in 2019 and 2020. These were funded by the National Science Foundation. Also, there were five known seismic surveys in the Atlantic Ocean funded by the oil and gas industry and permitted by the Bureau of Ocean Energy Management. Each of these seismic surveys included a MMPA incidental take authorization and were each subject to a separate ESA section 7 consultation. Each of these finalized consultations resulted in a "no jeopardy" opinion.

#### 6.5.6.4 *Marine Construction*

Marine construction in the action area that produces sound includes drilling, dredging, pile-driving, cable-laying, and explosions. These activities are known to cause behavioral disturbance and physical damage to marine mammals (NRC 2003a). While most of these activities are coastal, offshore construction does occur.

### 6.5.7 Cetacean Scientific Research and Enhancement Activities

Regulations under ESA section 10(a)(1)(A) allow issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research. Prior to the issuance of such a permit, the proposal must be reviewed for compliance with section 7. Scientific research permits issued by NMFS currently authorize studies of ESA-listed species in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. Marine mammals have been the subject of field studies for decades. Over time, NMFS has issued dozens of permits on an annual basis for various forms of "take" of marine mammals in the action area from a variety of research activities.

Authorized research on ESA-listed cetaceans includes aerial and vessel surveys, close approaches, photography, videography, behavioral observations, active acoustics, remote ultrasound, passive acoustic monitoring, biological sampling (i.e., biopsy, breath, fecal, prey, skin, sloughed skin, environmental DNA), and tagging. Research and enhancement activities involve non-lethal "takes" of these marine mammals.

There have been numerous research permits issued since 2009 under the provisions of both the ESA and MMPA authorizing scientific research and enhancement activities on cetaceans all over the world, including for research in the action area. The consultations which took place on the issuance of these ESA/MMPA scientific research permits each found that the authorized research and enhancement activities will have no more than short-term effects and will not result in jeopardy to the species or adverse modification of designated critical habitat.

#### 6.5.7.1 *Authorized Take of ESA-listed Cetaceans by the Permits Division*

Scientific research and enhancement activities similar to that which will be conducted under this programmatic consultation has and will continue to impact ESA-listed cetaceans within the action area. Currently (as of October 6, 2022), there are at least 39 active and pending research and enhancement permits, including the MMHSRP's current permit, that may affect the ESA-listed cetaceans in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans considered during this programmatic consultation. The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. These research and enhancement activities may directly or unintentionally result in harassment, stress, and injury. The permits for the research and enhancement activities authorize takes of all cetacean lifestages including calves, juveniles, and adults. No mortalities are authorized for any ESA-listed cetacean of any age, and no mortalities of ESA-listed cetaceans have been reported from the research permits currently active in the action area. Three research and enhancement permits authorize auditory research on stranded cetaceans on the beach or in rehabilitation facilities. There are approximately 30 ESA/MMPA permits solely for the import/export/receipt of marine mammal parts including cetacean parts for the purposes such as cell line development or genetic analysis; these do not authorize take of live animals and there are no effects to ESA-listed cetaceans for these research and enhancement activities.

Based on permits issued over the past 15 years by the Permits Division, approximately 40 permits are active for research and enhancement activities on ESA-listed cetaceans at any time. Based on analyses required under the Paperwork Reduction Act, the Permits Division does not foresee significant changes in the number of permits for cetaceans authorized over time (NMFS 2019b).

A total of at least 40 research permits in Arctic, Atlantic, Indian, Pacific, and Southern Oceans represents substantial research. Nonetheless, in the action area research activities are typically concentrated around easily accessible areas. As such, repeated disturbances of individuals may occur within a year. However, all permits contain conditions requiring the permit holders to coordinate their research activities with the NMFS' regional offices and other permit holders and, to the extent possible, share data to avoid unnecessary duplication of effort and associated disturbance of cetaceans. In addition, many "take" numbers represent permitted research activities occurring over the entire range of the species. Nevertheless, the "take" numbers in the scientific research permits represent a worst-case scenario in the action area.

#### 6.5.7.2 *International Research and Enhancement Activities*

In addition to cetacean research conducted by ESA/MMPA permit holders, numerous non-profit and research organizations outside the U.S. conduct similar research on ESA-listed species. These include but are not limited to: Areas Costeras y Recursos Marinos (Peru); Cetacean Alliance (global); Organización para la Conservación de Cetáceos (Uruguay); Conservation, Information, and Research on Cetaceans (Spain); Coastal Ecosystems Research Foundation (Canada); Eutropia (Chile); Israel Marine Mammal Research and Assistance Center (Israel); Johnstone Strait Killer Whale Interpretive Centre Society (Canada); Oceanographic Environmental Research Society (Canada); Pro Delphinus (Peru); The Dolphins of Monkey Mia Research Foundation (Australia); Mammal Research Institute at the University of Pretoria (South Africa); The Oceania Project (Australia); Whale and Dolphin Conservation Society (global); Whales of Guerrero Research Project (Mexico); Far East Russia Orca Project (Russia); and Marine Mammal Conservation Network of India (India). The scope of the research objectives of these organizations falls within the scope of this programmatic.

As detailed further below in our *Response Analysis*, cetaceans may respond to these research and enhancement activities in a variety of ways including no obvious response, minor behavioral disturbances, avoidance and stress-related response, temporarily abandoning important behaviors such as feeding and breeding, and in rare cases whales may become injured, infected, and possibly even die when biological samples are taken or implantable tags are used (NMFS 2017c; NMFS 2017d). The fact that multiple permitted "takes" of ESA-listed cetaceans are already permitted in the action area and are expected to continue to be permitted in the future means that research has the ability to contribute to or even exacerbate the stress response of cetaceans generated from other threats occurring in the action area.

### 6.5.8 Impact of the Environmental Baseline on Cetaceans

Collectively, the stressors described above have had, and likely continue to have, lasting impacts on the ESA-listed species considered in this consultation. Some of these stressors result in mortality or serious injury to individual animals (e.g., vessel strikes and whaling), whereas others result in more indirect (e.g., fishing that impacts prey availability) or non-lethal (e.g., whale watching) impacts. Assessing the aggregate impacts of these stressors on the species considered in this consultation is difficult and, to our knowledge, no such analysis exists. This becomes even more difficult considering that many of the species in this consultation are wide ranging and subject to stressors in locations throughout and outside the action area.

We consider the best indicator of the aggregate impact of the *Environmental Baseline* on ESA-listed resources to be the status and trends of those species. As noted in Section 5, some of the species considered in this consultation are experiencing increases in population abundance, some are declining, and for others, their status remains unknown. Taken together, this indicates that the *Environmental Baseline* is impacting species in different ways. The species experiencing increasing population abundances are doing so despite the potential negative impacts of the *Environmental Baseline*. Therefore, while the *Environmental Baseline* may slow their recovery,

recovery is not being prevented. For the species that may be declining in abundance, it is possible that the suite of conditions described in the *Environmental Baseline* is preventing their recovery. However, is also possible that their populations are at such low levels (e.g., due to historical commercial whaling) that even when the species' primary threats are removed, the species may not be able to achieve recovery. At small population sizes, species may experience phenomena such as demographic stochasticity, inbreeding depression, and Allee effects, among others, that cause their limited population size to become a threat in and of itself. A thorough review of the status and trends of each species is discussed in the *Species Likely to be Adversely Affected* sections (Sections 5.2) of this consultation.

## 6.6 Environmental Baseline Specific to Pinnipeds

The environmental baseline for ESA-listed pinnipeds (i.e., Beringia and Okhotsk DPSs of bearded seals; Guadalupe fur seals; Hawaiian monk seals; Mediterranean monk seals; Arctic, Baltic, Ladogo, Okhotsk, and Saimaa subspecies of ringed seals; Southern DPS of spotted seals; and Western DPS of Steller sea lions) in the action area includes fisheries interactions, pollution, marine debris, environmental variability, scientific research, climate change, and the impacts of hunting.

### 6.6.1 Pinniped Unusual Mortality Events

As stated in Section 3.2.1.3, a 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." Between 1989 and 2011, a total of 118 dead stranded animals were found along the Washington and Oregon coastline (Northwest Region Stranding Database; Wilkinson 2013). Between June 20 and November 1, 2007, 19 Guadalupe fur seals stranded on the Washington and Oregon outer coasts, prompting NOAA to declare an UME on October 19, 2007 (Lambourn et al. 2012). The UME was officially closed on December 11, 2009. In 2012, approximately 58 Guadalupe fur seals stranded on the outer coasts of Washington and Oregon (Lambourn 2013 pers. comm.). This is three times the number of strandings that prompted the UME in 2007. Of all the strandings reported off Washington and Oregon (1989 to 2012), most occurred from mid-May through August with occasional reports between October and December (Northwest Region Stranding Database; Lambourn et al. 2012; Wilkinson 2013).

An UME was declared for Guadalupe fur seals beginning in January 2015 and was closed in September 2021 (NMFS 2022a). The UME was declared due to the increased stranding of Guadalupe fur seals in California, and was expanded to include Oregon and Washington due to the elevated number of strandings there. Strandings began in California in January 2015, were eight times higher than the historical average, and continued to remain well above average through 2019 (Figure 23(NMFS 2022a)). Strandings in Oregon and Washington were well above typical numbers since 2015 (Figure 24); strandings in these two states were five times higher than the historical average in 2019 (NMFS 2022a). Guadalupe fur seal strandings generally peak in April through June each year. Stranded individuals were mostly weaned pups and juveniles, aged one to two years old. Most stranded individuals showed signs of malnutrition and had secondary bacterial and parasitic infections. These were likely caused by suboptimal prey conditions resulting from unusually warm water conditions in the Pacific due to the "Warm Water Blob", El Niño, and several ocean heatwaves (NMFS 2022a).

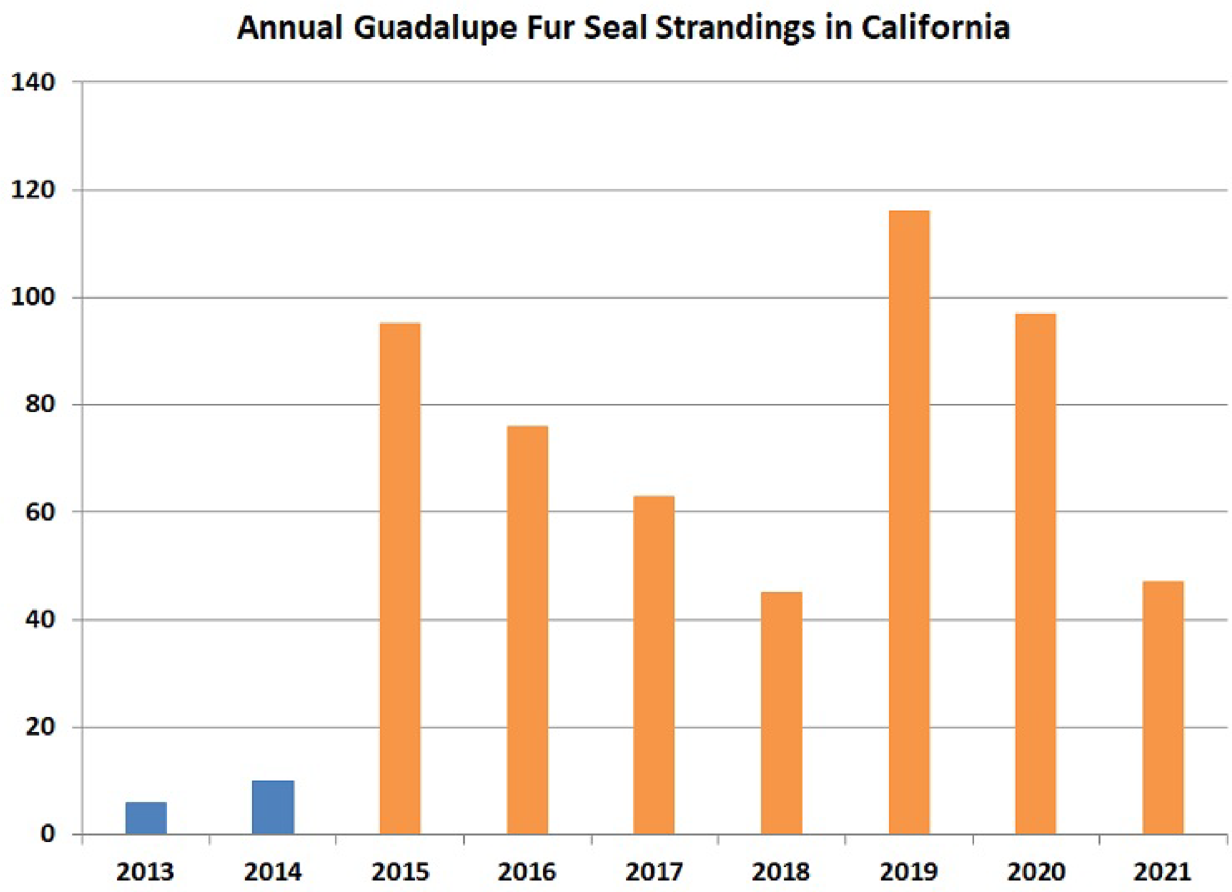


**Figure 23. Guadalupe fur seal annual strandings in California, 2013 through 2021. Orange bars indicate unusual mortality event years (NMFS 2022a).**

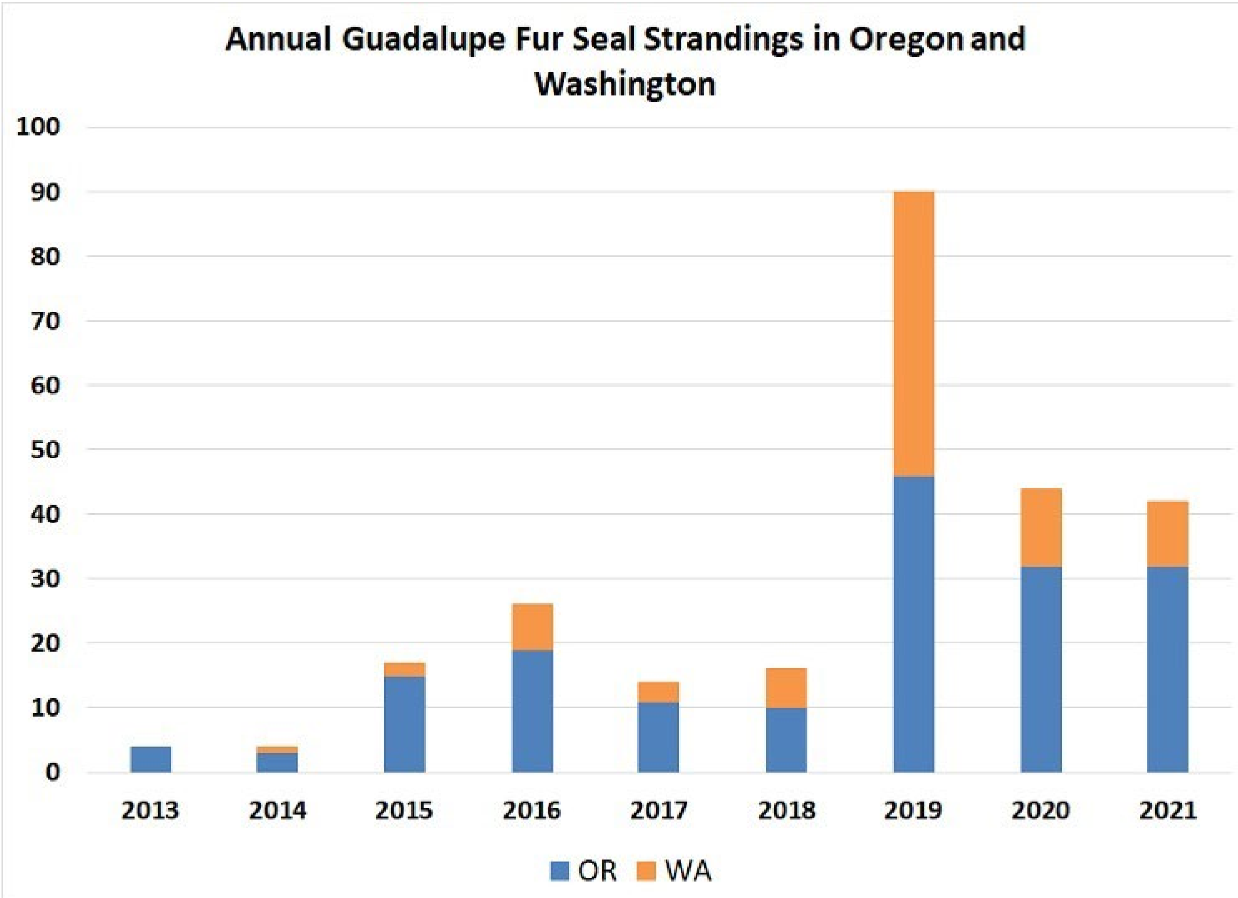


**Figure 24. Guadalupe fur seal annual strandings in Oregon and Washington, 2013 to present. Blue/light blue – Oregon; Beige/orange – Washington (NMFS 2022a).**

### 6.6.2 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.

### 6.6.3 Vessel Interactions

Vessels have the potential to affect animals through strikes, sound (Section ), and disturbance associated with their physical presence. Responses to vessel interactions include interruption of vital behaviors and social groups, separation of mothers and young, and abandonment of resting areas (Boren et al. 2001a; Constantine and Brunton 2001; Mann et al. 2000b; Nowacek et al. 2004; Samuels et al. 2000a). Shipping activities pose a threat to ringed and bearded seals and bowhead whales due to the potential for oil spills. Acoustic impacts from sounds produced by vessels can also interrupt the normal behavior of animals that may also be disturbed by the presence of the ships themselves. Currently the use of icebreakers on the North Sea Route keeps shipping lanes in the Barents and Kara Seas open through pack ice at a time when bearded seals are hauling out in peak numbers to whelp and molt (O'Rourke 2010) and when ringed seals occupy subnivean lairs (Kelly et al. 2010). Segments of the Northwest Passage are used as ice conditions permit in the Canadian Arctic, confining most traffic to the late summer when seals are thought to be largely aquatic (Cameron et al. 2010). Tourism is a factor because the number of tour ships in Greenland, for example, has grown significantly and wildlife viewing occurs mainly in areas favored by species such as bearded seals during late whelping and molting (Cameron et al. 2010).

Vessel traffic, in the form of sea lion research, tourism, and other marine vessel traffic, may disrupt sea lion feeding, breeding, or aspects of sea lion behavior. The Steller Sea Lion Recovery Plan (NMFS 2008b) ranked disturbance from these sources as a low threat to the recovery of the Western DPS of Steller sea lions. Disturbance from these sources is not likely affecting population dynamics in the Western DPS of Steller sea lions within the action area.

In regards to vessel strike there are records of this, NMFS' Alaska Region Stranding Program has records of three occurrences of Steller sea lions being struck by vessels in Southeast Alaska; all were near Sitka, which is located in the Southeast Alaska portion of the action area. Vessel strike is not considered a major threat to Steller sea lions (NMFS 2018b).

### 6.6.4 Fisheries Interactions

Fisheries interactions are a major threat to pinnipeds through several mechanisms: prey reduction, intentional shootings, incidental bycatch, and entanglement in fishing gear. Reduced quantity or quality of prey appears to be a major threat to several pinniped species, as evidenced by population declines, reduced body size/condition, low birth rates, and high juvenile mortality rates (Baker 2008; Trites and Donnelly 2003). Pinnipeds are also intentionally shot by fishermen as a result of actual or perceived competition for fish. An estimated 50-1,180 Steller sea lions are shot annually (Atkinson et al. 2008); six monk seals have been killed in recent years. Pinnipeds are also injured and killed accidentally as a result of being hooked by longline fisheries, entangled in fishing line, and entangled in gillnet, trawl, and other net-based fisheries. Commercial fishing is estimated to incidentally kill approximately 30 Steller sea lions annually (Atkinson et al. 2008). Hookings and entanglement in fishing gear represent major threats to Hawaiian monk seals. Aside from actively fished gear, derelict fishing gear (accidentally lost or intentionally discarded or abandoned fishing lines, nets, pots, traps, or other gear associated with commercial or recreational fishing) also represents an entanglement risk for pinnipeds.

Monitoring of commercial groundfish trawl, longline, and pot fisheries in the Bering Sea-Aleutian Islands for bearded seals was conducted by shipboard observers in the 1990s and 2000s. During the 1990s, three years (1991, 1994, 1999) had more than one mortality per year observed in the groundfish trawl fishery but the mean annual mortality over this monitoring period was still less than one animal (Angliss and Lodge 2002). From 2000 – 2004, there was one mortality in two of the years (2000 and 2001) in the pollock trawl fishery for a mean annual mortality of less than one over the entire monitoring period (Angliss and Allen 2009). From 2002-2006, observer coverage was greater and incidental mortalities of bearded seals were again observed in the pollock trawl fishery; two in 2006 for a mean annual mortality of one animal during the monitoring period (Allen and Angliss 2010). During 2010-2014, incidental mortality and serious injury of bearded seals occurred in the Bering Sea/Aleutian Islands pollock trawl, Bering Sea/Aleutian Islands flatfish trawl, and Bering Sea/Aleutian Islands Pacific cod trawl fisheries (Muto et al. 2017a). The estimated mean annual mortality and serious injury rate incidental to U.S. commercial fisheries for bearded seals is 1.4 animals based on observer data.

Commercial fisheries target species that are known prey items of bearded seals. U.S. fisheries are managed to prevent overfishing of individual stocks and the overall biomass levels of groundfish species have remained relatively stable since the 1970s (Mueter and Megrey 2006). Bycatch of other bearded seal prey items in fisheries could also affect seals due to potential reductions in biomass of prey. Non-target bycatch species were found to be largely animals that are not prey items for bearded seals in the Bering Sea for which there are data on bycatch (Cameron et al. 2010).

Due to natural variations in size and recruitment of prey species, changes in size and age at reproduction induced by targeted fishing are not expected to have a significant impact on bearded seals that already respond to natural variation in prey species (Cameron et al. 2010). Groundfish trawling affects benthic habitat bearded seals use for foraging. In U.S. waters, modifications to trawl gear and restrictions in areas where groundfishing can be done are likely to minimize the potential impacts to bearded seals associated with habitat impacts from trawling (Cameron et al. 2010). In other areas, such as the southern North Sea, the trawling intensity is too high for biomass to recover with several areas being trawled seven times a year on average (Goñi 1998; Hiddink et al. 2006).

Fishery interactions are a concern in the Main Hawaiian Islands, especially involving nearshore fisheries managed by the State of Hawaii (Gobush et al. 2016). Over the 30-year period between 1982 and 2012, approximately 11 Hawaiian monk seals have been observed entangled in fishing gear or other marine debris annually, with a total of nine documented deaths over the 31 years (Carretta et al. 2014). In 2014, 14 Hawaiian monk seal hookings were documented, 13 of which were classified as non-serious injuries, although nine of these would have been deemed serious had they not been mitigated (Carretta et al. 2017b). One monk seal was found dead as result of a hook perforating its esophagus and lung. There are no fisheries operating in or near the Northwest Hawaiian Islands. In 2016, 11 Hawaiian monk seal hookings were documented and all were classified as nonserious injuries, although six of these would have been deemed serious had they not been mitigated (Henderson 2018b; Mercer 2018). Several incidents involved hooks used to catch ulua (jacks, *Caranx* spp.). Gobush et al. (2017) individually identified 297 monk seals between 1988 and 2014 and recorded that 83 (28 percent) of these had at least one documented embedded hooking or fishing gear (i.e., net) entanglement. Most individuals were aged two years or younger and a quarter of them were hooked or entangled multiple times based on observational data. The proportion of monk seals alive one year after a documented fisheries interaction varied by age class and ranged between 76 percent and 84 percent (Gobush et al. 2017). Survival one year later for monk seals with a documented fisheries interaction versus matched controls (all age classes combined) was not significantly different.

One Guadalupe fur seal was found dead in Oregon in 2012, with injuries consistent with blunt force trauma. Additionally, a Guadalupe fur seal was found dead in Mexico with bullet holes in 2012 (Carretta et al. 2015). There were 13 records of human-related deaths or serious injuries to Guadalupe fur seals from stranding data for the five-year period from 2013 to 2017 (Carretta et al. 2020). These strandings included entanglement in marine debris and gillnet of unknown origin, and shootings. Observed human-caused mortality and serious injury for this stock very likely represents a fraction of the true impacts because not all cases are reported or documented (Carretta et al. 2020).

Ringed seals may be captured incidentally or as bycatch in commercial fisheries. Commercial fisheries may also affect ringed seals through competition for prey species that serve as prey for seals. Based on observer data from the Bering Sea-Aleutian Islands fisheries since the 1990s, trawl fisheries for pollock and flatfish resulted in the occasional incidental capture of one animal in some years but annual average mortality of ringed seals due to commercial fisheries were less than one animal (Kelly et al. 2010). Estimates of bycatch of ringed seals from other parts of the Arctic are not available but the distribution of ringed seals versus targeted fisheries have little overlap so bycatch levels are expected to be low (Kelly et al. 2010).

The U.S. fisheries in the North Pacific are managed to prevent overfishing of individual fish stocks, which is likely to reduce the potential indirect effects to ringed seals associated with targeted fishing of prey species. Commercial fishing can affect prey characteristics because larger fish are targeted, often leading to population shifts toward reproduction at earlier ages and smaller sizes. Ringed seals seem to be adapted to existing variations in size and recruitment success of prey species so changes in prey sizes are not expected to have a significant impact on the seals unless fishing pressure increases (Kelly et al. 2010).

Although the Steller Sea Lion Recovery Plan (NMFS 2008b) ranked interactions with fishing gear and marine debris as a low threat to the recovery of the Western DPS of Steller sea lions, it is likely that many entangled sea lions may be unable to swim to shore once entangled, may die at sea, and may not be available to count (Raum-Suryan et al. 2009). Based on data collected within the action area by ADF&G and NMFS, Helker et al. (2017) reported Steller sea lions to be the most common species of human-caused mortality and serious injury between 2011 and 2015. During this timeframe, there were 146 cases of serious injuries to Eastern DPS Steller sea lions from interactions with fishing gear from marine debris. Raum-Suryan et al. (2009) observed a minimum of 386 animals either entangled in marine debris or having ingested fishing gear over the period between 2000-2007 in Southeast Alaska and northern British Columbia.

Over the same period, the Western DPS of Steller sea lions mostly interacted with observed trawl (66) and some longline (3) groundfish fisheries, typically resulting in death. The total current estimated annual mortality rate of Western DPS of Steller sea lions incidental to all U.S. commercial fisheries is 31 animals per year (Muto et al. 2018).

The Steller Sea Lion Recovery Plan (NMFS 2008b) ranked competition with fisheries for prey as a potentially high threat to the recovery of Western DPS of Steller sea lion. Substantial scientific debate surrounds the question about the impact of potential competition between fisheries and Steller sea lions. It is generally well accepted that commercial fisheries target several important Steller sea lion prey species (NRC 2003b) including salmon species, Pacific cod, Atka mackerel, pollock, and others. These fisheries could be reducing sea lion prey biomass and quality at regional and/or local spatial and temporal scales such that sea lion survival and reproduction are reduced.

### 6.6.5 Pollution

Within the action area, pollution poses a threat to ESA-listed pinnipeds. Pollution can come in the form of marine debris, pesticides, contaminants, and hydrocarbons.

#### 6.6.5.1 *Marine Debris*

See the beginning of Section 6.5.5.1 for a general discussion of marine debris.

Observations of Guadalupe fur seals entangled in fishing gear are scarce, although individuals have stranded showing evidence of interaction with discarded fishing gear or marine debris (Goldstein et al. 1999). For Guadalupe fur seals, marine debris is listed as the leading cause of observed human-caused injury and mortality, with ten records of such instances from 2009 to 2013. The records indicated the debris was from a variety of sources, including balloon string, gillnet fragments, nylon netting, twine, plastic line, and plastic pieces found in the stomach (Carretta et al. 2015).

Several hundred cases of marine debris entanglement with Hawaiian monk seals have been documented (nearly all in the Northwest Hawaiian Islands), including nine mortalities (Henderson 2001; Henderson 2018a). The fishing gear polluting the reefs and beaches of the Northwest Hawaiian Islands and entangling monk seals seldom includes types used in Hawaii fisheries. For example, trawl net and monofilament gillnet accounted for approximately 35 percent and 34 percent, respectively, of the debris removed from reefs in the Northwestern Hawaiian Islands by weight, and trawl net alone accounted for 88 percent of the debris by frequency (Donohue et al. 2000), even though trawl fisheries have been prohibited in Hawaii since the 1980s. As a result, it is likely this gear is transported into the action area from distant locations outside of the action area by currents and waves. The NMFS and partner agencies continue to mitigate impacts of marine debris on monk seals and other wildlife. Marine debris is removed from beaches and seals are disentangled during annual population assessment activities at the main reproductive sites. Since 1996, annual debris survey and removal efforts in the

Northwestern Hawaiian Island coral reef habitat have been ongoing (Dameron et al. 2007; Donohue et al. 2000; Donohue et al. 2001).

Although the Steller Sea Lion Recovery Plan (NMFS 2008b) ranked interactions with fishing gear and marine debris as a low threat to the recovery of the Western DPS, it is likely that many entangled sea lions may be unable to swim to shore once entangled, may die at sea, and may not be available to count (Loughlin 1986; Raum-Suryan et al. 2009). Based on data collected by ADF&G Game and NMFS, Helker et al. (2017) reported Steller sea lions to be the most common species of human-caused mortality and serious injury between 2011 and 2015. During that time period, Helker et al. (2017) reported ten Western DPS of Steller sea lions experienced mortality or serious injury as a result marine debris interactions. Raum-Suryan et al. (2009) observed a minimum of 386 animals either entangled in marine debris or having ingested fishing gear over the period 2000 through 2007 in Southeast Alaska and northern British Columbia. Over the same period, the Western DPS mostly interacted with observed trawl (66) and some longline (3) groundfish fisheries, typically resulting in death. The total current estimated annual mortality rate of Western DPS of Steller sea lions incidental to marine debris is two sea lions per year (Muto et al. 2018).

#### 6.6.5.2 *Pesticides and Contaminants*

See the beginning of Section 6.5.5.2 for a general discussion of pesticides and contaminants.

Bearded seals bioaccummulate mercury in tissues and rates of accumulation appear to be somewhat higher than in ringed seals (Smith and Armstrong 1978). Toxic effects of this bioaccumulation were not reported. Organochlorine compounds and heavy metals have been found in most bearded seal populations that have been studied though research on contaminants and bearded seals is limited compared to ringed seals (Cameron et al. 2010). Of six marine mammals tested in Alaska, bearded seals had the highest concentrations of DDT (Kelly 1988). Dieldrin and lindane were found in bearded seals though at less than half the concentration of DDT (Galster and Burns 1972). PFCs and related synthetic compounds have also been detected in bearded seals in the western Arctic (Powley et al. 2008). There are high concentrations of organochlorine compounds in the blubber of male bearded seals, particularly from Alaska and the White Sea, in comparison to other areas where samples were collected are reported (Bang et al. 2001; Muir et al. 2003; Quakenbush et al. 2010). Cameron et al. (2010) concluded that pollution poses a low to moderate threat to bearded seals particularly given the potential for increased input of pollutants to the marine environment through freshwater runoff.

Because POPs are both ubiquitous and persistent in the environment, Guadalupe fur seals (and other forms of marine life) will continue to be exposed to POPs for all of their lives. The effects of POPs to Guadalupe fur seals are unknown and not directly studied, but it is possible that the effects could be sub-lethal and long-term in nature, and include impacting reproduction, immune function, and endocrine activity. These are effects that would become more apparent as time goes on. At present, however, the effects of POPs in Guadalupe fur seals are not currently well known.

Heavy metals such as mercury, selenium, cadmium, and zinc have been reported in the tissues of ringed seals, particularly liver, kidney and muscle tissue, from different locations in the Arctic (Kelly et al. 2010). Toxic effects of heavy metal concentrations were not detected, however. Organochlorine pollutants, including compounds such as DDT and PCBs, have been reported in ringed seals. Concentrations increased with age in males but were reduced in nursing females due to transfer of contaminants to nursing pups (Kelly et al. 2010). Concentrations of some of these pollutants in Arctic ringed seals did not change between 1981 and 2000 according to Addison et al. (2005). Perfluorinated contaminants (PFCs), used in many industrial products such as fire retardants, insecticides and herbicides, lubricants, adhesives, and paints, have been detected in ringed seals in the Alaskan Bering and Chukchi Seas (Quakenbush and Citta 2008). The contaminants did not appear to bioaccumulate with age in male or female seals (Quakenbush and Citta 2008). Kelly et al. (2010) concluded that pollution poses a low to moderate threat to ringed seals, particularly given that levels of organochlorines are expected to continue increasing and climate change has the potential to increase the transport of pollutants from lower latitudes to the Arctic.

Beckmen et al. (2008) assessed blood, blubber, milk, and feces samples that were collected from 53 free-ranging and three captive Steller sea lions in Alaska from 1998 through 2003 to measure exposure to selected organochlorine contaminants (e.g., dioxin-like PCBs, and dichlorodiphenyltrichloroethanes [DDTs]). Regional organochlorine contaminant exposure was compared in blubber samples of pups through subadults of the Eastern DPS in Southeast Alaska (n=48) as compared to the Western DPS Gulf of Alaska (n=55) and Aleutian Islands (n=43). Pesticides and polybrominated diphenyl ethers were identified in 25 and 15 animals respectively, including four individuals that were sampled at five month intervals. Transfer of organochlorine contaminants through the placenta was extremely low. Concentrations of organochlorine contaminants peaked in pups sampled between two to six weeks of age, declined by midway through the suckling period, and increased again through the first year of the presumed dependent suckling period though the weaning period. At the time of the study, Beckmen et al. (2008) suggested these data show that exposure to organochlorine contaminants is at a level of concern especially in young pups in portions of the range of the endangered western stock of Steller sea lions. However, in a more recent study, Zaleski et al. (2014) assessed effects of organochlorine contaminants on the survival and movement probabilities of Steller sea lions estimated in program MARK using resighting data collected from 2003 through 2009. During the study, survival and movement were determined to be most affected by age and location rather than organochlorine contaminants.

#### 6.6.5.3 *Hydrocarbons*

See the beginning of Section 6.5.5.3 for a general discussion of hydrocarbons.

Disturbance, injury, or mortality from oil spills and/or other discharges associated with oil and gas activities are considered to be moderately significant threats to the Beringia and Okhotsk DPSs of bearded seals (Cameron et al. 2010). Oil spills would be difficult to clean up in the

Arctic due to issues such as access and effectiveness of cleanup technologies. Bearded seal pups are not fully molted at birth and would be particularly prone to physical impacts from oiling. Seals could also be affected by oil exposure leading to skin irritation, disorientation, lethargy, conjunctivitis, corneal ulcers, and liver lesions, as well as due to inhalation of vapors. Bearded seals are benthic foragers and could be affected by ingestion of contaminated prey. Spilled oil can cause disruptions in benthic communities and transfer of contaminants through the food web (Stowasser et al. 2004) with colder climates making these effects last longer. Threats to bearded seals from oil and gas activities are greatest where activities converge with breeding aggregations or migratory corridors such as the Bering Strait (Cameron et al. 2010) where these activities are considered a moderate threat.

Exposure to hydrocarbons released into the environment via oil spills and other discharges pose risks to Hawaiian monk seals. Marine mammals 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). Acute exposure of marine mammals to petroleum products causes changes in behavior and may directly injure animals (Geraci 1990). Hawaii has been increasingly reliant on imported crude oil (52 billion barrels/year) for electricity generation and transportation (Gulko et al. 2000). Large tankers use MHI ports that are immediately adjacent to coral reefs, and there was a 200 percent increase in the number of oil spills between 1980 to 1990 (Gulko et al. 2000). While 40 percent of reported spills are small, larger spills have resulted from ship groundings or offloading accidents. In a 1998 case, an oil spill near O'ahu caused reef damage when it washed ashore 75 miles northwest on Kaua'i. Oil spills in the NWHI are almost entirely due to groundings of fishing vessels on the isolated atolls. The October 1998 grounding of a 25 meter fishing vessel at Kure Atoll released over half of its 11,000 gallons of diesel onto the shallow reef environment (Gulko et al. 2000).

The Steller Sea Lion Recovery Plan ranked the threat of toxic substances as medium (NMFS 2008b). Toxic substances can affect animals in two major ways. First, the acute toxicity caused by a major point source of a pollutant (such as an oil spill or hazardous waste) can lead to acute mortality or moribund animals with a variety of neurological, digestive and reproductive problems. Second, toxic substances can impair animal populations through complex biochemical pathways that suppress immune functions and disrupt the endocrine balance of the body, causing poor growth, development, reproduction and reduced fitness. Sea lions exposed to oil spills may become contaminated with PAHs through inhalation (Calkins D. G. et al. 1994), dermal contact and absorption, direct ingestion, or by ingestion of contaminated prey (Albers and Loughlin 2003).

Some Steller sea lions are likely directly exposed to oil, particularly during tanker breaches like the spill from the *Exxon Valdez* in 1989. Exposure or fouling fur (pelage) is not as detrimental to a sea lion as an otter or bird because the blubber is the primary insulation. While, no significant adverse effects of the oil were confirmed following the Exxon spill

(Calkins *et al.* 1994) ingestion and exposure of mucosal membranes may have chronic effects on an individual's health (Albers and Loughlin 2003).

### 6.6.6 Sound

The ESA-listed pinnipeds (see Section 5.2) that occur in the action area are regularly exposed to several sources of anthropogenic sounds. These include, but are not limited to maritime activities, aircraft, seismic surveys (exploration and research), and marine construction (dredging). The ESA-listed pinnipeds in Section 5.2 have the potential to be impacted by either increased levels of anthropogenic-induced background sound or high intensity, short-term anthropogenic sounds.

Anthropogenic sound in the action areas may be generated by commercial and recreational vessels, sonar, aircraft, seismic surveys, in-water construction activities, wind farms, military activities, and other human activities. These activities occur to varying degrees throughout the year. The scientific community recognizes the addition of anthropogenic sound to the marine environment as a stressor that can possibly harm marine animals or significantly interfere with their normal activities (NRC 2005). The species considered in this Opinion may be impacted by anthropogenic sound in various ways. Once detected, some sounds may produce a behavioral response, including but not limited to, changes in habitat to avoid areas of higher sound levels or changes in diving behavior (MMC 2007).

#### 6.6.6.1 *Vessel Sound, Commercial Shipping, and Aircraft*

Vessel sounds from commercial shipping is expected to occur in the action area. Much of the increase in sound in the ocean environment is due to increased shipping, as vessels become more numerous and of larger tonnage (Hildebrand 2009b; McKenna et al. 2012; NRC 2003b). Commercial shipping continues to be a major source of low-frequency sound in the ocean, particularly in the Northern Hemisphere where the majority of vessel traffic occurs. Although large vessels emit predominantly low frequency sound, studies report broadband sound from large cargo vessels above 2 kiloHertz. The low frequency sounds from large vessels overlap with the predicted hearing ranges for otariids (60 Hertz to 39 kiloHertz) (NMFS 2018a) and may mask their vocalizations and cause stress (Rolland et al. 2012). At frequencies below 300 Hertz, ambient sound levels are elevated by 15 to 20 dB when exposed to sounds from vessels at a distance (McKenna et al. 2013). Analysis of sound from vessels revealed that their propulsion systems are a dominant source of radiated underwater sound at frequencies less than 200 Hertz (Ross 1976). Additional sources of vessel sound include rotational and reciprocating machinery that produces tones and pulses at a constant rate. Other commercial and recreational vessels also operate within the action area and may produce similar sounds, although to a lesser extent given their much smaller size.

Individual vessels produce unique acoustic signatures, although these signatures may change with vessel speed, vessel load, and activities that may be taking place on the vessel. Peak spectral levels for individual commercial vessels are in the frequency band of 10 to 50 Hertz and range from 195 dB re: µPa$^2$-s at 1 meter for fast-moving (greater than 37 kilometers per hour [20 knots]) supertankers to 140 dB re: µPa$^2$-s at 1 meter for small fishing vessels (NRC 2003b). Small boats with outboard or inboard engines produce sound that is generally highest in the mid-frequency (1 to 5 kilohertz) range and at moderate (150 to 180 dB re: 1 µPa at 1 meter) source levels (Erbe 2002a; Gabriele et al. 2003; Kipple and Gabriele 2004). On average, sound levels are higher for the larger vessels, and increased vessel speeds result in higher sound levels. Measurements made over the period 1950 through 1970 indicated low frequency (50 Hertz) vessel traffic sound in the eastern North Pacific Ocean and western North Atlantic Ocean was increasing by 0.55 dB per year (Ross 1976; Ross 1993; Ross 2005). Whether or not such trends continue today is unclear. Most data indicate vessel sound is likely still increasing (Hildebrand 2009a), and we assume is also occurring within the action area. However, the rate of increase appears to have slowed in some areas (Chapman and Price 2011), and in some places, ambient sound including that produced by vessels appears to be decreasing (Miksis-Olds and Nichols 2016).

Aircraft within the action area may consist of small commercial or recreational airplanes or helicopters, to large commercial airliners. These aircraft produce a variety of sounds that could potentially enter the water and impact marine mammals. While it is difficult to assess these impacts, several studies have documented what appear to be minor behavioral disturbances of Steller sea lions in response to aircraft presence (Kucey 2005a).

The effects of noise on Guadalupe fur seals specifically are not known, although generally noise in the marine environment is thought to cause at least disturbance to pinnipeds within the vicinity (Fair and Becker 2000). In other pinniped species, many researchers have described behavioral responses of Steller sea lions to sounds produced by boats and vessels, as well as other sound sources such as helicopters and fixed-wing aircraft (Kucey and Trites 2006; Wilson et al. 2012a). Most observations have been limited to short-term behavioral responses, which included avoidance behavior and temporary cessation of feeding, resting, or social interactions. Masking may also occur, in which an animal may not be able to detect, interpret, and/or respond to biologically relevant sounds. This can have a variety of implications for an animal's fitness including, but not limited to, predator avoidance and the ability to reproduce successfully (MMC 2007). Although the impacts of noise on pinnipeds is receiving attention and regulating bodies are working to mitigate those effects, sources of marine noise are likely to persist or increase into the future.

#### 6.6.6.2 *Seismic Surveys*

There are two major categories of seismic surveys: (1) deep seismic surveys which include ocean bottom, vertical seismic profile or borehole, two-dimensional, three-dimensional, four-dimensional and wide azimuth surveys, and (2) high resolution surveys. Deep seismic survey acoustic sources consist of airgun arrays while receiver arrays consist of hydrophones or geophones encased in plastic tubing called streamers. When an airgun array fires an acoustic energy pulse is emitted and reflected or refracted back from the seafloor. These reflected/refracted acoustic signals create pressure fluctuations, which are detected and recorded by the streamers. Seismic airguns generate intense low-frequency sound pressure waves capable of penetrating the seafloor and are fired repetitively at intervals of ten to 20 seconds for extended periods (i.e., hours, days, weeks, months) (NRC 2003a). Most of the energy from airguns is directed vertically downward, but significant sound emission also extends horizontally. Peak SPLs from airguns usually reach 235 to 240 decibels at dominant frequencies of five to 300 Hertz (NRC 2003a). High-resolution surveys collect data on surface and near-surface geology used to identify archaeological sites, potential shallow geologic and manmade hazards for engineering, and site planning for bottom-founded structures. High-resolution seismic surveys may use airguns but also use other sound sources such as sub-bottom profilers (at 2.5 to 7 kHz), echosounders (single-beam at 12 to 240 kiloHertz; multibeam at 50 to 400 kiloHertz), boomers (at 300 to 3,000 Hertz), sparkers (at 50 to 4,000 Hertz), compressed high intensity radar pulse sub-bottom profiler (at 4 to 24 kiloHertz), pingers (at 2 kiloHertz), and side-scan sonars (16 to 1,500 kiloHertz). These sound sources are typically powered either mechanically or electromagnetically.

There are seismic survey activities involving towed airgun arrays that may occur within the action area. These activities may produce noise that could impact ESA-listed pinnipeds within the action area. Most of the sound energy is at frequencies below 500 Hertz, which is within the hearing range of otariids, such as Guadalupe fur seals and the Steller sea lion Western DPS (NMFS 2018a). NMFS issues permits for seismic activity conducted near ESA-listed species. MMPA and ESA permits specify the conditions under which researchers can operate seismic sound sources, such as airguns, including mitigation measures to minimize adverse effects to protected species. One such mitigation measure is the suspension of seismic survey activities whenever marine mammals are observed within the designated exclusion zone, which differs by species and sound source, as specified in the permit.

#### 6.6.6.3 *Marine Construction*

Industrial activities and construction both in the ocean and along the shoreline can contribute to underwater noise. Pile-driving is commonly used for the construction of foundations for a large number of structures including bridges, buildings, retaining walls, harbor facilities, offshore wind turbines, and offshore structures for the oil and gas industry. Pile-driving during construction activities is of particular concern because it generates noise with a very high source level. During pile installation, noise is produced when the energy from construction equipment is transferred to the pile and released as pressure waves into the surrounding water and sediments. The impulsive sounds generated by impact pile driving are characterized by a relatively rapid rise time to a maximal pressure value followed by a decay period that may include a period of diminishing, oscillating maximal and minimal pressures (Illingworth and Rodkin 2001; Illingworth and Rodkin 2007; Reyff 2012). The amount of noise produced by pile driving depends on a variety of factors, including the type and size of the impact hammer, size of the pile, the properties of the sea floor, and the depth of the water. The predominant energy in pile impact impulses is at frequencies below approximately 2,000 Hertz, with most occurring below 1,000 Hertz (Laughlin 2006; Reyff 2008; Reyff 2012). Pressure levels from 190 to 220 dB re: 1 μPa were reported for piles of different sizes in a number of studies (NMFS 2006c). Impact pile-driving occurs over small spatial and temporal scales and produces high-intensity, low-frequency, impulsive sounds with high peak pressures that can be detected by marine mammals. Injury to marine mammals is caused by pressure wave damage to hair cells, ear canals, or ear drums as these structures compress and expand with passage of the wave. Vibratory pile-driving produces a continuous sound with peak pressures lower than those observed in impulses generated by impact pile-driving (Popper et al. 2014b).

In 2016, NMFS Alaska Region conducted internal consultations with NMFS Permits and Conservation Division on the issuance of three IHAs to take marine mammals incidental to dock construction, fiber optic cable laying, and anchor retrieval in the Bering, Chukchi, and Beaufort Seas, during the 2016 open water season. The incidental take statements issued with the three biological opinions exempted take (by harassment) of 788 bowhead whales, 19 fin whales, 13 humpback whales, 706 bearded seals, 7,887 ringed seals, and 2,185 Western DPS Steller sea lions, as a result of exposure to continuous or impulsive sounds at received levels at or above 120 dB or 160 dB re: 1 μPa rms respectively. Fiber optic cable laying continued in 2017, and NMFS Alaska Region also conducted a consultation with NMFS Permits and Conservation Division on the issuance of an IHA for this project. Quintillion was permitted to install 1,904 km (1,183 mi) of subsea fiber optic cable during the open-water season, including a main trunk line and six branch lines to onshore facilities in Nome, Kotzebue, Point Hope, Wainwright, Utqiagvik/Barrow, and Oliktok Point (Liberty Development and Production Plan Biological Opinion PCTS AKR-2018-9747). The incidental take statement issued with the biological opinion exempted take (by harassment) of 314 bowhead whales, 15 fin whales, 3 Western North Pacific DPS humpback whales, 7 Mexico DPS humpback whales, 62 bearded seals, 855 ringed seals, and 8 Western DPS Steller sea lions, total, as a result of exposure to sounds of received levels at or above 120 dB re: 1 μPa rms from sea plows, anchor handling, and operation and maintenance activities (NMFS 2018c).

### 6.6.7 Pinniped Scientific Research and Enhancement Activities

Regulations under ESA section 10(a)(1)(A) allow issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research. Prior to the issuance of such a permit, the proposal must be reviewed for compliance with section 7. Scientific research permits issued by NMFS currently authorize studies of ESA-listed species in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. Marine mammals have been the subject of field studies for decades. Over time, NMFS has issued dozens of permits on an annual basis for various forms of "take" of marine mammals in the action area from a variety of research activities.

Authorized research on ESA-listed pinnipeds includes aerial and vessel surveys, close approaches, photography, videography, behavioral observations, active acoustics, remote ultrasound, passive acoustic monitoring, biological sampling (i.e., biopsy, breath, fecal, prey, hair, vibrissae, molted/sloughed skin, environmental DNA), branding, and tagging. Research and enhancement activities involve non-lethal "takes" of these marine mammals.

There have been numerous research permits issued since 2009 under the provisions of both the ESA and MMPA authorizing scientific research and enhancement activities on cetaceans all over the world, including for research in the action area. The consultations which took place on the issuance of these ESA/MMPA scientific research permits each found that the authorized research and enhancement activities will have no more than short-term effects and will not result in jeopardy to the species or adverse modification of designated critical habitat.

#### 6.6.7.1 *Authorized Take of ESA-listed Pinnipeds by the Permits Division*

Scientific research permits, issued by NMFS, authorize the study of ESA-listed resources in the action area. 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 3.2.2).

Scientific research and enhancement activities similar to that which will be conducted under this programmatic consultation has and will continue to impact ESA-listed pinnipeds within the action area. Currently (as of October 24, 2022), there are at least 30 active research and enhancement permits, including the MMHSRP's current permit, that may affect the ESA-listed pinnipeds in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans considered during this programmatic consultation. The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. These research and enhancement activities may directly or unintentionally result in harassment, stress, and injury. The permits for the research and enhancement activities authorize takes of all lifestages including pups, juveniles, and adults. The MMHSRP's current permit authorizes auditory research on stranded pinnipeds on the beach or in rehabilitation facilities. There are approximately 30 ESA/MMPA permits solely for the import/export/receipt of marine mammal parts including pinniped parts for the purposes such as cell line development or genetic analysis; these do not authorize take of live animals and there are no effects to ESA-listed pinnipeds for these research and enhancement activities.

#### 6.6.7.2 *International Research and Enhancement Activities*

In addition to pinniped research conducted by ESA/MMPA permit holders, numerous non-profit and research organizations outside the U.S. conduct similar research on ESA-listed species. These include but are not limited to: Seal Conservation Society, University of Eastern Finland,

and the North Atlantic Marine Mammal Commission. The scope of the research objectives of these organizations falls within the scope of this programmatic.

As detailed further below in our *Response Analysis*, pinnipeds may respond to these research and enhancement activities in a variety of ways including no obvious response, minor behavioral disturbances, avoidance and stress-related response, temporarily abandoning important behaviors such as feeding and breeding, and in rare cases pinnipeds may become injured, infected, and possibly even die when biological samples are taken or implantable tags are used (NMFS 2017c; NMFS 2017d). The fact that multiple permitted "takes" of ESA-listed pinnipeds are already permitted in the action area and are expected to continue to be permitted in the future means that research has the ability to contribute to or even exacerbate the stress response of pinnipeds generated from other threats occurring in the action area.

#### 6.6.8 Impact of the Environmental Baseline on 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.

### 6.7 Environmental Baseline Specific to Sea Turtles, Sturgeon, and Sawfish

The environmental baseline for ESA-listed sea turtles, sturgeon, and sawfish (i.e., Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, and North Atlantic DPSs of green turtles; hawksbill turtles; Kemp's ridley turtles; North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean DPSs of loggerhead turtles; breeding populations on the Pacific Coast of Mexico and all other areas of olive ridley turtles; Carolina, Chesapeake, Gulf of Maine, New York Bight, and South Atlantic DPSs of Atlantic sturgeon; Southern DPS of green sturgeon; Gulf sturgeon; shortnose sturgeon; and U.S. DPS of smalltooth sawfish) in the action area includes a multitude of conditions including habitat degradation, entrapment in fishing gear, dredging, pollutants, and vessel strikes among others. These are discussed below.

#### 6.7.1 Habitat degradation

A number of factors may be directly or indirectly affecting the ESA-listed species, mentioned in the previous paragraph, 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 2006c). The majority of the sound energy associated with pile driving is in the low frequency range (less than 1,000 Hertz; Illingworth and Rodkin Inc.

2001; Illingworth and Rodkin Inc. 2004; Reyff 2003), which is the frequency range at which sea turtles hear best. Dredging operations also have the potential to emit sounds at levels that could disturb sea turtles. Depending on the type of dredge, peak sound pressure levels from 100-140 dB re 1 micropascal were reported in one study (Clarke et al. 2003). As with pile driving, most of the sound energy associated with dredging is in the low-frequency range, less than 1,000 Hertz (Clarke et al. 2003).

Several measures have been adopted to reduce the sound pressure levels associated with in-water construction activities or prevent exposure of sea turtles to sound. For example, a six-inch block of wood placed between the pile and the impact hammer used in combination with a bubble curtain can reduce sound pressure levels by about 20 dB (NMFS 2008a). Alternatively, pile driving with vibratory hammers produces peak pressures that are about 17 dB lower than those generated by impact hammers (Nedwell and Edwards 2002). Other measures used in the action area to reduce the risk of disturbance from these activities include avoidance of in-water construction activities during times of year when sea turtles may be present; monitoring for sea turtles during construction activities; and maintenance of a buffer zone around the project area, within which sound-producing activities would be halted when sea turtles enter the zone (NMFS 2008a).

The destruction or modification of habitat is a threat at many nesting beaches used by the East Pacific leatherback population. In Costa Rica, coastal development along the northern and southern ends of the nesting beach at Playa Grande in Las Baulas National Park and in the town of Tamarindo has resulted in the loss of nesting beach habitat in addition to the removal of much of the natural beach vegetation. In addition to the loss and degradation of nesting beach habitat, stressors associated with development include pollution from artificial light, solid and chemical wastes, beach erosion, unsustainable water consumption, and deforestation. In Mexico, the extent of development near nesting beaches is generally low, given the remoteness of the beaches in Baja California and on the mainland (NMFS and USFWS 2020a). With the exception of beach erosion, likely the result of climate impacts described previously (e.g., storms, extreme high tides, and sea level rise), there is little information on additional anthropogenic-induced habitat loss at Western Pacific nesting areas due to the remoteness of beaches (NMFS and USFWS 2020a).

Marine debris is a significant concern for ESA-listed species and their habitats. Marine debris accumulates in gyres throughout the oceans. The input of plastics into the marine environment also constitutes a significant degradation to the marine environment. In 2010, an estimated 4.8-12.7 million metric tons of plastic entered the ocean globally (Baulch and Simmonds 2015). Law et al. (2010) presented a time series of plastic content at the surface of the western North Atlantic Ocean and Caribbean Sea from 1986-2008. More than 60 percent of 6,136 surface plankton net tows collected small, buoyant plastic pieces. The data identified an accumulation zone east of Bermuda that is similar in size to the accumulation zone in the Pacific Ocean and is a major accumulation center for anthropogenic debris (Schuyler et al. 2015).

For sea turtles, marine debris is a problem due primarily to individuals ingesting debris and blocking the digestive tract, causing death or serious injury (Laist et al. 1999; Lutcavage et al. 1997b). Schuyler et al. (2015) estimated that, globally, 52 percent of individual sea turtles have ingested marine debris. Of Pacific green sea turtles, 91 percent had marine debris (mostly plastics) in their guts (Wedemeyer-Strombel et al. 2015). Gulko and Eckert (2003) estimated that between one-third and one-half of all sea turtles ingest plastic at some point in their lives; this figure is supported by data from Lazar and Gracan (2010), who found 35 percent of loggerheads had plastic in their gut. Over 50 percent of loggerheads had marine debris in their guts (greater than 96 percent of which was plastic) in the Indian Ocean (Hoarau et al. 2014). One study found 37 percent of dead leatherback turtles had ingested various types of plastic (Mrosovsky et al. 2009). A Brazilian study found that 60 percent of stranded green sea turtles had ingested marine debris (primarily plastic and oil; Bugoni et al. 2001). Loggerhead sea turtles had a lesser frequency of marine debris ingestion. Plastic is possibly ingested out of curiosity or due to confusion with prey items; for example, plastic bags can resemble jellyfish (Milton and Lutz 2003). Marine debris consumption has been shown to depress growth rates in post-hatchling loggerhead sea turtles, elongating the time required to reach sexual maturity and increasing predation risk (McCauley and Bjorndal 1999). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997b; NRC 1990; O'Hara et al. 1988). Studies of shore cleanups have found that marine debris washing up along the northern Gulf of Mexico shoreline amounts to about 100 kilograms/kilometers (ACC 2010; LADEQ 2010; MASGC 2010; TGLO 2010). Sea turtles can also become entangled and die in marine debris, such as discarded nets and monofilament line (Laist et al. 1999; Lutcavage et al. 1997b; NRC 1990; O'Hara et al. 1988).

Marine debris represents a potential stressor for the East and West Pacific leatherback populations, although the impacts remain unquantified. Leatherback turtles can ingest marine debris, causing internal damage and/or blockages. Larger debris can entangle animals, leading to reduced mobility, starvation, and death. Given the amount of floating debris in the Pacific Ocean within the range of the West Pacific population, marine debris has the potential to be a significant threat, however the impact is unquantified (NMFS and USFWS 2020a). Lebreton and coauthors. (2018) estimated plastic debris accumulation to be at least 79,000 tons in the Great Pacific Garbage Patch, a 1.6 million $km^2$ area between California and Hawaii. Leatherback turtles feed exclusively on jellyfish and other gelatinous organisms and as a result may be prone to ingesting plastic items resembling their food source (Schuyler et al. 2014; Schuyler 2014). Few studies have addressed the susceptibility of West Pacific leatherbacks to plastic marine debris ingestion, or the magnitude of the risk this potential stressor represents. Entanglement in ghost fishing gear is also a concern (Gilman et al. 2016), and derelict nets account for approximately 46 percent by piece, and 86 percent by weight, of debris floating in the Great Pacific Garbage Patch (Lebreton et al. 2018).

The South Pacific Garbage Patch, discovered in 2011 and confirmed in mid-2017, contains an area of elevated levels of marine debris and plastic particle pollution, most of which is concentrated within the ocean's pelagic zone and in areas where East Pacific leatherbacks forage for many years of their life (NMFS and USFWS 2020). The area containing this aggregation is located within the South Pacific Gyre, which spans from waters east of Australia to the South American continent and as far north as the equator. Entanglement in and ingestion of marine debris and plastics is a threat that likely kills or injures individuals from this population each year; however, data are not available because most affected turtles are not observed.

Dams are used to impound water for water resource projects such as hydropower generation, irrigation, navigation, flood control, industrial and municipal water supply, and recreation. Dams can also have profound effects on anadromous species by fragmenting populations, impeding access to spawning and foraging habitat, and altering natural river hydrology and geomorphology, water temperature regimes, and sediment and debris transport processes (Pejchar and Warner 2001; Wheaton et al. 2004). The loss of historic habitat ultimately affects anadromous fish in two ways: 1) it forces fish to spawn in sub-optimal habitats that can lead to reduced reproductive success and recruitment, and 2) it reduces the carrying capacity (physically) of these species and affects the overall health of the ecosystem (Patrick 2005). Physical injury and direct mortality occurs as fish pass through turbines, bypasses, and spillways. Indirect effects of passage through all routes may include disorientation, stress, delay in passage, exposure to high concentrations of dissolved gases, elevated water temperatures, and increased vulnerability to predation. Activities associated with dam maintenance, such as dredging and minor excavations along the shore, can release silt and other fine river sediments that can be deposited in nearby spawning habitat. Dams can also reduce habitat diversity by forming a series of homogeneous reservoirs; these changes generally favor different predators, competitors and prey, than were historically present in the system (Auer 1996).

The detrimental effects of dams on populations of shortnose and Atlantic sturgeon are generally well documented (Cooke and Leach 2004; Kynard 1998). Perhaps the biggest impact dams have on sturgeon is the loss of upriver spawning and rearing habitat. Migrations of sturgeon in rivers without barriers are wide-ranging with total distances exceeding 200 km or more, depending on the river system (Kynard 1997). Although some rivers have dams constructed at the fall line that have not impacted sturgeon spawning, in many other rivers dams have blocked sturgeon upriver passage, restricting spawning activities to areas below the impoundment and leaving sturgeon vulnerable to perturbations of natural river conditions at different life stages (Cooke and Leach 2004; Kynard 1997). Sturgeon spawning sites remain unknown for the majority of rivers in their range. Observations of sturgeon spawning immediately below dams, further suggests that they are unable to reach their preferred spawning habitat upriver. Overall, 91 percent of historic Atlantic sturgeon habitat seems to be accessible, but the quality of the remaining portions of habitat as spawning and nursery grounds is unknown, therefore estimates of percentages of availability do not necessarily equate to functionality (ASSRT 2007b). Thus, dams may one of the primary causes of the extirpation of sturgeon subpopulations on the east coast.

The suitability of riverine habitat for sturgeon spawning and rearing depends on annual fluctuations in water flow, which can be greatly altered or reduced by the presence and operation of dams (Cooke and Leach 2004; Jager et al. 2001). Effects on spawning and rearing may be most dramatic in hydropower facilities that operate in peaking mode (Auer 1996; Secor and Niklitschek 2002c). Daily peaking operations store water above the dam when demand is low and release water for electricity generation when demand is high, creating substantial daily fluctuations in flow and temperature regimes. Kieffer and Kynard (2012) reported extreme flow fluctuations for hydroelectric power generation on the Connecticut River affected access to shortnose sturgeon spawning habitat, possibly deterred spawning, and left rearing shoals either completely scoured during high flows or dry and exposed during low flows.

Several dams within the Atlantic sturgeon historic range have been removed or naturally breached. Sturgeon appear unable to use some fishways (e.g., ladders) but have been transported in fish lifts (Kynard 1998). Data on the effects of the fish lift at the Holyoke Hydroelectric Project on the Connecticut River suggest that fish lifts that successfully attract other anadromous species (i.e., shad, salmon etc.) do a poor job of attracting sturgeon: attraction and lifting efficiencies for shortnose sturgeon at the Holyoke Project are estimated around 11 percent (ASSRT 2007a). Despite decades of effort, fish passage infrastructure retrofitted at hydroelectric dams has largely failed to restore diadromous fish to historical spawning habitat (Brown et al. 2013). While improvements to fish passage are often required when hydroelectric dams go through Federal Energy Regulatory Commission relicensing, the relicensing process occurs infrequently, with some licenses lasting up to 50 years. Over 95 percent of dams on the eastern seaboard are not hydroelectric facilities, and are thus not subject to continual relicensing or fish passage improvement measures (ASMFC 2008).

Modification and loss of smalltooth sawfish habitat, especially nursery habitat, is another contributing factor in the decline of the species. Activities such as agricultural and urban development, commercial activities, dredge-and-fill operations, boating, erosion, and diversions of freshwater runoff contribute to these losses (SAFMC 1998). Large areas of coastal habitat were modified or lost between the mid-1970s and mid-1980s within the United States (Dahl and Johnson 1991). Since then, rates of loss have decreased, but habitat loss continues. From 1998-2004, approximately 64,560 acres of coastal wetlands were lost along the Atlantic and Gulf coasts of the United States, of which approximately 2,450 acres were intertidal wetlands consisting of mangroves or other estuarine shrubs (Stedman and Dahl 2008). Further, Orlando et al. (1994) analyzed 18 major southeastern estuaries and recorded over 703 miles of navigation channels and 9,844 miles of shoreline with modifications. In Florida, coastal development often involves the removal of mangroves and the armoring of shorelines through seawall construction. Changes to the natural freshwater flows into estuarine and marine waters through construction of canals and other water control devices have also altered the temperature, salinity, and nutrient regimes; reduced both wetlands and submerged aquatic vegetation; and degraded vast areas of coastal habitat utilized by smalltooth sawfish (Gilmore 1995; Reddering 1988; Whitfield and Bruton 1989). While these modifications of habitat are not the primary reason for the decline of smalltooth sawfish abundance, it is likely a contributing factor and almost certainly hampers the recovery of the species. Juvenile sawfish and their nursery habitats are particularly likely to be affected by these kinds of habitat losses or alternations, due to their affinity for shallow, estuarine systems. Although many forms of habitat modification are currently regulated, some permitted direct and/or indirect damage to habitat from increased urbanization still occurs and is expected to continue to threaten survival and recovery of the species in the future.

### 6.7.2 Legal and Illegal Harvest

Sea turtles have been harvested throughout history as both a protein source (for meat or eggs) and as raw material in the manufacture of ornaments and artifacts. A threat unique to hawksbill turtles is the tortoiseshell trade. Tortoiseshell is made from hawksbill scutes and is used to produce products such as sunglasses, bracelets, and boxes that are often sold illegally on the black market (Shattuck 2011). In many parts of the world, the customs and traditions associated with the harvest, consumption and artistic use of sea turtle products have been passed from generation to generation and have developed cultural meaning and significance over time (Campbell 2003).

For many centuries, the harvest of sea turtles and turtle eggs was primarily limited to small-scale, artisanal and subsistence fisheries. Although small-scale turtle fisheries still exist today, by the mid-20th century directed turtle harvest was dominated by large-scale commercial operations with access to global markets (Stringell et al. 2013). From the 1950s to 1970s, commercial fisheries in Mexico accounted for about one-half of the global sea turtle harvest, consisting mainly of green and olive ridley turtles (Márquez 1990). During the peak of Mexico's sea turtle exploitation in 1968, it is estimated that the national take was over 380,000 turtles (Cantu and Sanchez, 1999 as cited in (Humber et al. 2014). By the late 1960s, the global capture of sea turtles had peaked at an estimated 17,000 tons (FAO 2011). Based on Japanese commercial import data, between 1970 and 1986 an estimated two million turtles (mostly hawksbills, greens, and olive ridleys) were harvested to satisfy the demand for turtle products in Japan alone (Milliken and Tokunaga 1987). To maximize efficiency, commercial harvesting effort was often concentrated at mass nesting sites or arribadas with high densities of breeding adult turtles. With the introduction of mechanized fishing in the 1970s to India's Orissa coast, an area known to support the world's largest olive ridley arribada, turtle take increased sharply to an estimated 50,000 adults per breeding season (Tripathy and Choudhury 2007). In Ecuador, during the 1970s, an estimated 100,000 to 148,000 olive ridley turtles were killed each year for both consumption of meat and the expanding turtle leather market (Alava et al. 2005).

Increased conservation awareness at the international scale has led to greater protection of marine turtles in recent decades. The Convention on International Trade in Endangered Species (CITES), which went into effect in 1975, helped to reduce demand and promote regional cooperation in increasing turtle populations. All six ESA-listed sea turtles are listed in CITES Appendix I, which provides the greatest level of protection, including a prohibition on commercial trade. Marine turtle species have also been listed on the International Union for Conservation of Nature Red List of Threatened Species since 1982 (IUCN 2017). In 1981, Ecuador, one of the two largest turtle harvesting nations at the time, banned the export of sea turtle products. In 1990, following international pressures, Mexico, the other major turtle exporter, closed commercial fisheries and instituted a moratorium on the take of turtles and eggs (Senko et al. 2014).

As of 2014, there were 42 countries and territories that reported sea turtle harvest through legally authorized fisheries (Humber et al. 2014). Collectively, an estimated 42,000 turtles are killed each year in these countries and territories. Over 80 percent of these are green turtles, followed by hawksbills (8.2 percent), loggerheads (2.5 percent), olive ridley (0.6 percent), and leatherback (0.1 percent) (Humber et al. 2014). Geographically, the legal take of sea turtles is currently concentrated in two regions: the Indo-Pacific region accounts for 63 percent and the wider Caribbean region accounts for 35 percent. The countries of Papua New Guinea (36 percent), Nicaragua (22 percent) and Australia (16 percent) combined account for almost three-quarters of the current legal take of sea turtles (Humber et al. 2014).

Humber et al. (2014) documented the change in the legal take of sea turtles over the past three decades. Just considering the 46 countries that still allow sea turtle directed take (including the four with current moratoria), turtle harvest has decreased by more than 60 percent over the past three decades. The average number of turtles killed in these fisheries annually has declined steadily over time: 116,420 in the 1980s; 68,844 turtles in the 1990s; and 45,387 in the 2000s (Humber et al. 2014). One of the major changes in species taken over the past three decades has been in the nearly complete cessation of the olive ridley harvest on the Pacific coast of Colombia from nearly 40,000 turtles per year in the early 1980s to fewer than ten turtles per year in the 1990s and 2000s. While legal directed take of sea turtles has declined significantly, illegal harvest may still represent a significant source of sea turtle mortality, one that is more difficult to estimate. The scale of global illegal take is likely to be severely underreported due to the inherent difficulty in collecting data on such activity (Humber et al. 2014).

The primary threat to the West Pacific population of leatherback sea turtles is the legal and illegal harvest of them and their eggs. The removal of nesting females from the population reduces both abundance and productivity; egg harvest reduces productivity and recruitment. Leatherback turtles are protected by regulatory mechanisms in all four nations where this population nests, but laws are largely ignored and not enforced (NMFS and USFWS 2020a). This is due to the extreme remoteness of beaches, customary and traditional community-based ownership of natural resources (which includes sea turtles), and overall lack of institutional capacity and funding for enforcement (Gjertsen and Pakiding 2011; Kinch 2006; von Essen et al. 2014).

Directed killing of nesting females, and male and female juvenile and adult leatherbacks in their foraging areas has been documented in all four countries where this population nests (Bellagio Sea Turtle Conservation Initiative 2008; Jino and coauthors. 2018; Kinch et al. 2009; Petro et al. 2007; Suarez and Starbird 1995; Tiwari et al. 2013a). While a number of relatively recent NMFS and USFWS funded programs are working to quantify and reduce directed take, egg and turtle harvest is a well-documented past and current threat and is prolific throughout the West Pacific leatherback range (Bellagio Sea Turtle Conservation Initiative 2008; NMFS 2013h; Tapilatu et al. 2013; Tapilatu and Tiwari 2007). In Indonesia, the direct harvest of turtles and eggs likely persists, although this threat has been minimized at Jamursba-Medi, Wermon, and Buru Island beaches due to the presence of monitoring programs and associated educational outreach activities (NMFS and USFWS 2020). In the Maluku islands of Indonesia, several villages of the Kei islands have engaged in an indigenous hunt (directed fishery) of juvenile and adult leatherback turtles foraging in coastal habitats for decades. While recent programmatic efforts are working to monitor and reduce this impact, the hunt was historically estimated to take over 100 leatherback turtles annually (NMFS and USFWS 2020; Suarez and Starbird 1996; WWF 2019). In Papua New Guinea, egg harvest and killing of nesting females is still a major threat despite the fact that leatherback turtles have been protected since the 1976 Fauna (Protection and Control) Act. The killing of nesting females and directed harvest of eggs in Vanuatu and the Solomon Islands is also well documented (Bellagio Sea Turtle Conservation Initiative 2008; NMFS 2013h; NMFS and USFWS 2020a).

The primary cause of the historical decline of the East Pacific leatherback population was the legal and illegal (post conservation measures) harvest of nesting females and eggs. The extensive and prolonged effects of comprehensive egg harvest levels of nearly 90 percent for about two decades have depleted the leatherback turtle population in Costa Rica and Mexico (Martinez et al. 2007; Tomillo et al. 2008; Wallace and Saba 2009). To reduce the harvest of turtles and eggs, several regulatory mechanisms and protections have been established in the three nations hosting nesting beaches. In Mexico, the harvest of turtles and eggs is now prohibited as a result of national legislation. In Costa Rica, establishment of Parque Nacional Marino Las Baulas in 1991 ensured increased protection at three nesting beaches (Playa Grande, Playa Ventanas, and Playa Langosta), greatly reducing egg poaching in the area. Though conservation efforts have reduced the levels of both, egg poaching remains high and affects a large proportion of the East Pacific breeding population.

### 6.7.3 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. This is discussed further in Section 5.2.

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.

Fishery bycatch in coastal and pelagic fisheries is a major threat to the West Pacific population of leatherback turtles, which is exposed to domestic and international fisheries throughout its extensive foraging range. Bycatch of leatherback turtles has been documented for a variety of gillnet and longline fisheries in the Pacific Ocean, but little is known about the total magnitude or full geographic extent of mortality (NMFS and USFWS 2020). Detailed bycatch data are available for U.S.-managed pelagic fisheries operating in the central and eastern Pacific Ocean due to regulatory mandates and high levels of observer coverage.

The summer nesting component of the population exhibits strong site fidelity to the central California foraging area (Benson et al. 2011), which puts migrating leatherbacks at risk of interacting with U.S. and international pelagic longline fleets operating throughout the Central and North Pacific oceans. Fishery observer data collected between 1989 and 2015 of 34 purse seine and longline fleets across the Pacific documented a total of 2,323 sea turtle interactions, of which 331 were leatherback turtles (Clarke 2017). Two bycatch hotspot areas were identified: one in central North Pacific (which likely reflects the 100 percent observer coverage in the Hawaii shallow-set longline fishery) and a second hotspot in eastern Australia. These data are unlikely to be representative of all bycatch hotspots as the data are driven by the presence of fishery observer programs, which are not extensive and are concentrated in certain nations fishing fleets.

Prior to 2001, an estimated 110 leatherback turtles were captured annually in all Hawaii longline fisheries combined, resulting in approximately nine annual mortalities (McCracken 2000). Subsequent management requirements designed to reduce sea turtle bycatch rates and post-hooking mortality include: gear modifications (e.g., large circle hooks and fin-fish bait) and handling measures; an annual limit on the number of allowable interactions in the shallow-set fishery; 100 percent observer coverage in the shallow-set fishery; and 20 percent observer coverage in the deep-set fishery (NMFS and USFWS 2020). The 2004 management measures introduced to the Hawaii longline fisheries have demonstrably reduced leatherback sea turtle interaction rates by 83 percent (Gilman and coauthors. 2007; Swimmer and coauthors. 2017). Between 2004 and 2017, there have been 99 total leatherback turtle interactions in the shallow-set longline fishery (or approximately eight leatherback turtles annually), based on 100 percent observer coverage (WPRFMC 2018). The estimated number of anticipated future interactions for leatherbacks in the shallow-set fishery is 21 interactions with three mortalities (NMFS 2019h). Between 2002 and 2016, an estimated 166 leatherback interactions have occurred in the Hawaii deep-set longline fishery (or approximately 11 annually) (McCracken 2019b). From the 2014 biological opinion for the Hawaii deep-set fishery (NMFS 2014f), the estimated future interactions for leatherbacks is 24 annual interactions resulting in 9 mortalities. Observer coverage of the American Samoa longline fishery has varied over time from 5 to 40 percent and has had an estimated 55 leatherback interactions between 2010 and 2017 (McCracken 2019a). From the 2015 biological opinion for the American Samoa longline fishery (NMFS 2015b), the estimated number of anticipated future interactions for leatherbacks is 69 captures, with 49 mortalities over three years.

From 1990 to 2009, there were 24 observed leatherback turtle interactions in the California drift gillnet fishery based on 15.6 percent per year observer coverage (Martin et al. 2015). Genetic analyses indicated that almost all originated from the West Pacific DPS (Dutton et al. 1999; NMFS SWFSC unpublished data). In 2001, NMFS implemented regulations (i.e., a large time/area closure offshore central California) that reduced interactions by approximately 80 to 90 percent (NMFS and USFWS 2020). Since the time/area closure went into effect in 2001, only two leatherbacks have been observed taken in the California drift gillnet fishery. Based on the latest biological opinion (NMFS 2013a), the California and Oregon drift gillnet fishery is anticipated to result in an estimated 3 leatherback interaction mortalities per year, up to 10 interactions over a five-year period, including up to seven mortalities over a five-year period.

The U.S. tuna purse seine fishery operating in the Western and Central Pacific Ocean interacted with approximately 16 leatherback turtles between 2008 and 2015 based on observer coverage ranging from 20 to 100 percent (NMFS and USFWS 2020). The anticipated future interactions of leatherbacks for this fishery is estimated to be 11 sub-lethal interactions per year, and mortalities are not anticipated from this fishery.

Historically, significant leatherback bycatch was documented in the North Pacific high seas driftnet fishery, which expanded rapidly during the late 1970s and was banned in 1992 by a United Nations resolution (summarized in Benson et al. 2015). High seas driftnet fishery bycatch was likely a significant contributor to the population declines observed at nesting beaches during the 1980s and 1990s (Benson et al. 2015). Bycatch in small-scale coastal fisheries has also been a significant contributor to leatherback population declines in many regions (Alfaro-Shigueto et al. 2011; Kaplan 2005)(Alfaro-Shigueto et al. 2011; Kaplan 2005), yet there is a significant lack of information from coastal and small-scale fisheries, especially from the Indian Ocean and Southeast Asian region (Lewison and coauthors. 2014).

In summary, West Pacific leatherbacks are exposed to high fishing effort throughout their foraging range, and likely in coastal waters near nesting beaches or en route to and from nesting beaches and foraging habitats, though very little fisheries data are available for coastal areas (NMFS and USFWS 2020). Bycatch rates in international pelagic and coastal fisheries are thought to be high, and these fisheries have limited management regulations despite hotspots of high interactions, for example in Southeast Asia (Alfaro-Shigueto et al. 2011; Clarke 2017; Clarke and coauthors. 2014; Lewison and coauthors. 2014; Lewison et al. 2004; Wallace et al. 2013). Annual interaction and mortality estimates are only available for U.S.-managed pelagic fisheries, which operate under fisheries regulations that are designed to minimize interactions with and mortalities of endangered and threatened sea turtles (NMFS and USFWS 2013; NMFS and USFWS 2020; Swimmer et al. 2017).

Bycatch in commercial and recreational fisheries, both on the high seas and nearshore, is considered the primary threat to the East Pacific leatherback population (NMFS and USFWS 2020). Juvenile and adult leatherbacks are exposed to high fishing effort throughout their foraging range and in coastal waters near nesting beaches. Mortality is also high in some fisheries, with reported mortality rates of up to 58 percent due in part to the use of gillnets and as well as consumption of bycaught turtles in Peru (NMFS and USFWS 2020). While efforts by individual nations and regional fishery management organizations have, to some extent, mitigated and reduced bycatch, this stressor remains a major threat to the East Pacific leatherback population (NMFS and USFWS 2020).

Directed harvest of Atlantic, green, gulf, and shortnose 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 these 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 2009h). 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[8]" (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.

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.

### 6.7.4 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

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[8] *"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.*

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).

Dissolved oxygen concentrations can be affected by maintenance dredging of federal navigation channels and other waters. Some of the consequences of dredging include entrainment on the pump heads and changing dissolved oxygen and salinity gradients in, and around, the channels (Campbell and Goodman 2004; Jenkins et al. 1993a; Secor and Niklitschek 2001b). Hydraulic dredges can kill sturgeon by entraining sturgeon in dredge dragarms and impeller pumps. Mechanical dredges have also been documented to kill shortnose sturgeon. Dredging operations may pose risks to shortnose sturgeon by destroying, or adversely modifying, their benthic feeding areas, disrupting spawning migrations, and filling spawning habitat with resuspended fine sediments (Jones 1986; Van Dolah et al. 1984). Since shortnose sturgeon are benthic omnivores, the modification of the benthos could affect the quality, quantity and availability of sturgeon prey species (Haley 1998). Most dredging activities are permitted by the U.S. Army Corps of Engineers, who have reported 24 bycaught sturgeon (11 shortnose and 11 Atlantic sturgeon) from 1990-2005 (ASSRT 2007a). Dredging has also degraded and/or modified smalltooth sawfish habitat in the southeastern U.S. (NMFS 2009i; NMFS 2010e).

### 6.7.5 Pollutants

Coastal habitats are often in close proximity to major sources of pollutants and heavy metals, which make their way into the marine environment from industrial, domestic and agricultural sources. Persistent organic pollutants (POPs) are organic compounds that are resistant to environmental degradation through chemical, biological, and photolytic processes. These contaminants bioaccumulate through the food chain and can result in lethal and sublethal effects on marine organisms.

A variety of heavy metals have been found in sea turtles tissues in levels that increase with turtle size. These include arsenic, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, silver, and zinc, (Barbieri 2009; Fujihara et al. 2003; García-Fernández et al. 2009; Godley et al. 1999; Storelli et al. 2008). Cadmium has been found in leatherbacks at the highest concentration compared to any other marine vertebrate (Gordon et al. 1998). Newly emerged hatchlings have higher concentrations than are present when laid, suggesting that metals may be accumulated during incubation from surrounding sands (Sahoo et al. 1996). Arsenic has been found to be very high in green turtle eggs (Van de Merwe et al. 2009). Sea turtle tissues have been found to contain organochlorines, including chlorobiphenyl, chlordane, lindane, endrin, endosulfan, dieldrin, perfluorooctane sulfonate, perfluorooctanoic acid, DDT, and PCB (Alava et al. 2006; Gardner et al. 2003; Keller et al. 2005; Oros et al. 2009; Storelli et al. 2007). PCB concentrations are reportedly equivalent to those in some marine mammals, with liver and adipose levels of at least one congener being exceptionally high (Davenport et al. 1990; Oros et al. 2009). Levels of PCBs found in green sea turtle eggs are considered far higher than what is fit for human consumption (Van de Merwe et al. 2009).

Several studies have reported correlations between organochlorine concentration level and indicators of sea turtle health or fitness. Organochlorines have the potential to suppress the immune system of loggerhead sea turtles and may affect metabolic regulation (Keller et al. 2006; Oros et al. 2009). Accumulation of these contaminants can also lead to deficiencies in endocrine, developmental and reproductive health (Storelli et al. 2007). Females from sexual maturity through reproductive life should have lower levels of contaminants than males because contaminants are shared with progeny through egg formation. Balazs (1991) suggested that environmental contaminants are a possible factor contributing to the development of the viral disease FP in sea turtles by reducing immune function. Day et al. (2007) investigated mercury toxicity in loggerhead sea turtles by examining trends between blood mercury concentrations and various health parameters. They concluded that subtle negative impacts of mercury on sea turtle immune function are possible at concentrations observed in the wild. Keller et al. (2004) investigated the possible health effects of organochlorine contaminants, such as polychlorinated biphenyls (PCBs) and pesticides on loggerhead sea turtles. Although concentrations were relatively low compared with other species, they found significant correlations between organochlorine contaminants levels and health indicators for a wide variety of biologic functions, including immunity and homeostasis of proteins, carbohydrates, and ions.

The life histories of sturgeon species (i.e., long lifespan, extended residence in estuarine habitats, benthic foraging) predispose them to long-term, repeated exposure to environmental contamination and potential bioaccumulation of heavy metals and other toxicants (Dadswell 1979b). Shortnose sturgeon collected from the Delaware and Kennebec Rivers had total toxicity equivalent concentrations of polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans, PCBs, DDE, aluminum, cadmium, and copper all above adverse effect concentration levels reported in the literature (Brundage III 2008). Dioxin and furans were detected in ovarian tissue from shortnose sturgeon caught in the Sampit River/Winyah Bay system (South Carolina).

Heavy metals and organochlorine compounds accumulate in sturgeon tissue, but their long-term effects are not well studied (Ruelle and Keenlyne 1993). High levels of contaminants, including chlorinated hydrocarbons, in several other fish species are associated with reproductive impairment (Billsson 1998; Cameron et al. 1992; Giesy et al. 1986; Hammerschmidt et al. 2002), reduced survival of larval fish (McCauley et al. 2015; Willford et al. 1981), delayed maturity and posterior malformations (Billsson 1998). Pesticide exposure in fish may affect anti-predator and homing behavior, reproductive function, physiological maturity, swimming speed, and distance (Beauvais et al. 2000; Scholz et al. 2000; Waring and Moore 2004). Sensitivity to environmental contaminants also varies by life stage. Early life stages of fish appear to be more susceptible to environmental and pollutant stress than older life stages. (Rosenthal and Alderdice 1976). Early life stage Atlantic and shortnose sturgeon are vulnerable to PCB and Tetrachlorodibenzo-p-dioxin (TCDD) toxicities of less than 0.1 parts per billion (Chambers et al. 2012). Increased doses of PCBs and TCDD have been correlated with reduced physical development of Atlantic sturgeon larvae, including reductions in head size, body size, eye development and the quantity of yolk reserves (Chambers et al. 2012). Juvenile shortnose sturgeon raised for 28 days in North Carolina's Roanoke River had a 9 percent survival rate compared to a 64 percent survival rate at non-riverine control sites (Cope et al. 2011). The reduced survival rate could not be correlated with contaminants, but significant quantities of retene, a paper mill by-product with dioxin-like effects on early life stage fish, were detected in the river (Cope et al. 2011).

Dwyer et al. (2005) compared the relative sensitivities of common surrogate species used in contaminant studies to 17 ESA-listed species including Atlantic sturgeons. The study examined 96-hour acute water exposures using early life stages where mortality is an endpoint. Chemicals tested were carbaryl, copper, 4-nonphenol, pentachlorophenal and permethrin. Of the ESA-listed species, Atlantic sturgeon were ranked the most sensitive species tested for four of the five chemicals (Atlantic and shortnose sturgeon were found to be equally sensitive to permethrin). Additionally, a study examining the effects of coal tar, a byproduct of the process of destructive distillation of bituminous coal, indicated that components of coal tar are toxic to shortnose sturgeon embryos and larvae in whole sediment flow-through and coal tar elutriate static renewal (Kocan et al. 1993).

### 6.7.6 Oil spills and releases

Oil pollution has been a significant concern in the Gulf of Mexico for several decades due to the large amount of extraction and refining activity in the region. Routine discharges into the northern Gulf of Mexico (not including oil spills) include roughly 88,200 barrels of petroleum per year from municipal and industrial wastewater treatment plants and roughly 19,250 barrels from produced water discharged overboard during oil and gas operations (MMS 2007b; USN 2008). These sources amount to over 100,000 barrels of petroleum discharged into the northern Gulf of Mexico annually. Although this is only 10 percent of the amount discharged in a major oil spill, such as the Exxon *Valdez* spill (roughly one million barrels), this represents a significant and "unseen" threat to Gulf of Mexico wildlife and habitats. Generally, accidental oil spills may amount to less than 24,000 barrels of oil discharged annually in the northern Gulf of Mexico, making non-spilled oil normally one of the leading sources of oil discharge into the Gulf of Mexico, although incidents such as the 2010 *Deepwater Horizon* incident are exceptional (MMS 2007a). The other major source from year to year is oil naturally seeping into the northern Gulf of Mexico. Although exact figures are unknown, natural seepage is estimated at between 120,000 and 980,000 barrels of oil annually (MacDonald et al. 1993; MMS 2007b).

Although non-spilled oil is the primary contributor to oil introduced into the Gulf of Mexico, concern over accidental oil spills is well-founded (Campagna et al. 2011). Over five million barrels of oil and one million barrels of refined petroleum products are transported in the northern Gulf of Mexico daily (MMS 2007b); worldwide, it is estimated that 900,000 barrels of oil are released into the environment as a result of oil and gas activities (Epstein and (Eds.). 2002). Even if a small fraction of the annual oil and gas extraction is released into the marine environment, major, concentrated releases can result in significant environmental impacts. Because of the density of oil extraction, transport, and refining facilities in the Houston/Galveston and Mississippi Delta areas (and the extensive activities taking place at these facilities), these locations have the greatest probability of experiencing oil spills. Oil released into the marine environment contains aromatic organic chemicals known to be toxic to a variety of marine life; these chemicals tend to dissolve into the air to a greater or lesser extent, depending on oil type and composition (Yender et al. 2002). Solubility of toxic components is generally low, but does vary and can be relatively high (0.5-167 parts per billion; Yender et al. 2002).

Several oil spills have affected the northern Gulf of Mexico over the past few years, largely due to hurricanes. The impacts of Hurricane Ivan in 2004 on the Gulf Coast included pipeline damage causing 16,000 barrels of oil to be released and roughly 4,500 barrels of petroleum products from other sources (BOEMRE 2010; USN 2008). The next year, Hurricane Katrina caused widespread damage to onshore oil storage facilities, releasing 191,000 barrels of oil (LHR 2010). Another 4,530 barrels of oil were released from 70 other smaller spills associated with hurricane damage. Shortly thereafter, Hurricane Rita damaged offshore facilities resulting in 8,429 barrels of oil released (USN 2008).

Major oil spills have impacted the Gulf of Mexico for decades (NMFS 2010b). 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 2010b). 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 2010b). The tanker *Alvenus* grounded in 1984 near Cameron, Louisiana, spilling 65,500 barrels of oil, which spread west along the shoreline to Galveston (NMFS 2010b). 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 2010b).

On April 20 2010, a fire and explosion occurred aboard the semisubmersible drilling platform *Deepwater Horizon* roughly 80 kilometers southeast of the Mississippi Delta (NOAA 2010a). The platform had 17,500 barrels of fuel aboard, which likely burned, escaped, or sank with the platform (NOAA 2010a). However, once the platform sank, the riser pipe connecting the platform to the wellhead on the seafloor broke in multiple locations, initiating an uncontrolled release of oil from the exploratory well. Over the next three months, oil was released into the Gulf of Mexico, resulting in oiled regions of Texas, Louisiana, Mississippi, Alabama, and Florida and widespread oil slicks throughout the northern Gulf of Mexico that closed more than one-third of the U.S. Gulf of Mexico exclusive economic zone to fishing due to contamination concerns. Apart from the widespread surface slick, massive undersea oil plumes formed, possibly through the widespread use of dispersants and reports of tarballs washing ashore throughout the region were common. Although estimates vary, roughly 4.1 million barrels of oil were released directly into the Gulf of Mexico (USDOI 2012). During surveys in offshore oiled areas, 1,050 sea turtles were seen and half of these were captured (Witherington et al. 2012). Of the 520 sea turtles captured, 394 showed signs of being oiled (Witherington et al. 2012). A large majority of these were juveniles, mostly green (311) and Kemp's ridley sea turtles (451) (Witherington et al. 2012). An additional 78 adult or subadult loggerheads were observed (Witherington et al. 2012). Captures of sea turtles along the Louisiana's Chandeleur Islands in association with emergency sand berm construction resulted in 185 loggerheads, eight Kemp's ridley, and a single green sea turtle being captured and relocated (Dickerson and Bargo 2012). In addition, 274 nests along the Florida panhandle were relocated that ultimately produced 14,700 hatchlings, but also had roughly two percent mortality associated with the translocation (MacPherson et al. 2012). Females that laid these nests continued to forage in the area, which was exposed to the footprint of the oil spill (Hart et al. 2014b). Large areas of *Sargassum* were affected, with some heavily oiled or dispersant-coated *Sargassum* sinking and other areas accumulating oil where sea turtles could inhale, ingest, or contact it (Powers et al. 2013; USDOI 2012). Of 574 sea turtles observed in these *Sargassum* areas, 464 were oiled (USDOI 2012).

Specific causes of injury or death have not yet been established for many of these individuals as investigations into the role of oil in these animals' health status continue. Investigations are ongoing by the MMHSRP. Above average fisheries bycatch may also have played a role in the large numbers of strandings observed in the central northern Gulf of Mexico. Large numbers of sea turtles also stranded in the region in 2011. Investigations, including necropsies, were undertaken by NMFS to attempt to determine the cause of those strandings. Based on the findings, the two primary considerations for the cause of death of the turtles that were necropsied are forced submergence or acute toxicosis. With regard to acute toxicosis, sea turtle tissue samples were tested for biotoxins of concern in the northern Gulf of Mexico. Environmental information did not indicate a harmful algal bloom of threat to marine animal health was present in the area. With regard to forced submergence, the only known plausible cause of forced submergence that could explain this event is incidental capture in fishing gear.

Use of dispersants can increase oil dispersion, raising the levels of toxic constituents in the water column, but speeding chemical degradation overall (Yender et al. 2002). Although the effects of dispersant chemicals on sea turtles is unknown, testing on other organisms have found currently used dispersants to be less toxic than those used in the past (NOAA 2003). It is possible that dispersants can interfere with surfactants in the lungs (surfactants prevent the small spaces in the lungs from adhering together due to surface tension, facilitating large surface areas for gas exchange), as well as interfere with digestion, excretion, and salt gland function (NOAA 2003). After dispersion, the remaining oil becomes tar, which forms floating balls that can be transported thousands of kilometers into the North Atlantic. The most toxic chemicals associated with oil can enter marine food chains and bioaccumulate in invertebrates such as crabs and shrimp to a small degree (prey of some sea turtles; Law and Hellou 1999; Marsh et al. 1992), but generally do not bioaccumulate or biomagnify in finfish (Baussant et al. 2001; Meador et al. 1995; Varanasi et al. 1989; Yender et al. 2002). Sea turtles are known to ingest and attempt to ingest tar balls, which can block their digestive systems, impairing foraging or digestion and potentially causing death (NOAA 2003), ultimately reducing growth, reproductive success, as well as increasing mortality and predation risk (Fraser 2014). Tarballs were found in the digestive tracts of 63 percent of post hatchling loggerheads in 1993 following an oil spill and 20 percent of the same species and age class in 1997 (Fraser 2014). Oil exposure can also cause acute damage on direct exposure to oil, including skin, eye, and respiratory irritation, reduced respiration, burns to mucous membranes such as the mouth and eyes, diarrhea, gastrointestinal ulcers and bleeding, poor digestion, anemia, reduced immune response, damage to kidneys or liver, cessation of salt gland function, reproductive failure, and death (NOAA 2003; NOAA 2010b; Vargo et al. 1986). Nearshore spills or large offshore spills can oil beaches on which sea turtles lay their eggs, causing birth defects or mortality in the nests (NOAA 2003; NOAA 2010b).

Oil can also cause indirect effects to sea turtles through impacts to habitat and prey organisms. Seagrass beds may be particularly susceptible to oiling as oil contacts grass blades and sticks to them, hampering photosynthesis and gas exchange (Wolfe et al. 1988). If spill cleanup is attempted, mechanical damage to seagrass can result in further injury and long-term scarring. Loss of seagrass due to oiling would be important to green sea turtles, as this is a significant component of their diets (NOAA 2003). The loss of invertebrate communities due to oiling or oil toxicity would also decrease prey availability for hawksbill, Kemp's ridley, and loggerhead sea turtles (NOAA 2003). Furthermore, Kemp's ridley and loggerhead sea turtles, which commonly forage on crustaceans and mollusks, may ingest large amounts of oil due oil adhering to the shells of these prey and the tendency for these organisms to bioaccumulate the toxins found in oil (NOAA 2003). It is suspected that oil adversely affected the symbiotic bacteria in the gut of herbivorous marine iguanas when the Galapagos Islands experienced an oil spill, contributing to a more than 60 percent decline in local populations the following year. The potential exists for green sea turtles to experience similar impacts, as they also harbor symbiotic bacteria to aid in their digestion of plant material (NOAA 2003). Dispersants are believed to be as toxic to marine organisms as oil itself.

Marine and anadromous fish species can be impacted by oil contamination directly through uptake by the gills, ingestion of oil or oiled prey, effects on eggs and larval survival, and through contamination of foraging and spawning sites. Studies after the Exxon *Valdez* oil spill demonstrated that fish embryos exposed to low levels of polyaromatic hydrocarbons in weathered crude oil develop a syndrome of edema and craniofacial and body axis defects (Incardona et al. 2005).

### 6.7.7 Entrainment, entrapment, and impingement in power plants

Industrial and power generating plants (e.g., hydro, steam, coal, nuclear) located within the action area can adversely affect ESA-listed species including sturgeon, sawfish, and sea turtles. Stressors caused by these operations include impingement and entrainment, thermal discharges, chemical discharges, and the indirect effect of prey reduction. Impingement occurs when organisms are trapped against cooling water intake screens, racks, or removal equipment by the force of moving water. Adult, juvenile, and larval sturgeon are known to be killed or injured due to impingement on cooling water intake screens (Dadswell et al. 1984; Hoff and Klauda 1979). Sea turtles entering coastal or inshore areas can also be affected by impingement in such systems. There is limited information on power plant impingement rates for sea turtles. Based on long-term monitoring data for the past 40 years, an average of 415 sea turtles were captured per year near the nuclear power plant in St. Lucie, Florida. Operation of this power plant has resulted in about seven turtle mortalities per year over this time period, mostly loggerheads and greens (NMFS 2016b). Entrainment occurs when marine organisms enter the intake water flow and pass through the cooling water intake structure and into a cooling water system. While sea turtles and adult sturgeon, salmon and sawfish are too large to be entrained, early life stages of ESA-listed fish species (e.g., eggs and larvae) are potentially susceptible to power plant entrainment.

Some power plants use “once-through-cooling” technology that withdraws large volumes of water from adjacent oceans, bays and rivers, pumps the water through the plant to cool the reactors, and then discharges the heated water back to rivers. There are approximately 550 “once-through-cooling” power plants currently operating in the U.S. (Turner-Tomaszewicz and Seminoff 2012). Cooling water discharge can alter habitat around the outflow pipe. Some discharges have been measured as high as 46 degrees Celsius (Hester and Doyle 2011). This can potentially present both advantages (e.g., provide thermal refuge 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 (e.g., alter normal ecological processes that sea turtles and fish 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. Sturgeon experience lower survival when water temperatures exceed 28 degrees Celsius (Niklitschek and Secor 2005). Increases in water temperature have also been shown to increase the susceptibility of sturgeon to hypoxia (Secor and Niklitschek 2001a). Simpfendorfer and Wiley (2004b) reported the occurrence of smalltooth sawfish in the warm water outfalls of power stations in Florida during the coldest time of year. They postulate that this potentially represents the use by sawfish of power plant outfall areas as thermal refugia; alternatively, sawfish may become trapped in the warm water outflow as surrounding temperatures decline below their tolerance level (Simpfendorfer and Wiley 2004b). Chemical discharges from cooling water intake structure may include radionuclides such as tritium, strontium, nickel, and cesium. Chlorine, lithium hydroxide, boron, and total suspended solids may also be discharged from cooling water intake structures.

Regulations have been implemented by the U.S. Environmental Protection Agency (USEPA) to reduce the risk of jeopardizing the continued existence of federally-listed species due to the impact of impingement and entrainment of cool water intakes at industrial facilities. Specifically, the USEPA promulgated a Clean Water Act section 316(b) regulation on August 15, 2014, establishing standards for cooling water intake structures (79 FR 48300-439 2015) and mandating the best technology available to reduce impingement and entrainment of aquatic organisms. As the rule is implemented it will include a number of provisions designed to reduce and monitor the take of ESA-listed species at the cooling water intakes.

A comprehensive biological opinion that covers all power plant cooling water intakes was issued by the U.S. Fish and Wildlife Service and NMFS in May, 2014. Effects would generally involve stress, injury, and mortality from being captured, entrained, or impinged by cooling water intake systems. Cooling water discharge (which is warmer than the surrounding water temperature) can alter habitat around the outflow pipe. This can present advantages (such as shelter from cold water temperatures that may stun sea turtles and allow for unseasonal growth of marine plants that green sea turtles may forage upon) and disadvantages (such as altering normal ecology sea turtles and sturgeon rely upon and result in individuals depending on unnatural conditions that can be problematic if a plant is decommissioned or goes offline) for ESA-listed species.

While power plants have not been identified as a major threat to Gulf Sturgeon, they do pose threats to Atlantic and shortnose sturgeon as they are susceptible to impingement on cooling water intake screens at power plants (ASSRT 2007a; NMFS 1998a). In general, electric power and nuclear power generating plants can affect sturgeon by impinging larger fish on cooling water intake screens and entraining larval fish. Similarly, power plants do not appear to be a major threat to smalltooth sawfish. However, a smalltooth sawfish was impinged upon cooling water intake structures at the St. Lucie Nuclear Power Plant, but released alive and in apparently good condition (NMFS 2016d).

### 6.7.8 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 2006e). These levels were far surpassed by the *Deepwater Horizon* incident.

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).

### 6.7.9 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).

### 6.7.10 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. 2010b). All sea turtles must surface to breathe, and several species are known to bask at the surface for long periods. Although sea turtles can move rapidly, sea turtles apparently are not able to avoid vessels moving at more than 4 kilometers per hour; most vessels move faster than this in open water (Hazel et al. 2007; Work et al. 2010b). Given the high level of vessel traffic in the Gulf of Mexico, frequent injury and mortality could affect sea turtles in the region (MMS 2007b). Hazel et al. (2007) suggested that green sea turtles may use auditory cues to react to approaching vessels rather than visual cues, making them more susceptible to strike as vessel speed increases. Each state along the Gulf of Mexico has several hundred thousand recreational vessels registered, including Florida with nearly one million—the highest number of registered boats in the United States—and Texas with over 600,000 (ranked sixth nationally; NMMA 2007; USCG 2003; USCG 2005). Commercial vessel operations are also extensive. Vessels servicing the offshore oil and gas industry are estimated to make 115,675 to 147,175 trips annually, and many commercial vessels travel to and from some of the largest ports in the U.S. (such as New Orleans and Houston; MMS 2007a; USN 2008).

#### 6.7.11 Disease

Fibropapillomatosis is a neoplastic disease that can negatively impact ESA-listed sea turtle populations. FP has long been present in sea turtle populations with the earliest recorded mention from the late 1800s in the Florida Keys (Hargrove et al. 2016). FP has been reported in every species of marine turtle but is of greatest concern in green turtles, the only known species where this disease has reached a panzootic status (Williams Jr et al. 1994). Historical data indicate that the disease rose in prevalence most noticeably in the 1980s. Prevalence rates as high as 45 to 50 percent have been reported within some local green turtle populations (Hargrove et al. 2016; Jones et al. 2015). FP primarily affects medium-sized immature turtles in coastal foraging pastures.

FP is characterized by both internal and external tumorous growths, which can range in size from very small to extremely large. Large tumors can interfere with feeding and essential behaviors, and tumors on the eyes can cause permanent blindness (Foley et al. 2005). Renan de Deus Santos et al. (2017) assessed stress responses (corticosterone, glucose, lactate, and hematocrit) to capture and handling in green sea turtles with different FP severity levels. Their findings suggest that moderate FP severity may affect a turtle's ability to adequately feed themselves (as evidenced by poor body condition), and advanced-stage FP severity may result in an impaired corticosterone response. While FP can result in reduced individual fitness and survival, documented mortality rates in Australia and Hawaii are low. The mortality impact of FP is not currently exceeding population growth rates in some intensively monitored populations (e.g., Florida and Hawaii in the U.S., and the Southern Great Barrier Reef stock in Queensland, Australia) as evidenced by increasing nesting trends despite the incidence of FP in immature foraging populations (Hargrove et al. 2016). Recovery from FP through natural processes has been documented in cases where the affliction is not too severe. Despite some conflicting conclusions, the overwhelming consensus among turtle researchers is that, at present, FP does not significantly impact the overall survival of sea turtle populations (Hargrove et al. 2016). However, FP cannot be discounted as a potential threat to sea turtle populations (particularly green turtles) as the distribution, prevalence rate, severity, and environmental co-factors associated with the disease have the capacity to change over time (Jones et al. 2015).

Environmental factors likely play a role in the development of FP. Most sites with a high frequency of FP tumors are areas with some degree of water quality degradation resulting from altered watersheds (Hargrove et al. 2016). Chemical contaminants which can affect sea turtle immune systems may be part of a multifactorial problem that leads to FP (Herbst 1994). An increased concentration of arginine in the diet of green turtles as a result of invasive macroalgae blooms has also been linked to an increasing prevalence of the disease (Van Houtan et al. 2010). Water temperature may also be a factor in lesion development and growth rate as warmer water temperatures during summer have been shown to promote lesion growth in some regions (Jones et al. 2015). Natural biotoxins have also been implicated as a co-factor involved in FP development. Despite there being a strong positive correlation between the prevalence of FP in green turtle populations and areas with degraded water quality, it is difficult to identify one specific causal contaminant or a combination of such working synergistically to lead to FP formation.

Expression of FP differs across ocean basins and to some degree within basins (Hargrove et al. 2016). Turtles in the Southeast U.S., Caribbean, Brazil, and Australia rarely have oral tumors, whereas such tumors are common and often severe in Hawaiian turtles. Internal tumors (on vital organs) have been found in turtles from the Atlantic and Hawaii, but are only rarely reported in Australia. Liver tumors appear to be common in Florida, but are not reported from Hawaii (Hargrove et al. 2016).

Fish diseases and parasitic organisms occur naturally in the water. Many fish species are highly susceptible to parasites and disease, particularly during early life stages. Native fish have co-evolved with such organisms and individuals can often carry diseases and parasites at less than lethal levels. While disease organisms commonly occur among wild fish populations, under favorable environmental conditions these organisms are not expected to cause population-threatening epizootics. However, outbreaks may occur when stress from disease and parasites is compounded by other stressors such as diminished water quality, flows, and crowding (Guillen 2003; Spence and Hughes 1996). At higher than normal water temperatures fish species may become stressed and lose their resistance to diseases (Spence and Hughes 1996). Consequently, diseased fish become more susceptible to predation and are less able to perform essential functions, such as feeding, swimming, and defending territories (McCullough 1999). The introduction of non-indigenous fish pathogens to wild fish populations through aquaculture operations also represents a threat to some fish populations. The aquarium industry is another possible source for transfer of non-indigenous pathogens or non-indigenous species from one geographic area to another, primarily through release of aquaria fish into public waters.

Salmonids are susceptible to numerous bacterial, viral, and fungal diseases. The more common bacterial diseases in New England waters include furunculosis, bacterial kidney disease, enteric redmouth disease, coldwater disease, and vibriosis (Egusa and Kothekar 1992; Olafesen and Roberts 1993; USFWS and Gaston 1988). Furunculosis, which is particularly widespread, can be a significant source of mortality in wild Atlantic salmon populations if river water temperatures become unusually high for extended periods (USFWS and Gaston 1988). Whirling disease is a parasitic infection caused by the microscopic parasite *Myxobolus cerebrali*. Infected fish continually swim in circular motions and eventually expire from exhaustion. The disease occurs both in the wild salmonids and in hatcheries. Saprolegnia is a fungal disease of Atlantic salmon and is primarily found in adult males. It invades the epidermis and is associated with the presence of high levels of androsteroids (Olafesen and Roberts 1993; USFWS and Gaston 1988).

In 1996, the first occurrence of the infectious salmon anemia (ISA) virus in North America was found in an aquaculture facility in New Brunswick, Canada (Fay et al. 2006). The first outbreak of ISA in the United States was reported in 2001 in an aquaculture facility in Cobscook Bay, Maine. Approximately 925,000 fish were removed from aquaculture pens throughout the Bay that year, and eventually all cultured salmon in the Bay had to be removed (Fay et al. 2006). While captive fish have the highest risk for transmission and outbreaks of diseases such as ISA, wild fish that must pass near aquaculture facilities are at risk of encountering both parasites and pathogens from hatchery operations. Although substantial progress has been made in recent years to reduce the risks to wild fish posed by aquaculture, this remains a potential threat.

There are over 30 identified parasites of Atlantic salmon including external parasites such as gill maggot, freshwater louse, and leech, and internal parasites such as trematodes (flukes), cestodes (tapeworms), acanthocephalans (spiny-headed worms) and nematodes (round worms) (Hoffman 1999; Scott and Scott 1988b). Several species of sea lice, a marine ectoparasite found in Atlantic and Pacific coastal waters, can cause deadly infestations of farm-grown salmon and may also affect wild salmon.

There have been very few incidences of disease in wild populations of sturgeon species and most disease related mortality has been documented in captive rearing facilities (SSSRT 2010). While some disease organisms have been identified from wild Atlantic sturgeon, they are unlikely to threaten the survival of the wild populations (ASSRT 2007a). Parasites, including flatworms and roundworms, have been documented in Atlantic sturgeon but are not considered a threat to populations of this species. Thirteen taxa of parasites have been identified in shortnose sturgeon including four coelenterates, two nematodes, three leeches, one arthropod, and the sea lamprey. The degree of parasite infestation is believed to be quite low and, in general, shortnose sturgeon do not appear to be harmed by these parasites (SSSRT 2010). Parasites are known to occur in both wild-caught and cultivated Nassau grouper, predominantly in the viscera and gonads. These include encysted larval tapeworms, nematode, isopods, and trematodes (Manter 1947; Thompson and Munro 1978). However, the impact of parasites on populations of Nassau grouper is largely unknown.

There are no studies indicating that diseases or parasitism represent a threat factor for populations of green sturgeon (NMFS 2021d) or Gulf sturgeon (USFWS and NMFS 2022). There is also no information to indicate that disease is a factor affecting populations of smalltooth sawfish (NMFS 2018g).

### 6.7.12 Scientific Research and Permits

Regulations under ESA section 10(a)(1)(A) allow issuance of permits authorizing take of certain ESA-listed species for the purposes of scientific research. Prior to the issuance of such a permit, the proposal must be reviewed for compliance with section 7. Scientific research permits issued by NMFS currently authorize studies of ESA-listed species in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans. Scientific research permits issued by NMFS currently authorize studies of ESA-listed sea turtles include methods such as 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 and Pacific Oceans. 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.

#### 6.7.12.1 *Authorized Take by the Permits Division*

Currently (as of November 1, 2022), there are at least 33, 75, and seven active research and enhancement permits, including the MMHSRP's current permit, that may affect the ESA-listed sea turtles, sturgeon, and smalltooth sawfish U.S. DPS respectively in the Arctic, Atlantic, Indian, Pacific, and Southern Oceans considered during this programmatic consultation. The primary objective of these studies is generally to monitor populations or gather data for behavioral and ecological studies. These research and enhancement activities may directly or unintentionally result in harassment, stress, and injury, or unintentionally result in mortality. The permits for the research and enhancement activities authorize takes of all lifestages including juveniles, subadults, and adults. There are currently two total ESA/MMPA permits solely for the import/export/receipt of sea turtles and sturgeon parts (one for sea turtles, one for sturgeon) and two such ESA/MMPA permits for the U.S. DPS of smalltooth sawfish parts for purposes such as cell line development or genetic analysis; these do not authorize take of live animals and there are no effects to ESA-listed sea turtles, sturgeon, or smalltooth sawfish for these research and enhancement activities.

Since 2006, conservative mitigation measures implemented by NMFS through permit conditions (e.g., reduced soak times at warmer temperatures or lower DO concentrations, minimal holding or handling time) and additional precautions taken by sturgeon researchers have reduced the lethal and sublethal effects of capture in gill, trammel and trawl nets on Atlantic and shortnose sturgeon. From 2006 through 2016, researchers reported only two shortnose sturgeon killed by capture gear out of 7,019 captured, for a capture mortality rate of 0.03 percent. Since they were listed in 2012, the mortality rate associated with Atlantic sturgeon capture in scientific research is 0.22 percent (14 killed out of 6,466 captured). In 2017, the Permits Division implemented a program for the issuance of permits for research and enhancement activities on Atlantic sturgeon and shortnose sturgeon. A section 7 programmatic consultation biological opinion determined that this action would not likely jeopardize the continued existence of ESA-listed species and would not likely result in the destruction or adverse modification of critical habitat (NMFS 2017e). In addition to the required mitigation measures designed to reduce lethal take and sub-lethal effects on sturgeon, the Program establishes annual limits on sturgeon mortality resulting from research activities by subpopulation (i.e., spawning stock) and life stage. Relative mortality limits are calculated as a proportion of the estimated population size and are based on the relative health of the population. A health index is calculated by NMFS based on the best available information on the population including abundance, population trends, known threats, and information on spawning activity. For adults/subadults and juveniles, relative annual maximum mortality limits are set at 0.4, 0.6, and 0.8 percent of the estimated population size for sturgeon populations with a health index rating of "low," "medium," and "high," respectively. For populations where there is insufficient information to calculate a health index or there is no estimate of population size, the default maximum mortality limit is conservatively established at one fish per year. Maximum annual mortality limits can be exceeded in any given year by up to two times (i.e., 2X), as long as the five-year moving average is within the established maximum annual mortality limit for that population and life stage.

In 2019, the Permits Division also implemented a program for the issuance of permits for research and enhancement activities on smalltooth sawfish. A section 7 programmatic consultation biological opinion determined that this action would not likely jeopardize the continued existence of ESA-listed species and would not likely result in the destruction or adverse modification of critical habitat (NMFS 2019e). As with sea turtles and sturgeon, mitigation measures implemented by NMFS through permit conditions and additional precautions taken by researchers have reduced the lethal and sublethal effects of research activities on smalltooth sawfish.

With the exception of Atlantic salmon and Gulf sturgeon, scientific research permits for other ESA-listed species considered in this opinion are issued by the NMFS regional office with jurisdiction over that particular species. The USFWS issues section 10(a)(1)(A) permits for Atlantic salmon. For Gulf sturgeon, a special rule promulgated at the time of listing (56 FR 49658) gives the states permitting authority to allow taking of this species, in accordance with applicable state laws, for educational purposes, scientific purposes, and enhancement of propagation.

### 6.7.13 Sea Turtle Strandings

As discussed above, bycatch studies are often compromised by limited data, lack of spatial coverage, and difficulty estimating the effects of post-capture mortality or reduced fitness (Lewison et al. 2004; Tomás et al. 2008). Supplemental information regarding the effects of bycatch and other potential threats on sea turtles can be derived from strandings data (i.e., turtles that wash ashore, dead or alive, or are found floating dead or alive, generally in a weakened condition). In this section we summarize information obtained from sea turtle strandings program reports and published papers based on strandings in U.S. waters and globally.

Previous studies have used turtle strandings data to evaluate sea turtle health, age, size composition, diet, reproductive status, and population trends. The cause of stranding (i.e., bycatch, ship strikes, biotoxins, and disease) can sometimes be inferred from stranded turtles, although it is often recorded as “unknown” because there is no clear indicator (i.e., lesions, tumors, fishing gear) on the carcass or because the carcass is too decomposed to determine. Fishery interactions, in particular, can be difficult to assess in stranded turtles as some fishing gears leave little or no evidence on the body (either in the form of attached gear or specific injuries), while others cannot always be attributed with certainty to a particular fishery. In addition, bycaught turtles that are released alive may be more susceptible to other mortality factors (e.g., ship strikes, disease) due to increased stress and/or injuries suffered during capture.

The relationship between unobserved turtle mortality at sea and observed strandings is not well-studied (Hart et al. 2006). Because carcasses decompose while entrained in currents and eddies, the number of recorded sea turtle strandings likely represents a minimum estimate of mortality (Epperly et al. 1996). Epperly et al. (1996) compared estimates of sea turtle mortalities from North Carolina’s winter trawl fishery in 1991-1992 to the number of turtles stranded on beaches adjacent to the fishing grounds. They found that the number of dead turtle strandings accounted for only 7 to 13 percent of the estimated fishery-induced mortalities. They attributed this discrepancy to offshore bottom currents, which normally transport lifeless turtles away from the beach during the winter.

Although inferences from reported strandings may be subject to a number of caveats, when considered over wide spatio-temporal extents and in conjunction with other data sources, strandings data can offer useful insights into turtle distributions, life histories, and vulnerability to various sources of mortality (Tomás et al. 2008). While the cause of a turtle stranding is not always determinable, strandings data have been used by researchers to indicate the relative impacts of various anthropogenic and natural stressors on turtle populations.

Long-term time series strandings data from several studies suggest that anthropogenic factors, particularly fisheries, are responsible for a relatively large proportion of mortalities in many sea turtle populations globally. Casale et al. (2010) used stranding data to investigate mortality factors in loggerhead turtles stranded in the waters around Italy from 1980-2008. They found that mortalities due to anthropogenic factors, primarily from bycatch, were two to three times as prevalent as natural mortalities in stranded loggerheads. In addition to bycatch in longlines and trawls, entanglement in ghost-gear or other debris and boat strikes were identified as important anthropogenic sources of mortality in this study.

Orós et al. (2016) analyzed the causes of stranding of 1,860 loggerhead turtles admitted to a rehabilitation center on Gran Canaria Island, Spain from 1998 to 2014. Entanglement in fishing gear and/or plastics accounted for 64 percent of the strandings with a known cause (20 percent were recorded as “unknown” cause), followed by ingestion of hooks and monofilament lines (15 percent), infectious disease (7 percent), and boat strike (7 percent). The cause of mortality could not be determined for 70 percent of the 226 loggerheads that were dead when admitted to the rehabilitation center; 12 percent died from entanglement, 9 percent from trauma, and 6 percent from ingestion of hooks (Orós et al. 2016). This study also reported a decrease in the number of annual strandings attributed to crude oil after 2006, presumably linked to the designation of the Canary Islands as a Particularly Sensitive Sea Area in 2005 by the International Maritime Organization (Camacho et al. 2013).

Panagopoulos et al. (2003) used strandings data from 1992 to 2000 to evaluate causes of sea turtle mortality in the waters around mainland Greece and the Greek Islands. A total of 1,080 turtle strandings were reported, of which nearly 93 percent were loggerheads. About 80 percent of turtles that were recovered with injuries showed signs of incidental capture in fishing gear. Of these, 46 percent were injured due to hook ingestion and/or entanglement; the remaining 34 percent were intentionally hit on the head, presumably after incidental capture in fishing gear (Panagopoulos et al. 2003).

Tomás et al. (2008) analyzed sea turtle strandings (n = 619) over a 14 year period (1993 to 2006) from the Mediterranean Sea near Valencia in eastern Spain. Loggerhead turtles accounted for 98 percent of recorded strandings. Interactions with longline fisheries accounted for 43.5 percent of observed stranding for which a likely cause was identified.

Strandings data have also been used to document the relative impact of disease in sea turtles, particularly the tumor forming disease FP (see section 6.7.11 for more details on this disease). Elevated mortality rates dues to the combination of disease and fisheries bycatch can be particularly impactful on turtle populations. Chaloupka et al. (2008b) investigated cause-specific temporal and spatial trends in sea turtle strandings in the Hawaiian Archipelago over a 22-year period (1982–2003). Green turtles comprised 97 percent of the 3,861 strandings recorded over this period. Fibropapillomatosis was the most common known cause of the green turtle strandings in this study (28 percent), followed by hook-and-line fishing gear-induced trauma (7 percent), gill net fishing gear-induced trauma (5 percent), boat strike (2.5 percent), and shark attack (2.7 percent) (Chaloupka et al. 2008b). Miscellaneous causes comprised 5.4 percent of strandings whereas 49 percent of green turtle strandings could not be attributed to any known cause. Estimated mortality rates (i.e., conditional probability) were 88 percent for FP, 69 percent for gill net gear and 52 percent for hook-and-line gear.

Poli et al. (2014) analyzed sea turtle strandings on the coast of Paraíba State, Northeastern Brazil, from August 2009 to July 2010. A total of 124 strandings were recorded in this period, 85 percent of which were green turtles and 12 percent hawksbill. The presence of external tumors, suggestive of FP, was found in nearly one-third of the strandings in this study. Twenty individuals had synthetic anthropogenic debris in the gastrointestinal tract. Other traces of human interactions were observed in 43 individuals, such as injuries caused by entanglement in fishing lines or nets, collisions with vessels, direct contact with oil spills and lesions caused by sharp or spiked objects (Poli et al. 2014).

Sea turtle mass stranding events have also been documented in the literature. Alava et al. (2005) studied the olive ridely mass mortality events that occurred in Ecuador in 1999. From August through September of that year a total of 1,113 turtles were stranded (99 percent were olive ridleys). The cause of this stranding event was not clear. The majority of dead turtles in the mass stranding events did not exhibit discernable injuries or other external damage that might have suggested prior interactions with fisheries. Other possible alternative explanations for the strandings put forward by the authors include thermal stress or hypothermia due to the presence of cold currents such as the Humboldt Current and the presence of an epizootic event or outbreak (e.g., bacteria or virus) that affected migratory olive ridleys in waters off Ecuador.

#### 6.7.13.1 *Sea Turtle Stranding and Salvage Network*

The Sea Turtle Stranding and Salvage Network (STSSN) was established in the southeastern United States and Gulf of Mexico in 1980, in Hawaii in 1982, and in the NMFS Southwest Region through the California Marine Mammal Stranding Network in 1983 in response to sea turtles washing up on beaches or floating in the water, dead or in need of assistance. The STSSN is organized through a structure that consists of Atlantic, west Pacific, and east Pacific coordinators, and there is a coordinator for each state. The network consists of trained volunteers, municipal, state and federal employees and their designated agents who operate under the direction of the state and national coordinators. Network participants document marine turtle strandings and incidental captures, including any fishing gear or other marine debris associated with the stranded turtle, in their respective states and enter that data into a central database.

Based on data collected by NOAA, in the Atlantic and Gulf of Mexico between 2005 and 2015, 3,928 in-water stranded sea turtles were reported to the STSSN (NMFS 2016h). The species composition of these events was 1,641 loggerheads, 1,659 green turtles, 47 leatherbacks, 80 hawksbills, 390 Kemp's ridleys and 111 unidentified species. The term "in-water stranded sea turtles" can be described as any animal encountered that is cold stunned, sick, injured, entangled or dead. In the Hawaiian Islands, 972 in-water strandings were reported between 2005 and 2015. The species composition of these events was 913 greens, one leatherback, 47 hawksbills, six olive ridleys and one unknown turtle species.

Leatherbacks, green turtles, loggerheads, and olive ridleys off the United States west coast face anthropogenic and natural threats that can result in both live and dead strandings. However, reported turtle strandings off the West Coast are significantly less common compared to strandings off the Atlantic and Gulf of Mexico coasts or Hawaii. In Oregon and Washington, 41 in-water strandings were reported between 2005 and 2015: 14 greens, one leatherback, four olive ridleys and one unknown species. In California, 60 sea turtles have been reported through the STSSN from 2005 to 2015: four loggerheads, 45 greens, five leatherbacks, four olive ridleys and two unknown species (NMFS 2016h). About 350 turtle strandings along the entire west coast were reported to NMFS between 1958 and 2009 (LeRoux 2012). The causes of these strandings included illness-related, marine debris (entanglement and ingestion), boat collisions, fisheries interactions, and power plant entrainments. Approximately one-third of the stranding incidents involved the capture and release of live turtles, the majority of which were stranded due to power plant entrainment. The remaining two-thirds involved either live animals that were transported to rehabilitation facilities and died or animals found dead; in many cases the direct cause of death was not determined (LeRoux 2012).

### 6.7.14 Impact of the Environmental Baseline on Sea Turtles, Sturgeon, and Sawfish

Numerous factors have contributed to the endangered status of sea turtles, sturgeon, and sawfish, including: harvesting/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, climate change, and habitat destruction/modification appear to be the major threats to the survival and recovery of sea turtle, sturgeon, and sawfish 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.

# 7 Effects of the Action

Section 7 regulations define "effects of the action" as all consequences to ESA-listed species or designated critical habitat that are caused by the proposed action, including the consequences of other activities that are caused by the proposed action. A consequence is caused by the proposed action if it would not occur but for the proposed action and it is reasonably certain to occur. Effects of the action may occur later in time and may include consequences occurring outside the immediate area involved in the action (50 C.F.R. §402.17).

In this section, we describe the potential stressors associated with the proposed action that are not likely to adversely affect and are likely to adversely affect the target and non-target ESA-listed marine mammals and non-target ESA-listed sea turtles and fish described in Section 5.2. We also discuss the probability of individuals of these ESA-listed species being exposed to the stressors likely to adversely affect them based on the best scientific and commercial evidence available and the probable responses to those individuals (given probable exposures) based on the available evidence.

## 7.1 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 described in Section 5.2

to the stressors associated with the proposed action. For marine mammals, stressors may include 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, and permanent captivity. For turtles and fishes, the stressors include vessel traffic, entanglement, capture, restraint, and handling.

### 7.1.1 Potential Response to Vessel and Aerial Surveys

The MMHSRP will use boats, planes, and UASs to approach marine mammals. During operations of these machines, staff will be vigilant in looking for marine mammals, sea turtles and fishes and following PDCs and measures required under the permit program to minimize the effects of operations to animals.

#### 7.1.1.1 *Close Approach and Vessel Use*

Close approaches would occur during numerous research and enhancement activities such as health assessment, disentanglement, biopsy sampling, breath sampling, tagging, photo identification, and collection of sloughed skin and feces. The potential response to all activities that would follow a close approach except documentation are further described below. Documentation of animals (e.g., photography, videography, recording of observations, etc.) is not expected to produce any response beyond that caused by a close approach, and thus is not analyzed further in this opinion. Close approaches increase the potential for accidental collisions (see Section 7.1.1.3) with animals and for stress responses among animals that are closely approached. Incidental takes of non-targeted animals from close approaches are likely if they are in the vicinity of the targeted animal(s).

There is mounting evidence that wild animals respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses (in which an animal perceives human activity as a potential threat and undergoes physiological changes to prepare for a flight or fight response), interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). These responses have been associated with abandonment of sites (Sutherland and Crockford 1993), reduced reproductive success (Giese 1996; Mullner et al. 2004), and the death of individual animals (Bearzi 2000; Daan 1996; Feare 1976). Stress is an adaptive response and does not normally place an animal at risk. However, distress involves a stress response resulting in a biological consequence to the individual. The stress response of fish and reptiles involves the hypothalamic-pituitary-adrenal axis being stimulated by a stressor, causing a cascade of physiological responses, such as the release of the stress hormones cortisol, adrenaline (epinephrine), glucocorticosteroids, and others (Atkinson et al. 2015; Barton 2002; Bayunova et al. 2002; Busch and Hayward 2009; Lankford et al. 2005; McConnachie et al. 2012; Wagner et al. 2002). These hormones subsequently can cause short-term weight loss, the release of glucose into the blood stream, impairment of the immune and nervous systems, elevated heart rate, body temperature, blood pressure, fatigue, cardiovascular damage, and alertness, and other responses (Aguilera and Rabadan-Diehl 2000; Busch and Hayward 2009; Dierauf and Gulland 2001; Guyton and Hall 2000; NMFS 2006a; Omsjoe et al. 2009; Queisser and Schupp 2012; Romero 2004; Wagner et al. 2002), particularly over long periods of continued stress (Desantis et al. 2013; Sapolsky et al. 2000). In some species, stress can also increase an individual's susceptibility to gastrointestinal parasitism (Greer 2008). In highly-stressful circumstances, or in species prone to strong "fight-or-flight" responses, more extreme consequences can result, including muscle damage and death (Cowan and Curry 1998; Cowan and Curry 2002; Cowan and Curry 2008; Herraez et al. 2007). The most widely-recognized indicator of vertebrate stress, cortisol, normally takes hours to days to return to baseline levels following a significantly stressful event, but other hormones of the hypothalamic-pituitary-adrenal axis may persist for weeks.

Cetaceans have been observed to react in a variety of ways to close vessel approaches. Reactions range from little to no observable change in behavior to momentary changes in swimming speed, pattern, orientation, diving, time spent submerged, foraging and respiratory patterns (Au and Green. 2000; Baker et al. 1983; Hall 1982; Jahoda et al. 2003; Koehler 2006; Scheidat et al. 2006). Individual factors related to a whale's physical or behavioral state can result in differences in the individual's response to vessels. These factors include the age or sex of the whale; the presence of offspring; whether or not habituation to vessels has occurred; individual differences in reactions to stressors; vessel speed, size, and distance from the whale; and the number of vessels operating in the proximity (Baker et al. 1988; Gauthier and Sears 1999; Hooker et al. 2001; Koehler 2006; Lusseau 2004; Richter et al. 2006; Weilgart 2007; Wursig et al. 1998b). Observations of large whales indicate that cow-calf pairs, smaller pods, and pods with calves appear to be particularly responsive to vessel approaches (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982). It should be noted that human observations of a whale's behavioral response may not reflect a whale's actual experience; thus, our use of behavioral observations as indicators of a whale's response to research may or may not be correct (Clapham and Mattila 1993).

Watkins et al. (1981) found that both fin whales and humpback whales appeared to react to vessel approach by increasing swim speed, exhibiting a startled reaction, and moving away from the vessel with strong fluke motions. In another study, 71 percent of 42 whales that were closely approached (within 10 meters) showed no observable reaction; when reactions occurred, they included lifting of the head or flukes, arching the back, rolling to one side, rolling to one side and beating the flukes, or performing a head lunge (Baumgartner and Mate 2003). Studies of other baleen whales, specifically bowhead and gray whales, have documented similar patterns of short-term behavioral disturbance in response to a variety of actual and simulated vessel activity and sound (Malme et al. 1983; Richardson et al. 1985). Behavioral disturbance may negatively impact essential functions such as breeding, feeding and sheltering. Close approaches by inflatable vessels for biopsy sampling caused fin whales (n = 25) in the Ligurian Sea to stop feeding and swim away from the approaching vessel (Jahoda et al. 2003). A study on the effects of tag boat presence on sperm whale behavior found that sperm whales (n = 12) off the coast of Norway spent 34 percent less time at the surface and 60 percent more time in a non-foraging silent active state when in the presence of the boat than in the post-tagging baseline period, indicating costs in terms of lost feeding opportunities and recovery time at the surface (Isojunno and Miller 2015).

Changes in cetacean behavior can correspond to vessel speed, size and distance from the whale, as well as the number of vessels operating in the proximity (Baker et al. 1988). Beal and Monaghan (2004) concluded that the level of disturbance was a function of the distance of humans to the animals, the number of humans making the close approach, and the frequency of the approaches. In a study on the effects of close approaches by boat to Indo Pacific bottlenose dolphins, results showed that behavioral responses varied significantly depending on the distance between the animal and the approaching vessel: there was significantly less feeding and resting when boats approached dolphin groups to a distance of 50 meters than when they did to a distance of 150 meters, or with controlled approaches. The dispersal of dolphin groups was also significantly tighter (less dispersed), and direction of movement was less neutral, when boats approached to 50 meters than that with 150-meter-distance or controlled approaches (Steckenreuter et al. 2011).

Pinniped responses to disturbance are variable depending on species, site (rookery vs. haul-out), season (breeding vs. nonbreeding), and the level of predation risk, if the site is abandoned (Allen et al. 1984; Calkins and Pitcher 1982; Engelhard et al. 2002; Maniscalco et al. 2007; Ono et al. 1987; Wirsing et al. 2008). In the water, pinnipeds are likely to respond to close approach by vessel with avoidance behaviors, such as diving. On land, pinnipeds are sensitive to human presence and may be influenced by chronic disturbance to rookery beaches (Wilson et al. 2012b). 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).

Effects determinations for stressors resulting from close approaches and vessel use regarding ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.1).

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). We do not expect these responses to increase the likelihood of injury by annoying a sea turtle 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 sea turtle species considered in this opinion.

According to Popper et al. (2014a), 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. 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. 2014a). This includes a study of rainbow trout (*Oncorhynchus mykiss*) exposed to increased noise for nine months in an aquaculture facility. The study also did not document any negative effects on the health of the fish from this increased exposure to noise (Popper et al. 2014a; Wysocki et al. 2007).

Popper et al. (2014a) suggest that low frequency vessel noise (primarily from shipping traffic) may mask sounds of biological importance. 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. 2014a). 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.

#### 7.1.1.2 *Use of Aircraft*

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 to 335 meters (804 to 1,099 feet) 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).

Potential responses of pinnipeds 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 (492 feet) altitude) twin-engine plane (Born et al. 1999). In Baffin Bay, Alaska, 44 bearded seals did not react to a twin-engine turboprop plane flying at 100 to 200 meters altitude (Finley and Renaud 1980). Burns and Frost (1979) report that bearded seals raise their heads but usually remain on ice unless a plane passes directly overhead. Kelly et al. (1986) report that all ringed seals (n = 13) subsequently returned to their lairs and hauled out, after entering the water in response to anthropogenic disturbances. In two separate studies, some Steller sea lions have demonstrated awareness to fixed wing aerial surveys at elevations between 195 to 250 meters (640 to 820 feet), but no sea lions left the beach or stampeded (Snyder et al. 2001; Wilson et al. 2012b). The presence and movements of vessels may disturb normal seal behaviors or cause seals to abandon their preferred habitats (Cameron et al. 2010; Kelly et al. 2010). On-ice ringed seals have been documented exhibiting short-term escape reactions (i.e., temporarily entered the water) when a ship came within 0.25 to 0.5 kilometers (Brueggeman et al. 1992).

**Figure 25.** One type of unmanned aerial system that has been used in the field for marine mammal research: the APH-22 Hexa-copter.

The field of UASs for marine mammal monitoring is still in its infancy; as such, published reports on behavioral responses to UASs among marine mammals were limited at the time of this opinion. Disturbance in marine mammals to UASs may result from sound or from visual cues (Smith et al. 2016). Reactions to UASs by pinnipeds may range from no response, to looking up at the UAS, to leaving the beach and entering the water. A study that employed a hexa-copter (Figure 25) 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).

Effects determinations for stressors resulting from aircraft use regarding ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.1).

Sea turtles may or may not respond to the presence of a manned aircraft, depending upon the altitude of and proximity of the aircraft to the turtle. In decades of aerial surveys by the NMFS Southwest Fisheries Science Center, researchers have very rarely observed behavior indicative of a startle or evasive response (e.g., change in travel direction or surfacing behavior) by turtles when flying overhead at 650 feet (198 meters) in altitude in Partenavia and Twin Otter aircraft; these two aircraft types are among the quietest available for marine wildlife surveys. Other sea turtle researchers have reported minor swimming or diving responses to aerial surveys. Since UASs are smaller and quieter than manned aircraft, they are expected to result in similar or less startle and evasive responses in the sea turtles than manned aircraft. Sea turtles near Australia exhibited no evasive behaviors in response to a drone flying at or above altitudes of 20 to 30 meters (66 to 98 feet) and at or above an altitude of 10 meters (33 feet) for juvenile green and hawksbill turtles foraging on shallow, algae-covered reefs (Bevan et al. 2018). We do not expect the aforementioned behavioral reactions to increase the likelihood of injury by annoying a sea turtle 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 aircraft use that may result in behavioral reactions is insignificant and is not likely to adversely affect the ESA-listed sea turtles species considered in this opinion.

Regarding ESA-listed fishes, any noise or visual disturbance associated with aircraft use during MMHSRP activities would be of short duration. ESA-listed fishes typically occupy the middle or lower parts of the water column, where the effects of aircraft presence would not be as pronounced as it would be at the surface. If an ESA-listed fish were to be disturbed by an aircraft, we would expect the animal to temporarily leave the area or move to a deeper depth where the disturbance would diminish. We do not expect the aforementioned 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 aircraft use that may result in behavioral reactions is insignificant and is not likely to adversely affect the ESA-listed fish species considered in this opinion.

#### 7.1.1.3 *Vessel Strike*

The use of vessels in close approaches, surveys and other activities under the MMHSRP means there is the potential for vessel strikes of ESA-listed species, particularly marine mammals and sea turtles but also some fish species.

Vessel strikes are known to adversely affect ESA-listed species including marine mammals, sea turtles, and fishes (Brown and Murphy 2010; Laist et al. 2001; NMFS and USFWS 2008; Work et al. 2010a). The probability of a vessel collision depends on the number, size, and speed of vessels, as well as the distribution, abundance, and behavior of the species (Conn and Silber 2013c; Hazel et al. 2007; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007). If an animal is struck by a research vessel, it may experience minor, non-lethal injuries, serious injuries, or death.

Marine mammals that spend long periods of time at the surface to restore oxygen levels after deep dives (e.g., sperm whales) are the most vulnerable to vessel strikes. Worldwide ship strike records show little evidence of strikes of small cetaceans and pinnipeds from the shipping sector and larger vessels (NOAA 2020). Many studies have demonstrated that small cetaceans often show avoidance behavior if surface vessels move toward them, either due to the physical presence of the vessel, the underwater noise of the vessel, or an interaction between the two (Amaral and Carlson 2005; Bain et al. 2006; Bejder et al. 1999; Bejder and Lusseau 2008; Bejder et al. 2009; Erbe 2002a; Goodwin and Cotton 2004; Lemon et al. 2006; Lusseau 2003; Lusseau 2006; Nowacek et al. 2001; Williams et al. 2002; Wursig et al. 1998a). It has been suggested that the noise generated during motion is probably an important factor (Blane and Jaakson 1994; Evans et al. 1992; Evans et al. 1994), and water disturbance may also be a factor. These studies suggest that the behavioral responses of cetaceans to surface vessels are similar to their behavioral responses to predators.

One gray whale in Alaska came up under a research vessel and made contact with the boat causing it to flip over in 2013. Other researchers have struck two North Atlantic right whales in the northeast U.S., though the incidents did not occur during NMFS-permitted marine mammal research activities, and neither North Atlantic right whale was seriously injured or killed as a result of the vessel strike. These incidents occurred in 2009 and in 2014.

For small cetaceans and pinnipeds, their smaller size and maneuverability generally make the risk of vessel strike very unlikely. We are not aware of researchers striking any small cetaceans in over 40 years. In 2021, a dolphin was accidentally struck by a Navy small boat in Saint Andrew's Pass, Florida with an associated MMPA Letter of Authorization (LOA) and ESA consultation (NOAA 2022). The exact species was not determined but based on the area it may have been a bottlenose dolphin (*Tursiops truncatus*). This was the first report in over 20 years of a small cetacean being struck by a vessel as a result of Navy activities.

Further, we have no confirmed reports of holders of any permits or authorizations issued by the Permits Division striking pinnipeds. A potential vessel strike of a pinniped was reported by a scientific research permit holder in 2016, when a cetacean research vessel in transit in Monterey Bay, California, felt something hit the hull. The vessel was transiting at 12-14 knots in thick but variable fog and was not conducting permitted research at the time. The engine was immediately stopped, and the researchers observed a light brown object or animal in the water, assumed by the researchers to be a California sea lion (*Zalophus californianus*). The object or animal was not observed again, and no fur or blood was observed in the water; therefore, this incident could not be confirmed as a vessel strike of a marine mammal.

In the previous 10 years of MMHSRP activities from 2012 through 2022, there have been two recorded vessel strikes of marine mammals - a fin whale and a manatee (*Trichechus manatus latirostris*; a species under the jurisdiction of the U.S. Fish and Wildlife Service). The MMHSRP has never struck a small cetacean or pinniped in 23 years, and there are no records of strikes of large cetaceans with the exception of the fin whale strike noted below.

The only instance of any vessel strike of a marine mammal under NMFS' jurisdiction by the MMHSRP was on August 8, 2021, when a Co-Investigator (CI) of the MMHSRP accidentally struck a fin whale with their small rescue vessel while conducting an emergency response to an entangled humpback whale. This was the first and only known vessel strike of a large whale incidental to authorized MMHSRP activities, which have occurred for decades. The fin whale was not seriously injured and the MMHSRP put additional mitigation measures in place that will be employed by all personnel to prevent vessel strikes in the future. The incident highlighted the benefit of having experienced personnel and a small, maneuverable vessel, which resulted in a swift reaction to reduce speed and alter course.

Much less is known about vessel strike risk for sea turtles, but it is considered an important injury and mortality risk within the action area (Lutcavage et al. 1997c). Based on behavioral observations of sea turtle avoidance of small vessels, green turtles may be susceptible to vessel strikes at speeds as low as 3.7 kilometers per hour (2 knots) (Hazel et al. 2007). If an animal is struck by a vessel, responses can include death, serious injury, and/or minor, non-lethal injuries, with the associated response depending on the size and speed of the vessel, among other factors (Conn and Silber 2013a; Jensen and Silber 2004; Laist et al. 2001; Vanderlaan and Taggart 2007).

The likelihood of vessel strikes of sea turtles is expected to be extremely unlikely given that researchers typically adhere to slow vessel transit speeds (usually 18.5 kilometers per hour [10 knots] or less) and the numerous observers on lookout for cetaceans will also be able to spot sea turtles that surface for air. On October 5, 2018, we received a report of an incident involving a vessel strike of an olive ridley turtle in Hawaii during cetacean research activities under a scientific research permit (Permit No. 20605). To our knowledge, this was the first report and only incident in the history of the cetacean research permitting program of a researcher striking a sea turtle with a research vessel during cetacean research and enhancement activities. At the time of the incident, the Permits Division and us consulted with NMFS sea turtle experts, and determined that the likelihood of additional vessel strikes of sea turtles is expected to be extremely unlikely. For this particular incident, the permit holder identified factors contributing to this incident (e.g., Beaufort sea state, debris in the water, and poor vessel configuration for forward observer) and provided mitigation measures for preventing a future vessel strike incident (e.g., properly outfitted research vessels and a dedicated non-target species observer).

Effects determinations for stressors resulting from vessel strikes to ESA-listed cetaceans, pinnipeds, and sea turtles are further discussed below in the *Risk Analysis* (Section 7.4.3).

Fish are able to use a combination of sensory cues to detect approaching vessels, such as sight, hearing, and their lateral line (for nearby changes in water motion). A study on fish behavioral responses to vessels showed that most adults exhibit avoidance responses to engine noise, sonar, depth finders, and fish finders (Jørgensen et al. 2004), reducing the potential for vessel strikes. Misund (1997) found that fish ahead of a vessel showed avoidance reactions at ranges of 50 to 350 meters (160 to 490 feet). When the vessel passed over them, some fish responded with sudden escape responses that movement away from the vessel laterally or through downward compression of the school. In an early study conducted by Chapman and Hawkins (1973), the authors observed avoidance responses of herring from the low-frequency sounds of large vessels or accelerating small vessels. Avoidance responses quickly ended within ten seconds after the vessel departed. Conversely, Rostad (2006) observed that some fish are attracted to different types of vessels (e.g., research vessels, commercial vessels) of varying sizes, noise levels, and habitat locations.

Interactions with ESA-listed fishes can potentially involve disturbance associated with research vessel operation and vessel strikes, but the possibility of these interactions is considered remote because the proposed research and enhancement activities are directed at cetaceans. The research vessels used for research and enhancement activities will be targeting cetaceans near the water's surface. Each of the ESA-listed fishes considered in this consultation are thought to spend at least some time in the upper portions of the water column where they may be susceptible to vessel strike. However, ESA-listed fishes typically occupy the middle or lower parts of the water column where vessel strikes will not occur. Despite these species' utilization of the upper portion of the water column for at least some of their life history, in most cases, we would anticipate the ESA-listed fishes considered in this consultation will be able to detect vessels or other in-water devices and avoid them. Therefore, we find the stressor of vessel strike to ESA-listed fishes considered in this opinion to be discountable.

### 7.1.2 Potential Response to Active Acoustic Playbacks, Hazing and Attractants

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 the use of acoustic deterrents, but source levels are not expected to reach the levels necessary to cause physical injury, including temporary or permanent hearing loss.

We expect that any adverse response by marine mammals to active acoustic playbacks would be from the stress of close approach by a vessel (described above, Section 7.1.1), 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 (328.1 feet)), 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 2014g). Effects determinations for stressors resulting from active acoustic playbacks, hazing, and attractants to ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.10).

Sea turtles and ESA-listed fishes are expected to be less affected by anthropogenic sounds than marine mammals. While less auditory data exists for sea turtles, the current best scientific evidence for hearing in sea turtles is thought to broadly encompass frequencies between 50 and 2,000 Hz with peak hearing at frequencies between 100 to 400 Hz in-water (Martin et al. 2012; Piniak et al. 2016b; Piniak et al. 2012; Ridgway et al. 1969; Samuel et al. 2005). Based on this information, many of the frequencies associated with the proposed active acoustic research methods should not be audible to sea turtles. Although sea turtles may be able to hear playbacks of biological sounds (e.g., cetacean calls or whistles), these sounds are naturally heard by sea turtles in the marine environment. The most likely response of ESA-listed fishes (sturgeon and smalltooth sawfish) to active acoustic playbacks, if any, will be minor temporary changes in behavior including increased swimming rate, avoidance of the sound source, or changes in orientation to the sound source, none of which rise to the level of ESA harassment or harm. If these behavioral reactions were to occur, we do not expect that they will have fitness impacts for the individuals, or population-level effects. Therefore, we find the risk to be insignificant and not likely to adversely affect ESA-listed sea turtles or fishes.

### 7.1.3 Potential Response to Capture, Restraint, and Handling

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, and throw nets. Chemical immobilization may also be used. We also consider the potential stressors to ESA-listed turtles and fishes as the result of being incidentally captured and/or entangled in a net.

Capture and restraint procedures constitute one of the most stressful incidents in the life of an animal, and intense or prolonged stimulation can induce detrimental responses (Fowler 1986).

The best available information leads us to believe that capture, restraint, and handling represent the greatest potential stressors proposed by the MMHSRP as part of the proposed action, both to marine mammals and non-target turtle and fish species. In addition to stress responses, capture, restraint, and handling may result in injury and unintentional mortality. Factors that may affect an animal's response to capture include the number of times the animal is captured, the duration of the restraint, the method(s) of restraint, as well as the species, age and general condition of the animal.

As described above, wild animals are believed to respond to human disturbance in the same way that they respond to predators (Beale and Monaghan 2004; Frid 2003; Frid and Dill 2002; Gill et al. 2001; Harrington and Veitch 1992; Lima 1998; Romero 2004). These responses manifest themselves as stress responses, in which the human disturbance (e.g., capture and restraint) is perceived as a threat which leads to the "flight or fight" response, as well as interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). Stress responses could also lead to hyperthermia and myopathy (described below). Continuous stimulation of the adrenal cortex, as from stress associated with chronic disturbance or repeated capture, can cause muscle weakness, weight loss, increased susceptibility to bacterial infections, and poor wound healing, and can lead to behavioral changes including increased aggressive and antisocial tendencies (Fowler 1986).

Capture myopathy is a non-infectious, metabolic muscle disease of wild mammals and birds associated with the stress of capture, restraint, and transportation (Herráez et al. 2013). Characterized by degeneration and necrosis of the brain, lung, liver, intestine, pancreas and lymph nodes, capture myopathy usually develops within seven to 14 days after capture and handling. It has been observed both in animals that exert themselves and those that remain relatively tranquil, and occurs with either physical or chemical restraint. Fear, anxiety, overexertion, repeated handling, and constant muscle tensions, such as those that may occur during a prolonged alarm reaction, are among the factors that lead to capture myopathy. A variety of factors can function in concert or individually. Muscle necrosis results from acidemia (low blood pH) from a buildup of lactic acid following profound muscle exertion; once necrosis has occurred, recovery from myopathy is unlikely. It has rarely been seen in pinnipeds (Seguel et al. 2014) but may occur in some species of cetaceans more frequently (Camara et al. 2020; Herráez et al. 2013; Rojas-Bracho and coauthors. 2019).

Effects of capture and handling when conducted by experienced trained personnel using appropriate equipment are expected to be minor and short-term. Wells et al. (2013) reviewed 69 cases of small cetaceans that had some intervention by members of the MMHSRP conducted under emergency response. Eighteen bottlenose dolphins were captured due to entanglement, out-of-habitat, or maternal death situations. Eleven of these animals were released immediately following treatment (without being brought to a rehabilitation facility) while the other seven were rehabilitated. The animals that were captured under these protocols, treated as necessary, and released immediately showed an 82 percent success rate, with the animals being resighted from 365-1,451 days post-release (average 862 days). Mc Hugh *et al.* (2021) provided summaries of 27 well-documented common bottlenose dolphins that had interventions between 1985-2019 and follow-up monitoring lasting multiple years. Nearly all (92 percent) of the rescued dolphins survived longer than 6 weeks post-release, and 13 of them were still frequently observed at the time of the paper's publication in good physical condition, engaging in normal behavior (McHugh et al. 2021).

Indicators of stress including elevated blood cortisol and aldosterone concentrations have been observed in cetaceans subjected to capture, restraint, and handling (Fair and Becker 2000; St Aubin and Geraci 1990). In cetaceans, shock associated with live-stranding and capture has been compared to capture myopathy observed in other mammals. Herráez et al. (2013) reviewed the necropsy reports of 51 cetaceans (odontocetes and mysticetes) that live-stranded on the coasts of the Canary Islands for symptoms of capture myopathy. All had experienced different types of rescue procedures involving capture, handling, and transportation to rehabilitation centers, where some animals were maintained and treated medically. While live-stranding in cetaceans represents an extreme and multifactorial condition, the results showed the presence of acute degenerative skeletal muscle, myocardial and renal lesions with myoglobinuria in 49 percent (25/51) of the live-stranded cetaceans following human capture/rescue interactions, indicating that cetaceans experience capture myopathy similar to that of terrestrial wildlife (Herráez et al. 2013). Thus we would expect that any cetaceans captured during enhancement activities may experience capture myopathy, which could compound any pre-existing health-related conditions that warranted a response by the MMHSRP.

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).

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. In rare cases, 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 1999-2013, two Hawaiian monk seals 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.

Capture can cause stress responses in sea turtles (Gregory 1994; Gregory and Schmid 2001; Hoopes et al. 1998; Jessop et al. 2004; Jessop et al. 2003; Thomson and Heithaus 2014), sturgeon (Kahn and Mohead 2010; Lankford et al. 2005), and other fishes including smalltooth sawfish (Korte et al. 2005; Moberg 2000; Sapolsky et al. 2000). Although corticosterone does not appear to increase with entanglement time for green and Kemp's ridley sea turtles (Snoddy et al. 2009), we expect any incidental capture of a turtle or fish to be a stressful experience as indicated by severe metabolic and respiratory imbalances resulting from forced submergence (Gregory and Schmid 2001; Harms et al. 2003; Stabenau and Vietti 2003). We also expect behavioral responses (attempts to break loose of the netting via rapid swimming and biting) as well as physiological responses (release of stress hormones; Gregory et al. 1996; Gregory and Schmid 2001; Harms et al. 2003; Hoopes et al. 2000; Stabenau and Vietti 2003). We expect individuals captured to be rapidly removed from the net, although responses associated with subsequent stressors will continue. For example, handling has been shown to result in progressive changes in blood chemistry indicative of a continued stress response (Gregory and Schmid 2001; Hoopes et al. 2000). Encircling net captures also entails a risk of vessel-strike to sea turtles and fishes. However, as these animals would be evading capture, they will generally be moving away from the vessel. In addition, trained spotters will be on the lookout for any non-targeted species that may be encircled in the net, and activities will be stopped if such a non-target animal is present.

Additional risk to sea turtles in entanglement nets results from forced submersion. Sea turtles forcibly submerged in any type of restrictive gear eventually suffer fatal consequences from prolonged anoxia and/or seawater infiltration of the lungs (Lutcavage et al. 1997b). Trawl studies have found that no mortality or serious injury occurred in tows of 50 minutes or less, but these increased rapidly to 70 percent after 90 minutes (Epperly et al. 2002; Henwood and Stuntz 1987). However, mortality has been observed in summer trawl tows as short as 15 minutes (Sasso and Epperly 2006). Metabolic changes that can impair a sea turtle's ability to function can occur within minutes of a forced submergence. Serious injury and mortality is likely due to acid-base imbalances resulting from accumulation of carbon dioxide and lactate in the bloodstream (Lutcavage et al. 1997b); 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 captured turtle is submerged, researchers will inspect the net prior to tending 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 PDCs 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.

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, because 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).

Smalltooth sawfish and sturgeon entangled in nets would likely experience stress in association with the event and some lacerations associated with net contact. If disentangled according to NOAA-approved protocols (NMFS 2009h), no further injury should occur. We expect incidental capture, handling, and restraint of sturgeon to cause short-term stress (Kahn and Mohead 2010). This can be exacerbated by less than ideal environmental conditions, such as relatively high water temperature (higher than 28° Celsius), high salinity, or low dissolved oxygen, potentially resulting in mortality or failure to breed (Hastings et al. 1987; Jenkins et al. 1993b; Kynard et al. 2007; Moser and Ross 1995; Niklitschek 2001; Niklitschek and Secor 2009; Secor and Niklitschek 2002b; Secor and Gunderson 1998; Secor and Niklitschek 2001a). 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 2009h).

For incidentally captured and released sea turtles, sturgeon, and sawfish, the duration of encounter is expected to be minutes not hours and most would be released without handling.

Because of this, we expect ESA-listed sea turtles, sturgeon, and sawfish to experience only minor stress and to resume normal behavior quickly with no long-term adverse impacts to individuals encountered. Effects determinations for stressors resulting from captures of ESA-listed cetaceans, pinnipeds, sea turtles, and fishes are further discussed below in the *Risk Analysis* (Section 7.4.2.2 and Section 7.4.3).

### 7.1.4 Potential Response to Transport

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 related to the extended transport time (Colgrove 1978). Most physiological stress response indices in healthy beluga whales have been reported to normalize within the first week of captivity (described in Curry 1999). In studies with captive beluga whales, physiological stress responses from transport and integration into new surroundings with unfamiliar conspecifics returned to baseline as whales adapted to new settings and conspecifics, indicating beluga whales exhibit a healthy physiological response and can adapt to transport, novel environments, and new social groups (Spoon and Romano 2012). In addition to these potential responses, it is expected that animals being transported would experience the stress of restraint and handling as described above. 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. Effects determinations for stressors resulting from transport of ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.3).

### 7.1.5 Potential Response to Holding

As discussed in the *Description of the Proposed Action*, the Permits Division proposes to authorize the MMHSRP to temporary hold animals in captivity for enhancement activities. Temporary holding of animals may occur when animals require rehabilitation prior to release in the wild, or when animals are deemed non-releasable but require temporary holding until they can be placed in a permanent captive facility.

As a result of temporary holding, animals may experience changes in behavior, increased stress, injury, lower reproduction, and or even death, with the response depending greatly on the conditions in which the animal is held and the duration of the holding (NMFS 2009e; Rose et al. 2009). Captive marine mammals are often confined to relatively small enclosures and become increasingly bored, leading to stereotypic behavior which can have further health consequences (Rose et al. 2009). Being maintained in a relatively small enclosure may also be stressful, as animals may have limited ability to move and exercise (NMFS 2009e; Rose et al. 2009). Animals may suffer stress by being maintained in solitarily, or at the other extreme, with too many conspecifics. Captive animals may also injure themselves be attempting to escape captivity, interact with foreign objects, or as the result of stereotypic behavior (Rose et al. 2009). Animals may also be exposed to pathogens that they would not encounter in the wild (NMFS 2014g). Finally, while data comparing captive marine mammal reproduction and fitness to wild populations are limited, there is evidence of reduced reproduction and increased mortality in some species (Rose et al. 2009).

Importantly, most of these responses occur when animals are held in permanent captivity. For the short duration animals would be held in captivity for enhancement activities, more severe responses such as injury, reduced reproduction, and death are not expected to occur. Nonetheless, to minimize adverse effects that may result from temporary holding, all facilities would follow the *Policies and Best Practices for Marine Mammal Stranding Response, Rehabilitation, and Release*, and *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012c), which further require facilities rehabilitating ESA-listed species to have quarantine protocols to minimize the spread of infectious diseases within the facility. Furthermore, temporary holding would always occur under the direct supervision of a qualified veterinarian, and only take place for enhancement purposes (e.g., for rehabilitation purposes or to rescue animals from imminent threats [e.g., nearby oil spill]). As such, any adverse effects from holding would be outweighed by the benefits of the temporary holding. Most, if not all, of these individuals would likely die otherwise.

In summary, while animals may experience changes in behavior, stress, injury, reduced reproduction, or even death as the result of temporary holding, animals would only be held when the benefits outweigh these possible adverse effects such that the net effect of temporarily holding would enhance the individual's (and thus the species) chances for survival in the wild, or if deemed non-releasable, in captivity. Effects determinations for stressors resulting from holding ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.14).

### 7.1.6 Potential Response to Release

In general, the release of an animal previously held for enhancement purposes likely increases the fitness and wellbeing of that animal, and contributes to the total wild population abundance. However, the release of animals is not without possible adverse effects. For example, the release of pinnipeds on rookeries or haul-out sites could disrupt other animals. When pinnipeds are startled and disperse from rookeries, pups may be trampled or abandoned. Juvenile and adult animals may be trampled during stampedes or injured on underwater rocks and cliff faces

(NMFS 2014g). In addition, the release of animals carrying pathogens and non-native species picked up in captivity or while in holding (Section 7.1.5) into the wild may introduce disease, viruses, or invasive species that could have adverse impacts on the rest of the wild population. However, *NMFS Facility Standards for Rehabilitating ESA-Listed Species* (NMFS 2012c) requires facilities rehabilitating ESA-listed species to have quarantine protocols to minimize the spread of infectious diseases within the facility, and *NMFS Standards for Release* (NMFS 2009f) requires that an extensive health assessment be completed prior to release, including screening for possible pathogens and non-native species. Thus, the release of animals carrying pathogens and non-native species that may be spread to wild marine mammal and non-marine mammal populations is considered extremely unlikely. Effects determinations for stressors resulting from the release of ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.14).

### 7.1.7 Potential Response to Attachment of Tags and Scientific Instruments

Attachment methods for tags and other instruments placed on cetaceans include, but are not limited to: bolt, tethered-buoy, tethered, punch, harness, suction cup, implant, or ingestion. Pinniped attachment methods include, but are not limited to: glue, bolt, punch, harness, suction cup, surgical implant, or ingestion. Types of tags that may be used include, but are not limited to: roto-tags (cattle tags), button tags, VHF radio tags, satellite-linked tags, PIT tags, RFID tags, DTAGs, LIMPET tags, CDMA tags, pill (e.g., stomach temperature telemeters), TDRs, LHX tags, and video cameras such as Crittercams.

Effects of attached devices on animals may range from subtle, short-term behavioral responses to long-term changes that can affect survival and reproduction; attached devices may also cause effects not detectable in observed behaviors, such as increased energy expenditure by the tagged animal (White and Garrot 1990; Wilson and McMahon 2006). Internally placed devices may cause blockage, be rejected from the animal's body, or cause tissue reactions and infection (Eagle et al. 1984; Green et al. 2009; Guynn Jr et al. 1987; Hernandez-Divers et al. 2001; Lander et al. 2005). 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.

Suction cup tagging procedures have been analyzed by the Permits Division in several environmental assessments (EAs) with findings of no significant impact to animals, and associated Section 7 consultations have resulted in no jeopardy opinions (NMFS 2017b; NMFS 2017d; NMFS 2017e). The possibility of injury to an animal comes from the remote risk of a remotely-deployed suction cup landing in or striking a sensitive part of the animal, such as the eye, mouth, or blowhole, which may cause injury, even though the tag will not be able to attach to these areas. However, given the experience of researchers and the body size of the target cetaceans, the risk is expected to be minimal or non-existent. The non-invasive nature of suction cup tags eliminates the threat of infection, but not inflammation. The suction cup would remain attached for a short duration (typically not longer than 48 hours), and would likely release within a few hours (Baird 1997). The animal could dislodge the tag by rolling, breaching, or rubbing (Schneider et al. 1998). An animal could sustain injuries while trying to remove the tag by rubbing against the sea floor or other animals. The tag may migrate along the skin of the animal but would not cover the blowhole, as drag would move it away from the blowhole. The ease and speed with which some animals can remove a suction cup tag suggests that it is unlikely an animal would endure long-term stress from the attachment.

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, 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 26.** Crossbow deployment of a satellite tag (visible in the dorsal fin) on an adult male killer whale at Marion Island, South Africa (Reisinger et al. 2014).

Physiological effects to cetaceans from implantable tags are likely dependent on several factors including tag size and design. Walker and Boveng (1995) concluded the effects of devices on animal behavior are expected to be greatest when the device-to-body size ratio is large. Gendron et al. (2014) reported that the tag attachment that remained embedded in a blue whale for at least 10 years originated from a surface-mounted satellite tag with two sub-dermal attachments, each consisting of cast bronze temple toggles mounted to stainless steel posts holding the tag to the whale's back. Subsequent veterinary advice (when the electronics packages became small enough) suggested implanting tags into the muscle layer so that attachments could deploy below the tough fascia at the blubber-muscle interface, in order to enhance long-term tag attachment and encourage encapsulation (Gendron et al. 2014). However, a necropsy on a North Atlantic right whale found that a pointed needle that was implanted through the blubber into the muscle had bent at 80 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). There is the potential for significant effects in cetaceans; for example long term secondary effects, which are very difficult to measure, may cause reduced biological performance, particularly during critical periods such as lactation (Walker and Boveng 1995; White and Garrot 1990). In addition, hydrodynamic drag as a result of tag attachment can result in increased swim costs, compromised swimming capacity and maneuverability, and extra load on an animal's tissue (Pavlov et al. 2007).

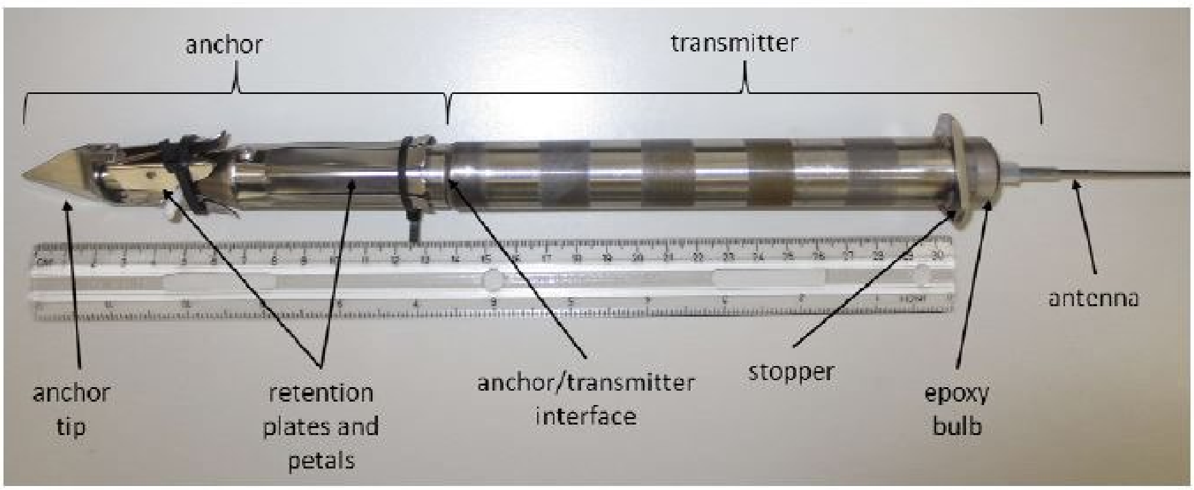


**Figure 27.** Example of an implantable satellite tag currently used in various large cetacean studies. Retention plates and petals are shown in pre-deployment position. Equally spaced etchings along the body of the tag are used to assess the rate at which it is ejected from the animal, using photo-identification 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 (NMFS 2015a). In their study on the effects of implantable tags on humpback whales in the Gulf of Maine, Robbins et al. (2016) examined the effects of implantable tags on vital rates of both males and females. For both sexes, there did not appear to be any effect on survival and many tagged females continued to successfully reproduce. However, tagging did appear to increase females' inter-birth intervals, with non-tagged females being nearly twice as likely to produce a calf compared to tagged females in the year following the initial tagging (or relevant year for non-tagged females). This suggest that implantable tagging may have an effect on pregnancy. Following this first year after tagging, tagged and non-tagged females appeared to be similarly likely to reproduce. Additional analyses investigating the effects of different tag models indicated that this impact on reproduction may have been due to a tag design flaw with the articulated anchors that lead to tag breakage and parts of the tag being left inside the whale after the tag detached. This flaw was addressed with a fully integrated implantable tag, and data using these tags does not currently show the same negative effect on reproduction.

In examining the health effects and long-term impacts of implantable tags on large whales in the Pacific, Calambokidis (2015) used photographs and sightings records to evaluate tag-site wound healing and tagging effects on survival. Data came from a variety of long-term studies on blue and gray whales, which were tagged with implantable tags between 1993 and 2008 for blue whales, and in 2011 and 2013 for gray whales. While no effect on re-sighting rate was found for blue whales, tagged gray whales appeared to be less likely to be seen in subsequent years as compared to a control group. When sighting data were used in Cormack-Jolly-Seber capture recapture models to examine the effects of tagging on survival, there was no unequivocal evidence to support a tagging effect on survival, but several of the top models included a negative effect of tagging. Given this and the small sample size, caution should be used when interpreting these results, and effects of tagging on gray whale survival appear to be possible.

Importantly, many advances in tag technology have been made since the deployment of the tags discussed in the previous studies. These include smaller tag designs, stronger materials, fully-integrated designs, improved sterilization techniques, and better tag application methods. With these improvements, the chances of long-term adverse effects are greatly reduced (Mate et al. 2007; NMFS 2016c; Robbins et al. 2016; Szesciorka et al. 2016).

Based on the results reported by Moore et al. (2013), tags that do not cross the blubber-muscle interface may also be less likely to result in tissue damage. The LIMPET satellite tag (Figure 28) may be less likely to result in tissue damage compared to implantable tags that cross the blubber-muscle interface. The electronics in a LIMPET tag are external to the whale's body and the tag package is attached via small percutaneous anchors; thus, for large cetaceans, the tag embeds only in the blubber layer. LIMPET tags have been successfully applied to over 20 species of cetaceans (Baird et al. 2012b; Ford et al. 2013; Moore et al. 2013; Reisinger et al. 2014; Schorr et al. 2009; Schorr et al. 2014; Straley et al. 2014). Published literature on physiological or behavioral responses to LIMPET tag attachment is limited; however, no significant difference in survival was detected among LIMPET tagged versus non-tagged false killer whales and short-finned pilot whales in Hawaiian waters (Baird et al. 2013). After deployment on a killer whale, dart penetration holes had completely healed over 262 days after tag deployment (217 days after the initially deployed tag fell out), with minor swelling at the site of each dart penetration point; 405 days after first tag deployment and 98 days after a second tag deployment, all wounds were re-pigmented and healed, with no swelling or scars visible at either tag site (Andrews et al.

2014). However, not all reports of LIMPET tags have been as positive, as exemplified by the 2016 death of a Southern Resident DPS killer whale.

**Figure 28.** North Atlantic right whale shortly after the attachment of an external tag tagging. Activities depicted authorized by Permit No. 14450-02 (Andrews 2015).

Physiological and stress responses of pinnipeds to tagging and attachment of scientific instruments is expected to vary depending on species and type of tag or device. Antarctic fur seals (*Arctocephalus gazella*) fitted with both time-depth recorders and radio-transmitters had increased durations of foraging trips and nursing visits compared with animals carrying only radio transmitters (Walker and Boveng 1995). A study using devices attached with epoxy glue that examined the effects of research handling (including blood sampling, flipper tagging and the placement of time-depth recorders, data loggers and video recorders) on the migratory behavior, survival and body condition of Hawaiian monk seals found no difference between animals that were tagged (n = 437) and/or had telemetry instruments attached to their pelage (n = 93) with control animals for both categories (n = 437 and n = 93, respectively) (Baker and Johanos 2002); there was no direct assessment of how the attachment of devices affected the seals' foraging success.

A review of peer-reviewed articles published over a 31-year period (1980-2011) addressing the effects of marking and tagging (Walker et al. 2012) found that none of the reviewed studies that assessed visual tag (e.g., roto tag) attachment found that visual tags might 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).

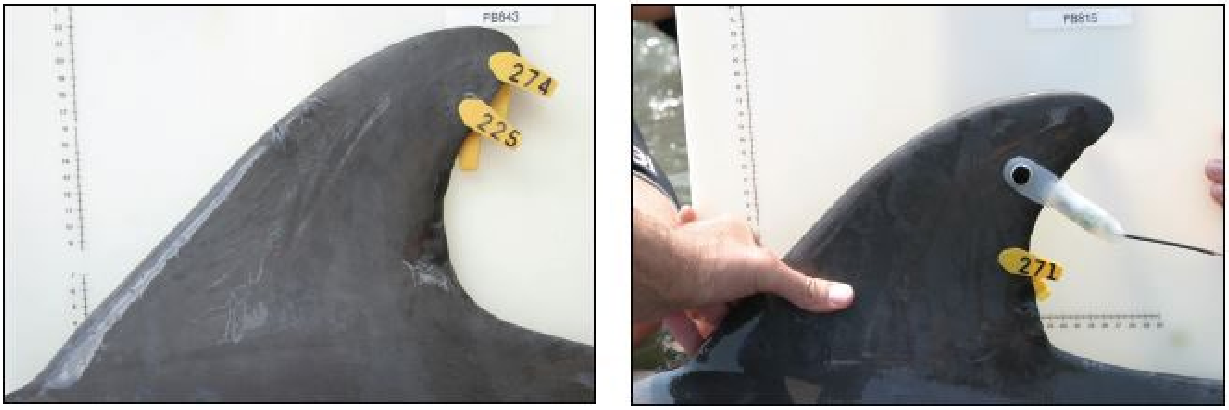


**Figure 29.** Roto tags (left); radio tag and roto tags (right) affixed to dorsal fins of bottlenose dolphins.

Internally placed devices (e.g., PIT tags, LHX tags) may cause blockage, be rejected from the animal's body, or cause tissue reactions and infection (Eagle et al. 1984; Green et al. 2009; Guynn Jr et al. 1987; Hernandez-Divers et al. 2001; Lander et al. 2005). A review by Walker et al. (2012) reported on the outcomes of several published studies on internally placed devices in marine mammals. Three studies reviewed by Walker et al. (2012) investigated the effects of intraperitoneal implantation of LHX tags in sea lions (Horning et al. 2008; Mellish et al. 2007b; Walker et al. 2009). Horning et al. (2008) reported that California sea lions (*Zalophus californianus*) and Steller sea lions recovered well after implantation surgery, with minimal swelling around the incision site. Physiological effects of the surgical implantation of LHX tags included increased levels of acute-phase proteins. (i.e., indicators of infection, inflammation or tissue trauma) at two weeks post-surgery, with levels returning to baseline within six weeks (Mellish et al. 2007b). Dive behavior recorded post-surgery showed that dive depth, duration, frequency and dispersal distances were similar among LHX-implanted individuals and non-LHX-implanted individuals (Mellish et al. 2007b). Behavioral responses in Steller sea lions in the days after abdominal surgery to implant LHX tags included changes in back arching, standing, locomotion, time alert, lying time, and time spent with pressure on the belly, with behaviors still affected 12 days post-surgery, leading the authors to suggest more effective analgesic methods be explored for this procedure (Walker et al. 2009). PIT tags, which are placed subcutaneously, have been used on a wide variety of species, including cetaceans, seals, sea lions, and fur seals. When inserted into animals that have large body sizes relative to the size of the tag (e.g., cetaceans and pinnipeds), empirical studies have demonstrated that PIT tags have no adverse effect on growth, survival, reproductive success, or behavior (Brännäs et al. 1994; Clugston 1996; Elbin and Burger 1994; Hockersmith et al. 2003; Jemison et al. 1995; Keck 1994; Skalski et al. 1998). No tissue reactions to PIT tag placement were found in sea otters and southern elephant seals, and no differences in survival were documented between PIT-tagged and non-PIT-tagged individuals (Galimberti et al. 2000).

The MMHSRP proposes the attachment of tags to pinnipeds with epoxy glue. Though epoxy glue has the potential to cause thermal burns or react with the skin, such effects have not been documented (Walker et al. 2012). The attachment of instruments to juvenile grey seals did not alter the surface temperature of wet seals; however elevated temperatures were detected around the edges of the attachment site when the seal was dry (McCafferty et al. 2007). Such heat increases are small and localized (approximately three percent of body surface area) and do not have a significant influence on the total heat exchange (approximate 0.5 percent of basal metabolic rate) of seals (McCafferty et al. 2007).

The MMHSRP also proposes to mount video cameras (such as Crittercams) on some individuals. Littnan et al. (2004) assessed the effects of video cameras on the foraging behavior of immature Hawaiian monk seals. Video cameras, time-depth-recorders, and VHF radio transmitters were affixed to seals, and after three to ten days (mean duration 5.7 days) the video cameras were removed (TDR and VHF remained until 4-48 days later). Descent and ascent on dives was slower with the video cameras, possibly indicating energetic costs to individuals, but the results were not statistically significant, and the authors did not report a significant difference in foraging behavior of immature monk seals equipped with video cameras compared to those without; however, the sample size of the study was small (seven seals). Abernathy and Siniff (1998) found that monk seals fitted with TDRs dove to the same range of depths as seals equipped with cameras. Instrumentation, especially with larger equipment such as video cameras, may cause hydrodynamic drag, reducing foraging abilities and/or increasing the energy cost to animals. Effects determinations for stressors resulting from attachment of tags and scientific instruments to ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.4).

### 7.1.8 Potential Response to Marking

As described above (Section 3.2.3.10) the MMHSRP proposes to mark marine mammals using methods including: bleach, crayon, zinc oxide, paint ball, notching, freeze branding and hot branding. Crayons, zinc oxide, and paint balls may be used on cetaceans and pinnipeds for temporary, short-term marking. Bleach or dye markings may be used on pinnipeds. Notching can be used to permanently mark cetaceans by cutting a piece from the trailing edge of the dorsal fin. Notching in pinnipeds removes a piece of skin from the hind flipper of phocids and the foreflipper of otariids.

Information on the effects of marking marine mammals is somewhat limited in that research has tended to focus on short-term behavioral responses; few studies have addressed the effects of marking on reproduction, growth, or survival. Walker et al. (2012) reviewed 39 peer-reviewed articles published from January 1980 to April 2011 addressing the effects of marking; a preponderance of studies focused on short-term effects such as injuries and behavioral changes (Walker et al. 2012). Of the studies reviewed by Walker et al. (2012), none of the studies designed to measure the effects of marking on survival demonstrated reduced life-expectancy as a result of marking. The majority of studies that addressed behavior and injury found effects, though the responses varied by marking device and species studied (Walker et al. 2012). It should be noted that the review included the use of marking devices such as paint or hot-iron brands, as well as radio- and satellite-telemetry devices and data loggers (the latter are discussed above in Section 7.1.7).

Temporary or short term marking procedures include paint, bleach, grease pen, crayon, zinc oxide or dye. Researchers have applied many thousands of bleach markings on monk seals and have observed no negative effects other than the occasional minor disturbance (NMFS 2013i). Most individuals are approached while sleeping and do not awaken during the process. Bleach marking, like branding, facilitates long-range identification, thereby reducing the necessary approach distance and consequently the chance of disturbance. Studies on the effects of paint marking are limited. In a comparison of painted and unpainted regions from northern fur seals marked with fluorescent paste, paint was not reported to cause histological abnormalities of tissue biopsies (Griben et al. 1984). We expect that paint applied remotely using a paint gun could potentially cause a stress response and/or a startle reaction. Other non-target animals may also be temporarily disturbed. Cetaceans and pinnipeds may also be marked with a grease pen, crayon, or zinc oxide; we believe these types of marks would not result in any adverse impacts. For any of these procedures (marking with paint, bleach, grease pen, crayon, zinc oxide or dye) that require capture as opposed to remote marking, we believe the capture and restraint necessary to perform the marking procedure would be the greatest potential stressor and would have the greatest potential for an adverse impact to the animal associated with the activity.

Notching of a fin or fluke is invasive as it does involve removal of tissue but it can generally be accomplished quickly. Because it entails the removal of tissue, there is the possibility that notching may result in infection. However, we could not find evidence of infections as a result of notching; any infections that may result are expected to be minor and to heal quickly, as notching would remove very small (less than 1 centimeter) pieces of flesh from the dorsal fin or fluke, and cetaceans are resilient to wounds of this scale, which they experience routinely throughout their lives.

Branding is useful because it can provide a mark that remains visible throughout the animal's life and is visible from long distances. Hot branding has been used extensively as a method to permanently mark pinnipeds, as well as livestock and large birds. Branding provides a permanent mark that remains visible throughout an animal's life and is not subject to the same problems as plastic or metal tags which eventually become worn and unreadable or fall off. The brand can also be easily read from a distance providing much higher resight rates than tags. The humaneness of hot branding as a marking method for marine mammals has been frequently debated (Jabour-Green and Bradshaw 2004; McMahon 2007).

Cold branding works by damaging the pigment-producing melanocytes but leaves the hair follicles intact allowing for regenerative growth of white hair (Daoust et al. 2006). There is limited information on the response of marine mammals to freeze branding. Machpherson and Penner (1967) reported that adult and juvenile seals tried to escape their restraints as soon as cold irons were applied to their skin, possibly indicating a response to pain. Both Lay et al. (1992) and Schwartzkopf-Genswein et al. (1997) reported that domestic cattle tried to break free from their restraints during freeze-branding and showed evidence of discomfort or avoidance responses for up to five days after they had been branded. Sherwin et al. (2002) reported that four species of bats experienced "discomfort" during freeze branding, but did not provide more information on the response of these small mammals to the branding procedure.

Hot branding (or "hot iron branding") involves the use of steel branding irons with numbers and letters (Figure 30), heated to "red-hot" (about 500° Fahrenheit) in a propane forge, and applied to the body of an animal for two to seven seconds to produce burns that penetrate the entire outer layer of the skin and into the inner skin layer (i.e., second degree burns). These burns are characterized by formation of blisters, swelling, and fluids seeping from the burned area (Figure 30).

Several studies have examined the physiological responses of pinnipeds to hot branding. In a captive study, Steller sea lions anaesthetized with Isoflurane exhibited a three-fold increase in breathing rate, from baseline (pre-branding) to branding, while heart rate increased over baseline by an average of 9.3 percent (Walker et al. 2011). In separate captive study, the physiological response of juvenile Steller sea lions to hot branding was monitored over a period of 2-8 weeks. Serial serum samples were analyzed for general inflammatory reaction (white blood cells, platelets), acute phase response (globulins, haptoglobins), and adrenocorticoid levels (cortisol). Overall, white blood cell counts, platelet levels, and haptoglobin and globulin values all increased within two weeks after branding (likely a result of minor tissue trauma), but had returned to capture levels within seven to eight weeks, while serum cortisol levels did not differ between pre- and post-brand samples. Results indicated that while hot branding may induce a short-term immune response, it did not appear to have any lasting physiological effects that might lead to impaired function or mortality (Mellish et al. 2007a)


**Figure 30:** Stages of hot brand healing in a juvenile Steller sea lion, shown as (A) day of brand, (B) one week post-brand, (C) three weeks post-brand, and (D) eight weeks post-brand (Mellish et al. 2007a).

Studies have also been undertaken to determine whether hot branding affects pinniped behavior. In a study of captive juvenile Steller sea lions (n = 11), the animals' behavior was monitored for three days prior to and three days following hot branding. Following branding, the sea lions increased wound-directed grooming and spent less time with pressure on their branded side, possibly due to increased sensitivity to pain, or hyperalgesia. Results showed that Steller sea lion behavior changes for up to 72 hours after hot-iron branding (Walker et al. 2010).

The behavior of Steller sea lion pups (n = 8) was monitored two days prior to and five days after hot branding in 2010 at Medny Island, Russia. A control group (n = 5) went through the same procedures as branded pups (handling, measuring, anesthetizing) but were bleach marked and not branded. Play behavior, grooming behavior, suckling and sleeping were monitored; of those, only duration of play behavior changed significantly among branded pups during the initial days after branding, but resumed to pre-branding level on the third day after branding. Overall, the branding procedure appeared to have only short-term effects on the behavior of Steller sea lion pups (Fomin et al. 2011).

Steller sea lion pups in the wild were visually monitored one week prior to and one week after hot branding to analyze changes in behavior. Overall, average activity profiles of pups were similar throughout the day and both before and after branding with most pups exhibiting resting behaviors, though differences in specific behaviors such as alertness and playing suggested an increase in stress may have occurred in branded pups versus non-branded pups during the week following branding (Di Poi et al. 2009).

The responses described in the studies above are consistent with previous studies on pain responses associated with hot branding. In a review of animal tagging and marking techniques, Walker et al. (2012) report that in studies of cattle, hot branding results in greater escape avoidance reactions, as well as a greater incidence of behavioral changes (tail-flicking, kicking and falling) and more prolonged physiological responses (elevated heart rate and plasma concentrations of cortisol and epinephrine), compared with freeze branding.

Several studies have examined whether hot branding is related to increased mortality rates in pinnipeds. In a study of 1,489 Steller sea lions pups hot branded from 1987-1989 at rookeries in Alaska and Russia, one-month survival was 99.8 percent; from 4-9 months later, no difference was found in mortality rates of branded and unbranded pups from sightings on the beach (Merrick et al. 1996).

The results of a study on hot branded California sea lions from 1980-1982 found that branding did not result in higher mortality rates versus non-branded pups, branded pups appeared to be as healthy as non-branded pups, and most branded pups (89 percent, 90 percent, and 93 percent, respectively, in each of the three years) were alive six months after branding. Mortality rates for years that pups were branded did not differ from years when no pups were branded, and the number of dead pups present on the rookery in non-branding and branding years indicated that survival was independent of branding. No mortalities could be attributed to branding (Aurioles and Sinsel 1988).

A mark-recapture study conducted for 12 weeks after hot branding from 2001-2002 at Lowrie Island, Alaska, found weekly survival of branded pups (n = 366) was nearly identical to estimates from a control group of undisturbed/unbranded pups born to 10-11 year old branded adult females in 2005 (0.987-0.988/week). 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 2009d).

Any marking technique that requires restraint of the animal is expected to result in the responses to capture, handling, and restraint described above. 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. Effects determinations for stressors resulting from marking ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.5).

### 7.1.9 Potential Response to Disentanglement

The MMHSRP proposes to disentangle ESA-listed pinnipeds and cetaceans, including removal of gear, line, or debris, that has become wrapped around, hooked into, or otherwise associated with the outside of an animal's body, and the removal of ingested gear including hooks, line, or other marine debris. Though the goal of disentanglement is to reduce an animal's stress, pain, suffering, and likelihood of serious injury and mortality, adverse effects could occur during disentanglement activities. Takes of entangled animals would occur during close approaches by aircraft (to locate entangled animals or for photo-identification), by vessel (for documentation, general assessment, photo-identification, and disentanglement attempts), or by land or water (for entangled pinnipeds).

Responses among cetaceans and pinnipeds to disentanglement attempts depend on the species and the specific details of the entanglement. Stress responses may result from close approach, either by vessel or plane (or both). Floats, buoys, and control lines may be attached to large whales during attempts to physically restrain the animal, potentially resulting in increased stress or pain. An entangled animal may sustain what is assumed to be increased trauma (line wounds) as a result of increased drag force from disentanglement (kegging) efforts and possibly from carrying a tethered tag package, sometimes over several days' time. Based on annual reports submitted by the MMHSRP, disentanglement drag trauma may result in wounds increasing by several inches or may free the animal of the entangled gear. Physical restraint of pinnipeds may cause injuries or death. Chemical restraint of free-swimming animals may lower the respiratory rate, slow their breaching, and decrease their swimming strength, increasing the risk for drowning. Sedatives that may be delivered through a tethered dart syringe could startle the animal and cause it to react; if so, reactions would be similar to those expected from remote biopsy darts. If darts are used to administer medication across the blubber-muscle interface, they have a tether to allow them to be retrieved and not remain embedded in the animal, as epaxial muscle movement may result in more serious health impacts (Moore et al. 2013).

**Figure 31.** 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 31). In the event that a line is embedded in an animal's tissue, when no other options to safely remove gear exist and only after consideration of the possible damage and animal and human safety, a responder may intentionally cut into the skin to free the line and reduce the entanglement. An attempt to disentangle a North Atlantic right whale resulted in lesions from both a spring-loaded knife (lesions were 4.5 centimeters (1.8 inches) wide, 15.5 centimeters (6.1 inches) long, and 5 centimeters (2.0 inches) deep) and a broadhead cutter (lesions from 0 to 7 millimeters (0 to 0.3 inches) into the blubber) that were deployed in attempts to cut entangling line off the whale (Moore et al. 2013). Effects determinations for stressors resulting from disentanglement of ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.12).

### 7.1.10 Potential Response to Diagnostic Imaging

The MMHSRP proposes to perform diagnostic imaging on ESA-listed marine mammals. The greatest impacts of ultrasound sampling performed on free-swimming cetaceans would be the stress associated with close approach by vessel. 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. 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. 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.

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). Effects determinations for stressors resulting from diagnostic imaging of ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.6).

### 7.1.11 Potential Response to Sample Collection

Samples that may be collected by the MMHSRP from ESA-listed marine mammals include biopsy, blood, breath, urine, blowhole, fecal, milk, sperm, hair, nails, vibrissae, gas, and gastric sampling, sloughed skin, tooth extraction, and colonic temperatures.

Remote biopsy samples (taken with a crossbow or rifle) are typically one centimeter in diameter by 1.5-2 centimeters deep. Most cetaceans exhibit mild behavioral responses to biopsy darting without any long term adverse effects (Barrett-Lennard et al. 1996; Best et al. 2005; Brown et al. 1991; Clapham and Mattila 1993; Gauthier and Sears 1999; Hooker et al. 2001; Jahoda et al. 2003). Gauthier and Sears (1999) reported that minke, fin, blue, and humpback whales showed no behavioral reaction to 45.2 percent of successful biopsy samples taken using punch-type tips fired from crossbows; whales that responded to biopsy sampling typically resumed their normal behavior immediately or within a few minutes (Gauthier and Sears 1999). When they occurred, behavioral responses included tail flicks and submergence. The authors concluded that biopsy sampling is an efficient method for obtaining high-quality whale skin and blubber samples with limited behavioral disturbance to balaenopterid whales.

Weinrich et al. (1991) studied the behavioral responses of humpback whales in the Gulf of Maine to biopsy sampling, classifying responses into the following categories: no reaction; low-level reaction (immediate dives but no other overtly forceful behavior); moderate reaction (trumpet blows, hard tail flicks, but no prolonged evidence of behavioral disturbance); and strong reaction (surges, tail slashes, numerous trumpet blows). Out of 71 biopsy attempts, seven percent resulted in no behavioral response, 26.8 percent resulted in low-level behavioral response, 60.6 percent involved a moderate reaction, and 5.6 percent involved a strong reaction. Clapham and Mattila (1993) also concluded that humpback whales exhibited low to moderate reactions to being struck by biopsy darts, with results showing that 66.6 percent of biopsied humpback whales showing no behavioral reaction or low-level reaction to the procedure. A separate study noted that studies on biopsy procedures showed no evidence of significant impact on cetaceans in either the short or long term (Clapham and Mattila 1993).

Based on the best available information, reactions among small cetaceans to biopsy sampling are expected to be similar to those of large whales (Krützen et al. 2002; Weller et al. 1997). Reactions among Indo Pacific humpback dolphins (*Sousa chinensis*) to remote biopsy sampling by crossbow were mostly slight, with a few moderate reactions noted out of 49 total biopsy dart hits, but no extreme reactions (e.g., breaches or radical changes in the general behavior of the dolphins) were observed. Most dolphins flinched, and some also exhibited a tail-swish or fluke-slap. They generally sped up and swam away from the vessel, but it was possible to approach several sampled individuals closely again within three to five minutes of sampling. Dolphins reacted similarly to hits and misses, and their reaction was characterized as a startle response. All observable reactions were short-term, and there was virtually no evidence of long-term impacts on behavior, social organization, or distribution patterns. Wounds appeared to heal well and were healed over with tissue in less than 21 days (Jefferson and Hung 2008). Krützen et al. (2002) studied behavioral reactions among bottlenose dolphins to biopsy sampling using a modified 0.22 caliber rifle. No significant difference in reaction to the darting procedure was observed when an animal was hit or missed, and wounds were healed after approximately 23 days. A significant positive correlation was observed between the size of the sample obtained and the reaction to biopsy sampling, suggesting the size of biopsy darts should be adjusted relative to the size of the animal being sampled (Krützen et al. 2002). In studies that have reported stronger reactions among cetaceans to biopsy sampling (e.g., breaching), reactions were reported to be of short duration (less than three minutes) and animals were approached and photographed immediately following the procedure, suggesting any responses were very short term in nature (Parsons et al. 2003).

A common dolphin in the Mediterranean Sea died following penetration of a biopsy dart and subsequent handling (Bearzi 2000). Likewise, a bottlenose dolphin died following biopsy sampling in Mobile Bay, Alabama. The cause of death was attributed to a bacterial infection (*Erysipelothrix rhusiopathiae*) at the biopsy site.

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 have been two documented cases of fitness reductions as a result of biopsy sampling. However, no long-term adverse responses or fitness consequences have resulted from biopsy sampling performed by the MMHSRP historically. 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. 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 (below) 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. The loss of a single tooth (#15 in the lower left jaw of cetaceans) does not appear to 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 2014g). 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 2014g). 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 2014g). The mild discomfort associated with the sampling described above is expected to 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 2014g). 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 2005b). 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 2005b).

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. The reaction of free-swimming cetaceans to physical contact for breath sampling has not been adequately studied; however, the collection of breath samples from free swimming anumals would only occur using a pole with a mesh or plate or via a UAS. Breath from animals that are captured and restrained would involve the quick physical contact of the vacuum cylinder or pneumotachograph (a device that records the rate of airflow to and from the lungs) is very brief, lasting only a few seconds. Based on behavioral responses to biopsy sampling among cetaceans (described above), which is more invasive than breath sampling, we believe breath sampling procedures performed from vessels is not likely to disrupt behavior, beyond that which would be expected from vessel close approach (described above). Depending on advances in technology, it is possible that breath sampling of free-swimming cetaceans may be possible via UAS during the duration of the permit. If this occurs, the procedure would be expected to be even less disruptive to cetaceans as close approach by boat would no longer be necessary. The collection of feces or sloughed skin from free-swimming animals would not be expected to cause any impact beyond that expected from close approach. Effects determinations for stressors resulting from collecting samples from ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.7).

### 7.1.12 Potential Response to Administration of Medications

Antibiotics, antifungals, and other medicines may be administered during response and rehabilitation. The MMHSRP may also administer vaccines, either prophylactically or in response to a detected pathogen. Potential responses to the administration of medications are expected to vary depending on species, condition of the animal, type of drug, dosage and method of administration. Potential adverse effects from the administration of medications include drug interactions, incorrect drug dosages, side effects, injuries, infections, and death.

Early reports describe the problems associated with anesthetic use in pinnipeds, including: narrow margins of safety, thermoregulatory disturbances, cardiovascular changes, and fatalities (Gage et al. 1993; Gales 1989). Until fairly recently, field-based chemical restraint and anesthesia of pinnipeds have been accomplished with intra-muscular agents, primarily combinations of a arylcyclohexylamine (particularly ketamine or tiletamine) and a sedative or anti-anxiety drug (diazepam, zolazepam, or xylazine) (Gales et al. 2005). Delivered in this manner, these drugs achieved variable results, exhibited adverse side-effects, and elevated rates of mortality (see reviews by (Gales 1989; Haulena and Heath 2001; Lynch et al. 1999)).

Delivery of anesthesia or sedation in marine mammals can be complicated by their particular anatomical and physiological specializations to the marine environment, compounded by the inherent challenges of working with wild animals. Anesthesia or sedation may activate the dive reflex, which would include breath holding, slowing of the heart rate, and the pooling of blood from peripheral vessels. The typical induction time for most chemical restraint agents is 10-20 minutes following intramuscular injection; as a result, darting can be dangerous because it can scare an animal into the water before the immobilization has taken affect, which can result in drowning; animals are at severe risk of drowning until completely awake (Heath et al. 1996). Miscalculation of an animal's weight can also lead to an overdose, which can have lethal consequences (Fowler 1986). The safest injection site for projectile syringes (darts) are in the deep muscle areas of the hind limbs of terrestrial animals (Day et al. 1980); however, the blubber layer on pinnipeds can make delivery of an injectable drug into the muscle, where needed for proper absorption and distribution, very difficult. In addition, inadvertent injection of drugs into the blubber frequently results in aseptic necrosis, sometimes leading to large abscesses (Geraci and Sweeney 1986). Injections into the chest cavity or stomach region can result in puncture of the lungs or stomach, which may be lethal.

A study on the use of Telazol (a general anesthetic that provides immobility and muscle relaxation) on Steller sea lions reported that of 51 adult female sea lions immobilized with Telazol darts between 1992-1994, there were five deaths (9.8 percent) (Heath et al. 1996); two of the sea lions drowned after falling into small rainwater pools and aspirating water, two others died after experiencing a depressed respiratory rate, then bradycardia, hypoxia, apnea, and finally asystole (Heath et al. 1996), and one died during isoflurane anesthesia due to improper positioning of the isoflurane tank. In 1993, under Permit No. 771 issued to National Marine Mammal Laboratory, a hauled out adult Steller sea lion darted with Telazol moved toward the water, rolled over into the surf and ultimately died. In February 1993, under Permit No. 771, 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. This additional stress could alter an animal's reaction to medications in unpredictable ways, and could have lethal consequences. In a deworming study on Hawaiian monk seals, researchers reported that after multiple captures, individual seals became skittish and more evasive; the authors noted that repeated captures may alter seal behavior or increase their level of stress (Gobush et al. 2011). Petrauskas et al. (2008) reported that sedation does not elicit a significant stress response in California and Steller sea lions based on serum and fecal corticosteroid analysis; however, handling and restraint (without sedation) consistently resulted in a significant stress response, as indicated by elevated fecal corticosterone concentrations, serum cortisol levels, and glucocorticoid responses (Petrauskas et al. 2008). Similarly, Champagne et al. (2012) found that sedated northern elephant seals did not exhibit a cortisol response; whereas physically restrained seals (without sedation) exhibited a stress response, as indicated by increases in circulating cortisol, epinephrine, and glucose concentrations, as well as increased endogenous glucose production in weanlings (Champagne et al. 2012). Finally, Harcourt et al. (2010) found that administering a light dose of the sedative diazepam significantly ameliorated the cortisol response of handled Weddell seals without affecting testosterone levels; they concluded that mild sedation may reduce acute capture stress responses (Harcourt et al. 2010). From these studies, we conclude that sedation likely reduces the stress response of pinnipeds that must be handled for health assessment, but can result in fitness consequences and mortality if animals are not carefully monitored and in the absence of adequate safety protocols.

Hyperthermia can occur in animals under anesthesia because the blubber layer can make heat dissipation a problem. Even at ambient temperatures that are comfortable for the researchers: otariids over 25 kg tend to become hyperthermic during anesthesia (Gage et al. 1993). Hypothermia can also occur in sedated animals, during anesthesia or post-recovery, as many drugs can affect thermoregulation. In hypothermia, the reduction in body temperature reduces tissue metabolism, while hyperthermia increases it. Both of these can have implications for the animal's reaction to any drugs administered, as well as any pathological conditions that may exist.

Medications that are injected may result in localized swelling and abscesses. Of forty-three wild Hawaiian monk seals injected with a deworming treatment, three seals developed minor swellings near the injection site that subsided on their own (all three seals were also noted to have previous wound histories unrelated to the study), one seal developed an abscess at the injection site and one seal displayed signs of respiratory distress (Gobush et al. 2011).

Large whales may be sedated to facilitate disentanglement by limiting evasive movements of the animal. Sedation of free-swimming cetaceans carries the risk that an excessively sedated animal could become excessively lethargic and drown (Moore et al. 2010). For this reason, very few attempts have been made at sedating cetaceans at sea. Following initial trials with beached whales, Moore et al. (2010) developed a sedation protocol for North Atlantic right whales. Two free swimming entangled whales were administered midazolam and butorphanol, first with a cantilevered pole syringe and later with darts, in increasing doses over multiple disentanglement attempts. After the third attempt to sedate one of the whales, a statistically significant increase in respiratory frequency was observed, with increased swimming speed and marked reduction of boat evasion that enabled decisive cuts to entangling gear. The whale was not re-sighted, thus the relative impact on the entangled whale's survival remains unknown. The results suggest that butorphanol and midazolam delivered ballistically, in appropriate dosages and combinations, may have merit in future free swimming entangled right whale cases until other entanglement solutions are developed (Moore et al. 2010).

Darts used to administer drugs to large whales may result in tissue damage if the needle crosses the blubber-muscle interface and remains in the animal. Results of a necropsy on a chronically entangled North Atlantic right whale that had been sedated and administered antibiotics found that the needle from one of four darts had remained embedded in the whale, with an 80º bend in the needle at the blubber-muscle interface. The bent needle was attributed to epaxial muscle movement relative to the overlying blubber, with resultant necrosis and cavitation of underlying muscle; though the whale's death was not associated with embedded needle, the authors concluded that rigid, implanted devices that span the cetacean blubber-muscle interface, where the muscle moves relative to the blubber, could have secondary health impacts (Moore et al. 2013).

The MMHSRP proposes to vaccinate ESA-listed cetaceans and pinnipeds 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.

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 (NMFS 2015a).

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 2016j). Captive harbor seals (n = 5) were vaccinated with PureVax, the recombinant canarypox-vectored canine distemper vaccine. The vaccine was evaluated for safety (by monitoring seals for local and systemic adverse effects and by testing for shedding of the canarypox vector) and efficacy (by testing for serum neutralizing antibodies). None of the seals showed signs of local or systemic adverse reactions to the vaccination. Three seals that were vaccinated once did not seroconvert, but the recombinant vaccine induced a persistent serum virus neutralizing titer in the two seals that were vaccinated twice (Quinley et al. 2013).

From 2002-2006, eight captive southern sea otters (*Enhydra lutris nereis*) at risk of exposure to potentially lethal morbilliviruses were vaccinated with a commercial recombinant poxvirus vectored canine distemper vaccine. Serum-neutralizing antibody responses were followed for several years. Results indicated that the commercial recombinant vaccine is safe, provokes a measurable serum-neutralizing antibody response, and that vaccination may provide some protection from infection for free-ranging sea otters (Jessup et al. 2009).

The only data on vaccination of pinnipeds against West Nile virus is from SeaWorld, San Antonio, where captive Hawaiian monk seals have been vaccinated with the inactivated West Nile virus vaccine "Innovator," from Fort Dodge, following an outbreak of West Nile virus in the park and the loss of one monk seal to West Nile virus infection. The vaccinated seals sero-converted following vaccination with no adverse reactions reported (Braun and Yochem 2006).

ESA-listed cetaceans and pinnipeds may experience an immune response following vaccination, which can rarely result in a local reaction at the site of injection characterized by heat and swelling that resolves in five to seven days, or febrile response (i.e., fever). However, we believe more severe adverse effects are unlikely. Effects determinations for stressors resulting from administration of medications to ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.8 and Section 7.4.2.9).

### 7.1.13 Potential Response to Auditory Brainstem Response/Auditory Evoked Potential

The MMHSRP proposed to evaluate the hearing abilities of individual animals or species using Auditory Brainstem Response (ABR) or Auditory Evoked Potential (AEP). These procedures may be conducted on stranded animals, animals in rehabilitation, or animals captured during studies. Procedures on odontocetes are generally non-invasive, but in some circumstances depending on the animal being tested, the procedure could be minimally invasive. An animal may be resting at the surface or may be physically restrained (held by researchers) during the procedure. The minimally invasive procedure entails a small needle that pierces the skin.

Any adverse response in cetaceans to ABR/AEP would be from the stress of people being close enough to perform the procedure, and not from the procedure itself; maximum sound levels presented would be lower than sound levels produced by animal whistles and echolocation clicks (frequencies used for testing range from 5-120 kHz with maximum sound pressure levels less than 160 decibels re μPa). Likewise, for pinnipeds, ABR/AEP procedures are not expected to result in stress or fitness consequences beyond the stress of capture, restraint, and handling required to perform the procedure. AEP testing has been conducted on several marine mammal species without any documented adverse effects (Castellote et al. 2014; Mooney et al. 2008; Mooney et al. 2012; Szymanski et al. 1999a; Szymanski et al. 1998; Yuen et al. 2005).

Several stranded cetaceans that were tested with AEPs under the MMHRSP's previous permit; all tested animals showed no evidence of behavioral or stress responses. Of the tested animals that were subsequently released with tags, tag data showed that all of the released animals survived the stranding and AEP procedure. Short-term impacts, including inflammation and hyperemia, could result from the suction cups used to attach electrodes to the animal, and are expected to be minimal. Effects determinations for stressors resulting from ABRs/AEPs of ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.11).

### 7.1.14 Intentional Mortality (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), 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 2014g). Other potential adverse responses to euthanasia include hyperexcitability or violent reactions in response to some chemical agents (NMFS

2014g). 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 2014g). Effects determinations for stressors resulting from euthanasia of ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.13 and Section 7.4.3).

### 7.1.15 Potential Response to Permanent Captivity

As noted previously in Section 7.1.5, placing marine mammals in captivity may result in changes in behavior, increased stress, injury, lower reproduction, and or even death, However, animals would only be placed in captivity if they are deemed non-releasable either because they are unlikely to survive in the wild or pose a threat to the rest of the wild population (e.g., they carry a pathogen). In such circumstances, permanent captivity is considered to be the best option for the individual as any release would result in greater adverse impacts to the individual and or the species in the wild. Permanently captive animals are no longer considered part of the wild population and, as such, adverse impacts to these individuals have no effect on the wild population.

Nonetheless, they themselves may be subject to further enhancement and or baseline health research activities once they become permanently captive. Procedures conducted on permanently captive ESA-listed marine mammals would likely elicit the same responses to research procedures as those that we would expect from animals in the wild. In captivity, animals are provided husbandry and veterinary care on a daily basis, and in many cases, are trained to voluntarily participate (e.g., for weighing, measuring, ultrasound, blood sampling), which precludes the need for capture and sedation. Scientific research and enhancement permits issued under the permit program that is part of this consultation will be conditioned to require that researchers halt activities if animals exhibit signs of excessive stress, pain, or suffering. The permits will also be 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. Effects determinations for stressors resulting from permanent captivity regarding ESA-listed cetaceans and pinnipeds are further discussed below in the *Risk Analysis* (Section 7.4.2.14).

## 7.2 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.

Permits issued under the program considered in this consultation will include 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 will 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 species considered in this opinion, 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). 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.

## 7.3 Effects Analysis

In this section, we attempt to quantify the potential adverse effects to ESA-listed species due to exposure to the various stressors associated with the proposed action. The activities authorized by the Permits Division, for both enhancement and baseline health research, are summarized in Section 15.1. To estimate the likely exposure of ESA-listed species to the proposed activities over the duration of Permit 24359 and under the permit program considered in this consultation, we analyzed previous data on MMHSRP activities that resulted in take. We then used those previous take numbers to estimate future effects.

Under the proposed permit, the number of target ESA-listed cetaceans and pinnipeds that may be taken during the MMHSRP's emergency response, emergency response research, rehabilitation and release, disentanglement, intentional harassment, and import/export activities will be unlimited. The number of non-target ESA-listed cetaceans and pinnipeds that may be taken during the MMHSRP's emergency response activities via unintentional harassment will also be unlimited. However, based on historic MMHSRP data (described below), the average number of annual takes for any species or species DPS from emergency response activities have not exceeded 20 percent of the abundanzce estimates of that particular species or species DPS over the analyzed reporting periods. The Permits Division and Marine Mammal Division provide us information regarding the number of emergency response takes in annual reports, as described in Section 3.4. This information will enable us to ensure that average annual emergency response takes continue to remain below a 20 percent level over the life of each successive permit. The Permits Division will be limiting other takes, including, but not limited to, takes from deep-implant tags, in accordance with the cetacean programmatic (NMFS 2019b).

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 are 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.

### 7.3.1 Exposure of ESA-Listed Marine Mammals to Enhancement Activities

During enhancement activities, the permit program will authorize the MMHSRP to expose injured, sick, entangled, or stranded marine mammals, or healthy animals that may be part of the same populations as injured, sick, entangled, or stranded marine mammals (e.g., in the case of a UME or oil spill) to the stressors associated with close approaches, aerial and vessel surveys, hazing and attractants, capture, restraint, handling, transport, holding, release, attachment of scientific instruments, marking, diagnostic imaging, sample collections, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, and disentanglement. The permit program will also authorize the MMHSRP to euthanize marine mammals in irreversibly poor condition (i.e., moribund as determined by a veterinarian). Any procedures performed on sick animals would be part of enhancement and not baseline health research.

Though it is not possible to precisely predict the marine mammal health emergencies that will occur over the duration of the permit that will warrant enhancement activities from the MMHSRP, we primarily used data on previous exposures of ESA-listed species to MMHSRP activities to inform our estimate of likely exposures over the duration of the permit. We identified the takes that occurred as a result of enhancement activities from July 2009 through December 2020 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 15 and Table 16.

Prior to the previous opinion regarding MMHSRP activities (NMFS 2017b), 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 December 2020 were enhancement activities.

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 permits 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 under previous permits have resulted in data that are not entirely reliable. For instance, as described above, enhancement activities have not historically been reported separately from baseline health research activities, although these are separated in the annual reports since July 2015. In addition, the form does not clarify what constitutes a “take” under the ESA, making it difficult to evaluate the number of activities performed by NMFS Regional Stranding Coordinators or co-investigators and those that resulted in take of marine mammals. 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 15 and Table 16 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 under 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 122 takes over that period (Table 15). Of the 794 total enhancement takes that occurred between January 2009 and through 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 whales (DPS unknown). No takes for enhancement activities were reported for Cook Inlet beluga whales, Rice's whales, Western North Pacific gray whales, Southern Resident killer whales, blue whales, North Pacific right whales, or bearded seals. Thus, based on historical take reported in MMHSRP annual reports (during the period January 2009 through June 2015), we would expect that enhancement activities of the MMHSRP would result in the annual take of ESA-listed marine mammals over the duration of any permit of approximately: 43 humpback whales; 36 North Atlantic right whales; 19 Hawaiian monk seals; five Steller sea lions; 16 Guadalupe fur seals; two sperm whales; two sei whales; two fin whales; one ringed seal; one bowhead whale; and one false killer whale (see Table 15).

For the period of July 2015 through December 2020, enhancement activities under the Program resulted in a total of approximately 1,352 takes, for an annual average of 245.9 takes over that period (Table 16). Of the 1,352 total enhancement takes that occurred between July 2015 and through December 2020, percentages of species takes were as follows: approximately 30 percent (n = 401) were Steller sea lions (mostly Western DPS but not noted in some cases); approximately 23 percent (n = 307) were humpback whales; approximately 14 percent (n = 183) were Hawaiian monk seals; approximately 13 percent (n = 173) were Guadalupe fur seals; approximately five percent (n = 67) were gray whales (DPS unknown but likely the non ESA-listed Eastern North Pacific DPS); approximately four percent (n = 54) were North Atlantic right whales; approximately four percent (n = 50) were Southern Resident killer whales; approximately four percent (n = 50) were Cook Inlet beluga whales; approximately two percent (n = 33) were fin whales; approximately one percent (n = 15) were sei whales; approximately one percent (n = 9) were sperm whales; approximately 0.5 percent (n = 7) were ringed seals; approximately 0.1 percent (n = 2) were bearded seals (DPS unknown); and approximately 0.07 percent (n = 1) were blue whales. No takes for enhancement activities were reported for bowhead whales, false killer whales, or Rice's whales. Thus, based on historical take in MMHSRP annual reports (during the period July 2015 through December 2020), we would expect that enhancement activities under the MMHSRP would result in the annual take of ESA-listed marine mammals over the duration of a permit of approximately: 73 Western DPS Steller sea lions; 56 humpback whales; 34 Hawaiian monk seals; 32 Guadalupe fur seals; 13 gray whales; 10 North Atlantic right whales; 10 Southern Resident killer whales; 10 Cook Inlet beluga whales; six fin whales; three sei whales; two sperm whales; two ringed seals; one bearded seal; and one blue whale (see Table 16). These figures differ drastically for some ESA-listed species (e.g., Steller sea lions) from those predicted in the previous analysis in our previous biological opinion (NMFS 2017c) based on takes outlined above for the January 2009 through June 2015 period, illustrating the unpredictability of the number of emergency responses that may occur over a given period.

Reinitiation of our previous consultation (NMFS 2017c) was required because it was determined that the MMHSRP is likely to import and subsequently export live vaquita from Mexico in the event vaquita need veterinary care that can only be received in the U.S. or if a natural disaster such as a hurricane threatens vaquita at their facilities in Mexico. Originally, CIRVA recommended at least three vaquita be brought into captivity in Mexico but, with their continued decline, recent CIRVA reports recommended the Mexican government capture as many vaquita as possible to be held in captivity in Mexico (CIRVA 2016; CIRVA 2017). Thus, in addition to the potential take of ESA-listed marine mammals estimated above based on previous annual reports, we had estimated that up to a maximum of 24 vaquita may be exposed to import and export, and associated enhancement activities (e.g., transport, restraint, handling, veterinary care, etc.) if the Mexcian government later exports the captured vaquita to the United States from Mexico to evacuate the captured vaquita from a natural disaster or other emergency. Holding of the captured vaquita in the United States would likely only be temporary, and the vaquita would be returned to Mexico. However, vaquita have not survived in captivity and the most recent CIRVA report has instead recommended the removal of illegal totoaba gillnets and arresting and prosecuting fishers (CIRVA 2019). There are currently approximately ten vaquitas remaining (Rojas-Bracho et al. 2022). The MMHSRP does not plan on the capture and long-term holding of live vaquita but may import/export live vaquita upon request from Mexico, although this is unlikely (personal communication from T. Rowles (NMFS) to S. Thornton (NMFS), November 29, 2022).

**Table 15:** Takes of ESA-listed marine mammals associated with enhancement activities, from January 2009 through June 2015. Note that takes associated solely with analysis, import, export, archival, or transfer of biological samples are not included; interactions with animals that were dead upon initial contact with the animal are also not included.

| Species | Jan. 2009 - Dec. 2009 | Jan. 2010 - Dec. 2010 | Jan. 2011 - Dec. 2011 | Jan. 2012 - June 2013* | July 2013 -June 2014 | July 2014- June 2015 | Total takes Jan. 2009 - June 2015 | Average annual takes, Jan. 2009 - June 2015* |
|---|---|---|---|---|---|---|---|---|
| Bowhead whale | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0.15 |
| False killer whale*** | 0 | 0 | 0 | 0 | 1 | 0 | 1 | 0.15 |
| Fin whale | 0 | 1 | 0 | 6 | 1 | 0 | 8 | 1.23 |
| Guadalupe fur seal | 5 | 0 | 0 | 8 | 11 | 79 | 103 | 15.8 |
| Hawaiian monk seal | 1 | 8 | 17 | 34 | 31 | 31 | 122 | 18.8 |
| Humpback whale | 7 | 52 | 24 | 103 | 71 | 22 | 279 | 42.9 |
| North Atlantic Right Whale | 17 | 5** | 81 | 101 | 21 | 6 | 231 | 35.5 |
| Ringed seal*** | 0 | 0 | 0 | 1 | 2 | 1 | 4 | 0.62 |
| Sei whale | 0 | 0 | 6 | 0 | 0 | 1 | 7 | 1.08 |
| Sperm whale | 0 | 5 | 1 | 1 | 1 | 0 | 8 | 1.23 |
| Steller sea lion*** | 1 | 4 | 1 | 11 | 10 | 3 | 30 | 4.62 |
| **TOTAL** | **31** | **75** | **130** | **265*** | **150** | **143** | **794** | **122.1** |

* 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.

**Table 16.** Takes of ESA-listed marine mammals associated with enhancement activities, from July 2015 through December 2020. Note that takes associated solely with analysis, import, export, archival, or transfer of biological samples are not included; interactions with animals that were dead upon initial contact with the animal are also not included.

| Species | Jul. 2015 - Jun. 2016 | Jul. 2016 - Jun. 2017 | Jul. 2017 - Jun. 2018 | Jul. 2018 – Jun. 2019 | Jul. 2019 – Dec. 2020 | Total takes Jul. 2015 – Dec. 2020 | Average annual takes, Jul. 2015 – Dec. 2020* |
|---|---|---|---|---|---|---|---|
| Bearded seal* | 0 | 0 | 0 | 1 | 1 | 2 | 0.36 |
| Beluga whale | 2 | 0 | 31 | 0 | 17 | 50 | 9.09 |
| Blue whale | 0 | 0 | 0 | 0 | 1 | 1 | 0.18 |
| Fin whale | 2 | 13 | 1 | 16 | 1 | 33 | 6.00 |
| Gray whale* | 0 | 4 | 6 | 4 | 53 | 67 | 12.2 |
| Guadalupe fur seal | 35 | 27 | 32 | 47 | 32 | 173 | 31.5 |
| Hawaiian monk seal | 22 | 27 | 63 | 36 | 35 | 183 | 33.3 |
| Humpback whale | 34 | 14 | 14 | 158 | 87 | 307 | 55.8 |
| Killer whale | 0 | 1 | 0 | 49 | 0 | 50 | 9.09 |
| North Atlantic Right Whale | 4 | 35 | 2 | 2 | 11 | 54 | 9.82 |
| Ringed seal* | 0 | 0 | 2 | 2 | 3 | 7 | 1.27 |
| Sei whale | 4 | 1 | 6 | 3 | 1 | 15 | 2.73 |
| Sperm whale | 0 | 2 | 2 | 1 | 4 | 9 | 1.64 |
| Steller sea lion* | 73 | 33 | 288 | 3 | 4 | 401 | 72.9 |
| **TOTAL** | **174** | **157** | **421** | **322** | **250** | **1352** | **245.9** |

* 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.

For authorized enhancement activities targeting humpback whales, estimates of the number of individuals to be sampled are based on the location where research and enhancement activities will occur in the Pacific Ocean, but multiple DPSs of ESA-listed humpback whales can be found in this region. Using data from 2011 through 2013, Darling et al. (2019) found that these DPSs may seasonally mix in the North Pacific, based on recordings of humpback whale songs from Mexico, Hawaii, Japan, and the Philippines that were found to have similar song portions or similar songs entirely. To determine the exposure of individual humpback whale DPSs in the Pacific (see Table 17 and Table 18), we rely on NMFS internal guidance (NMFS 2016f; NMFS 2016k; Wade 2017b; Wade 2021). For Alaska, British Columbia, Washington, Oregon, and California, which in Wade (2021) is composed of several small sub-locations, we use the percentage estimates from Wade (2021) into the greater North Pacific Ocean (including Alaska, Washington, Oregon, California, and Hawaii) area that researchers have and will continue to request takes in. For scientific research permits, the proportion of research and enhancement activities in the Alaska, Washington, Oregon, California, and Hawaii portion of the action area is unknown. We use each location specified in Wade (2021) (Aleutian Islands/Bering Sea/Chukchi Sea/Beaufort Sea, Gulf of Alaska, and Southeast Alaska/Northern British Columbia) and the probability of encountering the DPS breakdown percentages across the larger Alaskan area. For reference, we also include the percentage estimates from Wade (2021) for each humpback whale DPS near Kamchatka, Russia.

**Table 17. Probability of encountering humpback whales from each distinct population segment of humpback whales in the North Pacific Ocean in various summer feeding areas. Adapted from (Wade 2021).**

| Summer Feeding Areas | Western North Pacific Distinct Population Segment | Hawaii Distinct Population Segment | Mexico Distinct Population Segment | Central America Distinct Population Segment |
|---|---|---|---|---|
| Kamchatka | 90.9% | 8.8% | 0.3% | 0% |
| Aleutian Islands, Bering Sea, Chukchi Sea, Beaufort Sea | 2.0% | 91% | 7.1% | 0% |
| Gulf of Alaska | 0.3% | 89% | 10.6% | 0% |
| Southeast Alaska, Northern British Columbia | 0% | 97.6% | 2.4% | 0% |
| Southern British Columbia, Washington | 0% | 68.8% | 25.4% | 5.9% |
| Oregon, California | 0% | 0% | 57.7% | 42.3% |

**Table 18: Probability of encountering humpback whales from each distinct population segment of humpback whales in the North Pacific Ocean in various winter mating and calving areas. Adapted from (Wade 2021).**

| Winter Mating and Calving Areas | Western North Pacific Distinct Population Segment | Hawaii Distinct Population Segment | Mexico Distinct Population Segment | Central America Distinct Population Segment |
|---|---|---|---|---|
| Kamchatka | 88.6% | 0.3% | 0.3% | 0% |

| | | | | |
|---|---|---|---|---|
| Aleutian Islands, Bering Sea, Chukchi Sea, Beaufort Sea | 11.3% | 11.4% | 60.8% | 0% |
| Gulf of Alaska | 0% | 7.4% | 8.3% | 0% |
| Southeast Alaska, Northern British Columbia | 0% | 79.8% | 6.4% | 0% |
| Southern British Columbia, Washington | 0% | 1.1% | 3.2% | 3.3% |
| Oregon, California | 0% | 0% | 21.3% | 96.7% |

To determine the presence of humpback whales belonging to the Cape Verde Islands/Northwest Africa DPS in the Atlantic Ocean, we rely on NMFS internal guidance as derived from the scientific literature. Based on photo-identification, humpback whales that forage in the Western North Atlantic Ocean and occur on the breeding areas in the Caribbean Sea originate both from the non ESA-listed West Indies DPS (comprising approximately 10,400 animals [CV=0.138]) and the Cape Verde Islands/Northwest Africa DPS (comprising approximately 171 to 260 animals) (Ryan et al. 2014). Given these estimates, we expect that no more than 2.5 percent of the humpback whales found in the Eastern North Atlantic Ocean feeding areas (Iceland, Norwegian Sea, and Northern Norway) are from the Cape Verde Islands/Northwest Africa DPS (see Table 19). The NMFS 2017 stock assessment report for the Gulf of Maine stock of humpback whales states that during winter, humpback whales from most of the Western North Atlantic Ocean feeding areas (including the Gulf of Maine) mate and calve in the West Indies, where spatial and genetic mixing among feeding groups occurs (Clapham et al. 1993; Katona and Beard 1990; Palsboll et al. 1997; Stevick et al. 1998).

Evidence shows that some humpback whales using Eastern North Atlantic Ocean feeding areas migrate to the Cape Verde Islands (Reiner et al. 1996; Stevick et al. 2016; Wenzel et al. 2009), as four have been photographed and identified in both the Cape Verde Islands and the Guadeloupe region (Lesser Antilles) of the Caribbean Sea (Stevick et al. 2016). Two of these humpback whales are assumed/confirmed as males (one was a biopsy confirmation and in a competitive group, one was a singer, and the other was in a competitive group). The male humpback whales were matched/resighted in the Cape Verde Islands, one was a resight in the northern feeding area (Norway), and all four were seen in Guadeloupe. None of these four animals has been resighted in the Cape Verde Islands and Guadeloupe during the same year. No resightings of Cape Verde Islands/Northwest Africa DPS of humpback whales have been made in the Navidad/Silver Bank breeding/calving area. The assumption is that the animals are traveling from the Cape Verde Islands to the northern feeding areas (Eastern North Atlantic Ocean) and then continuing to the Southeast Caribbean Sea in subsequent seasons. This is approximately 7,000 kilometers (3,779.7 nautical miles) from the Cape Verde Islands to Norway and 7,700 kilometers (4,158 nautical miles) from Norway to Guadeloupe. The two breeding and calving area sites (Cape Verde Islands and Caribbean Sea) are separated by an ocean basin and greater than approximately 4,000 kilometers (2,160 nautical miles). Timing of the humpback whales' arrival in Guadeloupe

(February through May) is approximately six weeks later (greatest abundance) than the humpback whales in Navidad Bank/Silver Bank (January through April) and may be related to the feeding area origin/destination (Stevick et al. 2018). Based on the aforementioned four animal resightings, we estimate that no more than 0.04 percent of the humpback whales occurring in the Lesser Antilles breeding areas (e.g., Guadeloupe) would be from the endangered Cape Verde Islands/Northwest Africa DPS of humpback whales (see Table 20).

**Table 19. Probability of encountering humpback whales from each distinct population segment of humpback whales in the North Atlantic Ocean in various summer feeding areas.**

| Summer Feeding Areas | West Indies Distinct Population Segment | Cape Verde Islands/Northwest Africa Distinct Population Segment |
|---|---|---|
| Gulf of Maine | 100% | 0% |
| Gulf of St. Lawrence | 100% | 0% |
| Newfoundland/Labrador | 100% | 0% |
| Western Greenland | 100% | 0% |
| Iceland | 97.5% | 2.5% |
| Norwegian Sea | 97.5% | 2.5% |
| Northern Norway | 97.5% | 2.5% |

**Table 20. Probability of encountering humpback whales from each distinct population segment of humpback whales in the North Atlantic Ocean in various winter breeding areas.**

| Winter Breeding Areas | West Indies Distinct Population Segment | Cape Verde Islands/Northwest Africa Distinct Population Segment |
|---|---|---|
| Greater Antilles (Mouchoir Bank, Silver Bank, Navidad Bank, and Samana Bay) | 100% | 0% |
| Lesser Antilles (Anguilla, Saint Martin, Guadeloupe, Martinique, Saint Vincent and Grenadines)<br>*From mid-March through late May or early June* | 99.96% | 0.04% |
| Cape Verde Islands | 0% | 100% |

To determine the exposure of endangered gray whales belonging to the Western North Pacific population, we rely on NMFS internal guidance as derived from Carretta et al. (2019). This population of gray whales feeds during the summer and fall in the Okhotsk and Bering Seas off northeastern Japan and eastern Russia, respectively. The non-ESA-listed Eastern North Pacific population of gray whales also feeds in the Bering Sea, in addition to the Beaufort and Chukchi Seas and the coastal waters of western North America. This population is estimated to be comprised of around 26,960 individuals, while the Western North Pacific population is comprised of around 290 individuals (reviewed in Carretta et al. (2019). Therefore, we expect no more than 1.1 percent of the gray whales observed in the North Pacific Ocean feeding grounds outside of the Okhotsk Sea to belong to the Western North Pacific population (see Table 21).

Previous studies have observed approximately 30 gray whales from the Western North Pacific population in the Western and Eastern North Pacific Ocean (including coastal waters of Canada, the U.S., and Mexico), as some gray whales from the Western North Pacific population are thought to migrate to the eastern North Pacific Ocean in winter, while others from this population migrate south to waters off Japan and China (reviewed in Carretta et al. (2019). Using this estimate of 30 animals, we expect no more than 0.1 percent of gray whales observed in the Eastern North Pacific Ocean breeding grounds to belong to the Western North Pacific population (see Table 22).

**Table 21: Probability of encountering gray whales from the Eastern North Pacific and Western North Pacific populations in the North Pacific Ocean in various summer feeding areas.**

| Summer Feeding Areas | Eastern North Pacific Population | Western North Pacific Population |
|---|---|---|
| Chukchi Sea | 100% | 0% |
| Beaufort Sea | 100% | 0% |
| Western North America (Kodiak Island, Alaska and northern California) | 99.9% | 0.1% |
| Bering Sea | 98.9% | 1.1% |
| Okhotsk Sea | 0% | 100% |

**Table 22: Probability of encountering gray whales from the Eastern North Pacific and Western North Pacific populations in the North Pacific Ocean in various winter breeding areas.**

| Winter Breeding Areas | Eastern North Pacific Population | Western North Pacific Population |
|---|---|---|
| Baja, California and Mexico | 99.9% | 0.1% |
| Japan/China (Pacific coast) | 0% | 100% |

We would not expect the five-year annual average (the duration of each permit) of enhancement takes to exceed twenty percent of each ESA-listed marine mammal species population at the DPS (e.g., beluga whale Cook Inlet DPS) or range-wide (e.g., sperm whales) level. This is based on the approximate annual takes listed above for the previous reporting periods and, for humpback whales and gray whales, the DPS encounter probabilities discussed above and the locations of previous MMHSRP enhancement activities as provided by the MMHSRP annual reports.

### 7.3.2 Exposure of ESA-Listed Marine Mammals from Baseline Health Research Activities

During baseline health research activities, the permit program and implementation of this programmatic consultation 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 permit program and programmatic would also authorize the MMHSRP to euthanize marine mammals in irreversibly poor condition (i.e., moribund as determined by a veterinarian). 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 from June 2009 through December 2020, 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 from 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. For the period from July 2015 through December 2020, a total of 31 individual animals from three ESA-listed species were taken with a total of 31 takes reported as a result of baseline health research activities.

We used information on previous takes that occurred as part of baseline health research (as defined in this opinion) to estimate the number of takes that are expected to occur over the duration of a permit for baseline health research activities. As described above, a total of 38 individual animals were taken, with a total of 162 takes reported (multiple takes per animal were 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 estimated that over the duration of a permit, the MMHSRP would take six individual animals annually, with 25 total takes occurring annually, as part of baseline health research activities.

Similar to the permit period from 2009 to 2015 for the 5.5 year period from July 2015 through December 2020, a total of 31 individul animals were taken, with a total of 31 takes reported as part of baseline health research. Thus, over that period, an average of six takes occurred annually, with an average of six individual animals taken annually (one take per animal). This matches the number of individual animals that were expected to be taken over this period, as described above, although it is fewer than the number of takes predicted in the permit.

It should be noted that our estimate of future takes associated with baseline health research under this programmatic is constrained by the very limited sample size available for creating an estimate. We used reported take numbers from previous permits to estimate the number of takes that are likely to occur annually over the duration of a 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, 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. Because most specimens will be acquired opportunistically with other ongoing studies, the MMHSRP will have minimal control over the age, size, sex, or reproductive condition of any animals that are sampled.

Due to the unpredictable nature of the actual baseline health research takes that will occur over the duration of a permit, the takes listed in Section 15 are the maximum annual take numbers for ESA-listed species that the MMHSRP anticipates could occur for these species under the initial five-year permit, 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 six annual takes will occur during "baseline health research," the MMHSRP has requested up to 70 annual takes of ESA-listed large whales (specifically for fin whales, fewer annual takes requested for other ESA-listed species) and 60 annual takes each of ESA-listed pinniped species (see Section 15.1).

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), 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, we believe it is reasonably certain that baseline health research activities could result in up to 70 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 70 individual fin whales, annually).

Section 7.3.1 offers estimates of proportions of endangered humpback and gray whale DPSs that may be exposed to MMHSRP enhancement activities. These estimates also apply to MMHSRP baseline health research activities.

### 7.3.3 Exposure of Non-Target Individuals of ESA-Listed Targeted Species and ESA-Listed 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 net deployments for capturing targeted marine mammals.

The Permits Division reviewed occurrences of mortality and serious injury in non-target marine mammals from annual and incident reports submitted by the MMHSRP from 2012 to 2022. The MMHSRP reported no mortality or serious injury for non-target animals over this period. However, other permitted researchers have reported seven mortalities of non-target marine mammals over this period. These mortalities were of non-ESA-listed species and included two belugas (not belonging to the Cook Inlet DPS), two bottlenose dolphins, two California sea lions, and one harbor seal. All beluga, bottlenose dolphin, and the one harbor seal mortality were caused by drowning in nets, while the California sea lion mortalities were due to trampling by conspecifics during stampedes and behavioral disturbance. Guadalupe fur seals and Western DPS Steller sea lions tend to have large group sizes and stampede (Aurioles-Gamboa et al. 2010; Szaniszlo 2005) if disturbed in certain situations (see Section 7.1). In addition, mortalities of non-target animals may also occur by euthanasia when the onsite veterinarian deems it the most humane course of action if accidents or serious injuries occur during MMHSRP activities. As such, the Permits Division believes authorizing a small number of mortality and serious injury takes for these species is warranted: a maximum of one mortality or serious injury of a non-target Guadalupe fur seal and Western DPS Steller sea lion annually during net captures and harassment that can result in stampedes, not to exceed three over the life of a permit.

Given the instances of non-lethal vessel strikes that have occurred during research activities, the Permits Division believes authorizing a small number of harassment/non-serious injury takes from vessel strikes during close approaches is also warranted: 10 ESA-listed small cetaceans, 10 ESA-listed large whales, and 10 ESA-listed pinnipeds every five years (two ESA-listed small cetaceans, two ESA-listed large whales, and two ESA-listed pinnipeds annually).

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 ensure 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. These include 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 duration of the MMHSRP activities from 2005 through July 2022. While a single smalltooth sawfish was previously incidentally captured during turtle research permitted to another individual, the net sampling technique that was used differs greatly from that proposed here by the MMHSRP and so this incident was not considered informative to this consultation.

#### 7.3.3.1 *Incidental Capture Rates*

As in our previous opinion (NMFS 2017b), historical data on net deployments from the MMHSRP were used to estimate future net deployments and likely incidental capture rates of ESA-listed animals. For this opinion, data used were from 2005 through July 2022, inclusive. Based on these data, 256 nets were deployed for baseline research activities, and 53 were deployed for emergency response, resulting in a total of 309 net deployments. These 309 deployments were further broken down in an overlap matrix according to their spatial overlap with non-target ESA-listed species' ranges because 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 through July 2022 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 0.65 percent of net deployments. However, given that we evaluate the effects to each ESA-listed species separately, we consider this a rate of 0.32 percent for loggerhead and 0.32 percent for green turtles respectively. Further, we broke down the historic data 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 0.32 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 (0.32 percent for each loggerhead and green turtle DPS, 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) – 0.65 percent, hawksbill turtles – 0.32 percent, Kemp's ridley turtles – 0.32 percent, loggerhead sea turtles (all DPSs) – 0.65 percent, olive ridley turtles (all DPSs) – 0.65 percent, leatherback turtles - 0.32 percent, smalltooth sawfish – 1.69 percent, Atlantic sturgeon (all DPSs) – 3.45 percent, Gulf sturgeon – 1.49 percent, shortnose sturgeon – 1.33 percent, green sturgeon (Southern DPS) – 3.45 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 a 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 first five-year permit to be issued under this programmatic can be seen in Table 23. From these data a total of 1,440 net deployments would be authorized. However, not all of these net deployments would overlap with the ranges of all the non-target species within the action area of this consultation. 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. In this regard, the number of future authorized net deployments that overlap with each non-target species as listed in Table 24 represents a minimum value because an unlimited number of emergency response net deployments within each species range would also be authorized. Where takes of target marine mammal species are specific to broad taxonomic groups spanning multiple oceans (e.g., "small cetaceans"), we conservatively assumed that all takes would overlap the non-target species' range.

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 expected future incidental take that would result from the MMHSRP's activities, we multiplied $ITR_{fmax}$ by both the requested annual net deployments (for baseline research only) and the predicted annual net deployments (for both baseline and emergency response). Table 24 summarizes these data, as well as other relevant annual data used in estimating these final annual incidental take numbers. However, as there was only one estimated take for a single species (i.e., South Atlantic DPS Atlantic sturgeon), we adopt the more conservative incidental take estimates from our previous opinion (NMFS 2017b), which also includes the two incidental turtle captures mentioned above (see Table 25). Based on that analysis, we estimated the MMHSRP may take up to ten hardshell sea turtles, two leatherback turtles, three smalltooth sawfish, three Atlantic sturgeon (all DPSs), one Gulf sturgeon, and one shortnose sturgeon annually. Further, we estimated an annual incidental take of one green sturgeon (Southern DPS) because they overlap with possible future pinniped net captures on the West coast of the U.S.

**Table 23.** Number of net deployments to be authorized under Permit No. 24359.

| Line No. from Take Table A2 | Species and Listing Unit/ Stock | Take Action | No. Possible Net Deployments |
|---|---|---|---|
| 4 | Small cetacean, unidentified; Range-wide | Capture/ Handle/ Release; Harass; Harass/ Sampling | 500 |
| 12 | Pinniped, unidentified; Range-wide | Capture/ Handle/ Release; Harass; Harass/ Sampling | 700 |
| 19 | Seal, ringed; Arctic and Okhotsk | Capture/ Handle/ Release; Harass; Harass/ Sampling | 60 |
| 16 | Seal, bearded; Beringia DPS | Capture/ Handle/ Release; Harass; Harass/ Sampling | 60 |
| 17 | Seal, Guadalupe fur; Range-wide | Capture/ Handle/ Release; Harass; Harass/ Sampling | 60 |
| 15 | Sea lion, Steller; Western DPS | Capture/ Handle/ Release; Harass; Harass/ Sampling | 60 |

**Table 24.** Summary of data used to estimate annual incidental takes of non-target Endangered Species Act-listed species (years 2005 through 2022).

| Listed Species | Historic Baseline Research Net Deployments | Historic Emergency Response Net Deployments | Historic Incidental Take Rate | Baseline Research (Predicted) | Baseline Research (Requested) | Emergency Response (Predicted) | Maximum Incidental Take Rate | Incidental Take (Predicted) | Incidental Take (Requested) | Estimated take |
|---|---|---|---|---|---|---|---|---|---|---|
| Green sea turtle (Central South Pacific) | 0 | 0 | 0.00% | 1 | 500 | 0 | 0.65% | 0 | 3 | |
| Green sea turtle (Central West Pacific) | 0 | 0 | 0.00% | 1 | 500 | 0 | 0.65% | 0 | 3 | |
| Green sea turtle (Central North Pacific) | 0 | 0 | 0.00% | 1 | 1200 | 0 | 0.65% | 0 | 8 | |
| Green sea turtle (East Pacific) | 0 | 0 | 0.00% | 1 | 1260 | 0 | 0.65% | 0 | 8 | |
| Green sea turtle (North Atlantic) | 14 | 3 | 0.32% | 50 | 500 | 13 | 0.65% | 0 | 3 | |
| Hawksbill sea turtle | 14 | 3 | 0.00% | 50 | 1260 | 13 | 0.32% | 0 | 4 | |
| Kemp's ridley sea turtle | 14 | 3 | 0.00% | 50 | 500 | 13 | 0.32% | 0 | 2 | 0 |
| Loggerhead sea turtle (North Pacific Ocean) | 0 | 0 | 0.00% | 1 | 1260 | 0 | 0.65% | 0 | 8 | |
| Loggerhead sea turtle (Northwest Atlantic Ocean) | 14 | 3 | 0.32% | 50 | 500 | 13 | 0.65% | 0 | 3 | |
| Loggerhead sea turtle (South Pacific Ocean) | 0 | 0 | 0.00% | 1 | 500 | 0 | 0.65% | 0 | 3 | |
| Olive ridley sea turtle (Mexico's Pacific coast breeding colonies) | 0 | 0 | 0.00% | 1 | 1260 | 0 | 0.65% | 0 | 8 | |
| Olive ridley sea turtle (All other areas) | 0 | 0 | 0.00% | 1 | 1260 | 0 | 0.65% | 0 | 8 | |
| Leatherback sea turtle | 14 | 3 | 0.00% | 50 | 1320 | 13 | 0.32% | 0 | 4 | 0 |
| Smalltooth sawfish | 2 | 2 | 0.00% | 8 | 500 | 9 | 1.69% | 0 | 8 | 0 |
| Atlantic sturgeon (Gulf of Maine) | 0 | 0 | 0.00% | 1 | 500 | 0 | 3.45% | 0 | 17 | |
| Atlantic sturgeon (New York Bight) | 0 | 0 | 0.00% | 1 | 500 | 0 | 3.45% | 0 | 17 | |
| Atlantic sturgeon (Chesapeake Bay) | 0 | 0 | 0.00% | 1 | 500 | 0 | 3.45% | 0 | 17 | 1 |
| Atlantic sturgeon (Carolina) | 1 | 0 | 0.00% | 1 | 500 | 0 | 3.45% | 0 | 17 | |
| Atlantic sturgeon (South Atlantic) | 4 | 3 | 0.00% | 2 | 500 | 13 | 3.45% | 1 | 17 | |

| Listed Species | Historic Baseline Research Net Deployments | Historic Emergency Response Net Deployments | Historic Incidental Take Rate | Baseline Research (Predicted) | Baseline Research (Requested) | Emergency Response (Predicted) | Maximum Incidental Take Rate | Incidental Take (Predicted) | Incidental Take (Requested) | Estimated take |
|---|---|---|---|---|---|---|---|---|---|---|
| Gulf sturgeon | 3 | 0 | 0.00% | 11 | 500 | 0 | 1.49% | 0 | 7 | 0 |
| Shortnose sturgeon | 4 | 3 | 0.00% | 15 | 500 | 13 | 1.33% | 0 | 7 | 0 |
| Green sturgeon (Southern) | 0 | 0 | 0.00% | 1 | 1260 | 0 | 1.49% | 0 | 19 | 0 |

**Table 25. Summary of data used to estimate annual incidental takes of non-target Endangered Species Act-listed species for previous Permit No. 18786-01 (years 2005 through 2015; includes the two incidental turtle captures).**

| Listed Species | Baseline Research Net Deployments | Emergency Response Net Deployments | Incidental Take Rate | Baseline Research (Predicted) | Baseline Research (Requested) | Emergency Response (Predicted) | Incidental Take Rate | Incidental Take (Predicted) | Incidental Take (Requested) | 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 |

| Listed Species | Baseline Research Net Deployments | Emergency Response Net Deployments | Incidental Take Rate | Baseline Research (Predicted) | Baseline Research (Requested) | Emergency Response (Predicted) | Incidental Take Rate | Incidental Take (Predicted) | Incidental Take (Requested) | Estimated take |
|---|---|---|---|---|---|---|---|---|---|---|
| Atlantic sturgeon (Gulf of Maine) | 0 | 0 | 0.00% | 1 | 3000 | 31 | 1.75% | 1 | 53 | |
| Atlantic sturgeon (New York Bight) | 0 | 0 | 0.00% | 1 | 3000 | 31 | 1.75% | 1 | 53 | |
| Atlantic sturgeon (Chesapeake Bay) | 0 | 0 | -- | 1 | 3000 | 2 | 1.75% | 0 | 53 | 3 |
| 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 |

## 7.4 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 7.1) 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 7.3).

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) to which those individuals belong.

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 3) and the *Exposure Analysis* (Section 7.3), it is important to distinguish between the risks posed by enhancement activities and those posed by baseline health research activities of the MMHSRP.

### 7.4.1 Risk to Marine Mammals Associated with Enhancement Activities

As described in the *Exposure Analysis* (Section 7.3), based on takes that have occurred previously during enhancement activities and recent information on takes associated with the import/export of vaquita, we estimate the annual take of ESA-listed marine mammals over the duration of a permit during enhancement activities to be as follows: 73 Steller sea lions; 56 humpback whales; 34 Hawaiian monk seals; 32 Guadalupe fur seals; 13 gray whales; 10 North Atlantic right whales; 10 killer whales; 10 Cook Inlet beluga whales; six fin whales; three sei whales; two sperm whales; two ringed seals; one bearded seal; and one blue whale and up to 10 vaquita. We assume these cetaceans and pinnipeds may represent any age, gender, reproductive condition, or health condition. Despite the estimates above, enhancement activities are conducted in response to emergency scenarios, and as these emergency scenarios are unpredictable, actual exposures among ESA-listed species to MMHSRP enhancement activities that will occur over the duration of the permit are largely unpredictable (as described in Section 7.3).

Based on historic MMHSRP data, we would not expect an annual average, when examined over the life of the permit, of more than 20 percent of ESA-listed marine mammals' population size (at the range-range or DPS level) to be exposed during MMHSRP enhancement activitities.

These activities include close approaches, aerial and vessel surveys, hazing and attractants, capture, restraint, handling, transport, holding, release, attachment of scientific instruments, marking, diagnostic imaging, sample collections, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, disentanglement, and euthanasia.

The enhancement activities of the MMHSRP entail responses to health emergencies involving marine mammals world-wide, including responses to animals that are stranded, entangled in fishing gear or marine debris, are in ill health, or are otherwise in danger or distress. Based on the best available information, we assume that for the vast majority of animals involved in enhancement activities, those animals would either die or suffer fitness consequences that would reduce their longevity or reproductive success in the absence of the MMHSRP's response to their distress. That is, we assume that animals involved in these emergencies may experience short-term harm but long term gain as a result of the MMHSRP's intervention. They are less likely to die, or experience reductions in fitness, because of the MMHSRP's response to these emergencies than if the program did not respond. Exceptions to this assumption could potentially include accidental mortality or fitness consequences in an animal that was either not the target of a response (e.g., the death of a non-target animal as a result of a pinniped stampede), or was a member of a population that was responded to, but was healthy upon initial response (e.g., mortality of a previously healthy animal in a capture net during a UME response). Based on the best available information, including MMHSRP annual reports and communications with the MMHSRP, there have been no documented instances of death or fitness consequences among previously healthy ESA-listed animals as a result of MMHSRP enhancement activities historically.

Based on the information above, we believe that over the duration of the permit, enhancement activities will lead to the improved condition of animals that are ill or in distress and will thus result in saved lives and increased fitness among ESA-listed marine mammal animals over the long-term, effectively adding animals to the populations of those species (versus the baseline in the absence of the MMHSRP's response, which would result in the potential 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.

### 7.4.2 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. However, 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 permit terms and conditions will greatly minimize the potential for stress, injuries, or mortalities associated with exposure to baseline health research activities.

Permits issued by the permit program considered in this programmatic would authorize annual directed take, specifically for baseline health research activities of the MMHSRP, as follows: as many as 70 annual takes of fin whales; as many as 40 annual takes of beluga whales (Cook Inlet DPS), blue whales, humpback 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 10 takes of Rice's whales; 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). Takes of Hawaiian monk seals in the wild for MMHSRP baseline health research is not proposed; however, the permit would authorize 60 annual takes of Hawaiian monk seals in captivity, rehabilitation, or "piggy-backing research" in the wild, for baseline health research. Permits will authorize directed take in the form of mortality (unintentional or euthanasia) and serious injury, specifically during baseline health research activities, as follows: a combined maximum of five mortalities or serious injuries of bearded seals (Beringia DPS), ringed seals (Arctic subspecies), or Steller sea lions (Western DPS); one mortality or serious injury of a Guadalupe fur seal; and one mortality or serious injury of a Hawaiian monk seal (in captivity, rehab, or during "piggy-backing" research in the wild), over the five year permit.

In addition, any permit issued by the permit program considered in this programmatic would authorize up to 5,000 annual takes in the form of behavioral harassment of ESA-listed large whales and ESA-listed small cetaceans and 10,000 annual takes in the form of behavioral harassment of ESA-listed pinnipeds during close approaches, aerial surveys, and vessel surveys associated with baseline health research activities.

#### 7.4.2.1 *Close Approach, Aerial Surveys and Vessel Surveys*

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 five-year permits will 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 7.1.1), cetaceans are likely to display a range of responses to close approaches (including aerial and vessel surveys), ranging from no response to behavioral reactions including lunging, lifting of the head or fluke, altering swimming speed or orientation, diving, and increasing time spent submerged. Researchers have noted that different approach techniques have a major influence on a whale's response to vessels (Bauer 1986; Bauer and Herman 1986; Clapham and Mattila 1993; Hall 1982). Responses are reported to range from minimal to non-existent when close vessel approaches are slow and careful, leading researchers to conclude that experienced, trained personnel approaching whales slowly would result in fewer individuals exhibiting responses that might indicate stress (Clapham and Mattila 1993; Weinrich et al. 1991).

We believe the potential for stress responses as a result of close approaches will be effectively minimized by the permit terms and conditions, which include the following requirements:

- No individual animal may be taken more than three times in one day (with the exception of some small cetacean species which tend to approach boats and are difficult to identify to individuals).
- Researchers must exercise caution when approaching animals and must retreat from animals if behaviors indicate the approach may be interfering with reproduction, feeding, or other vital functions.
- Where females with calves are authorized to be taken, researchers:
    - Must immediately terminate efforts if there is any evidence that the activity may be interfering with pair-bonding or other vital functions;
    - Must not position the research vessel between the mother and calf;
    - Must approach mothers and calves gradually to minimize or avoid any startle response;
    - Must not approach any mother or calf while the calf is actively nursing; and
    - Must, if possible, sample the calf first to minimize the mother's reaction when sampling mother/calf pairs.
- Any activity must be discontinued if an animal exhibits a strong adverse reaction to the activity or the vessel (e.g., breaching, tail lobbing, underwater exhalation, or disassociation from the group).
- Manned aerial surveys must be flown at an altitude of at least 750 feet (229 meters) 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 to minimize behavioral responses and the chances of striking the animals with the vessel. As a result, we believe that close approaches of cetaceans are likely to produce the same results as reported by Clapham and Mattila (1993): short- to mid-term stress responses that are not expected to cause 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 because of close approaches, including aerial and vessel surveys, and as a result of any vessel strikes that may occur during close approaches.

As described in the *Response Analysis* (Section 7.1), 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, 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 that could result in fitness consequences because 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 will 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.

#### 7.4.2.2 *Capture, Restraint, and Handling*

The permit would authorize 60 total 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 7.1.3), we believe that capture, restraint, and handling represent the greatest potential stressors among the activities proposed. Based on the best available information, we believe that the responses among ESA-listed pinnipeds to capture, restraint, and handling will include a range of stress responses, including vocalizing, biting, or trying to escape. Attempts to escape can potentially lead to injury or death. Stress responses could also lead to hyperthermia and myopathy, which can be fatal. Stress from capture, restraint, and handling may result in interruptions of essential behavioral or physiological events, alteration of an animal's time budget, or some combinations of these responses (Frid and Dill 2002; Romero 2004; Sapolsky et al. 2000; Walker et al. 2005). Death may also occur as a result of accidental drowning in nets used for capture.

Several studies have shown that fitness consequences resulting from capture, restraint, and handling of pinnipeds are uncommon. A six-year study on the effects of researcher presence, branding and handling of Steller sea lions on Alaska's Marmot and Ugamak Islands found that, despite the relatively high level of disturbance (most or all adults and juveniles displaced from the beach, many pups handled and separated from mothers), there were apparently only temporary behavioral changes and only one significant modification to on-land abundance. Over six years of monitoring, adult female and dependent pup abundance was not significantly affected, and there were no differences in the trends in pup production at disturbed versus undisturbed rookeries (Wilson et al. 2012b). 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 2009c) will minimize the likelihood of fitness consequences because of capture, handling, and restraint. These measures include the following:

- Researchers must carry out activities quickly and efficiently and use biologists experienced in capture and sampling techniques to reduce disturbance of rookeries, haul-outs, and colonies, and to minimize handling/restraint time;
- Researchers must capture and handle pinnipeds in groups small enough that individual animals can be adequately monitored;
- Efforts to approach and handle a particular pinniped must be immediately terminated if there is any evidence that the activities may be life-threatening to the animal;
- Researchers must immediately cease research-related procedures if a pinniped is showing signs of acute or protracted alarm reaction (e.g., overexertion, constant muscle tensions, abnormal respiration or heart rate) that may lead to serious injury, capture myopathy, other disease conditions, or death; and monitor or treat the animal as determined appropriate by the principal investigator, co-investigator, or attending veterinarian;
- Researchers must ensure that pinnipeds that have been captured or are recovering from immobilizing drugs have an opportunity to recover without undue risk of drowning or injury from other animals;
- Researchers must exercise caution when approaching all pinnipeds, particularly mother/pup pairs. Researchers must take reasonable steps to identify pregnant and lactating females to avoid disturbing them;
- In addition, for non-target protected species in the study area:
    - Researchers must make every effort to prevent interactions with non-target protected species;
    - For in-water captures, netting must not be initiated when non-target marine mammals or sea turtles are observed within the vicinity of the research; and
    - 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 their most recent permit application that a marine mammal veterinarian or other qualified personnel will 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 will either be sedated or be released immediately to minimize the risk that continued stress will lead to capture myopathy (NMFS 2014g).

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.

#### 7.4.2.3 *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 7.1.4), 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.

#### 7.4.2.4 *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 fin whales (70 annual takes), 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 7.1.7) the attachment of tags and scientific instruments can potentially result in a range of responses, from no response to subtle, short-term behavioral responses to long-term changes that have the potential to affect survival and reproduction. Implantable tags (e.g. satellite tags) can cause wounds, bruising, swelling, and hydrodynamic drag, while internally placed devices (e.g., PIT tags, LHX tags) may cause blockage, be rejected from the animal's body, or cause tissue reactions and infection. Responses may be compounded by the stress of close vessel approach (for cetaceans) or capture, restraint, and handling (for pinnipeds) required to attach the tag or scientific instrument.

Flipper tagging and instrumentation of pinnipeds is not expected to affect behavior or result in injuries or fitness consequences. In a study assessing short-term effects of flipper tagging (and capture and restraint) of weaned Hawaiian monk seal pups, behavior and survival among tagged pups (n = 13) was compared to a control group of untagged pups (n = 13); results showed no difference between the two groups in short term survival as well as days seen ashore, numbers and lengths of trips from the island, and 14 other behavioral categories; no mortality was attributable to tagging (Henderson and Johanos 1988). Baker and Johanos (2002) compared flipper tagged Hawaiian monk seals (n = 437) with non-tagged seals (n = 437) and reported no significant differences in resighting rates, rates of returns to the same subpopulations, and health or condition (emaciation, shark inflicted wounds, etc.). In the same study, Hawaiian monk seals that had instruments attached to their dorsal pelage using epoxy glue (n = 93) were compared with seals that did not have instrumentation attached (n = 93); instruments included time-depth recorders, satellite-linked time-depth recorders, video recorders (Crittercam), and GPS data loggers. As with flipper tagging, results indicated no significant differences in resighting rates, rates of return to the same subpopulations, and the seals' health or condition (Baker and Johanos 2002). A review of peer-reviewed articles addressing the effects of marking and tagging between 1980-2011 (Walker et al. 2012) found that none of the reviewed studies assessing visual tag (e.g., roto tag) attachment found visual tags affect survival (Baker and Johanos 2002; Hastings et al. 2009; Henderson and Johanos 1988). While visual tags can cause tissue damage at the site of tag attachment (Irvine et al. 1992) and tissue damage may result if tags are torn out (Henderson and Johanos 1988), any injuries are expected to be minor and short-term, with full healing expected to occur within days of any injuries (Paterson et al. 2011). Though epoxy glue has the potential to cause thermal burns or react with the skin, such effects have not been documented in its use in tag or instrument attachment on pinnipeds (Walker et al. 2012).

The extensive re-sighting history of North Atlantic right whales suggests survival rates of tagged versus untagged individuals is not discernibly different (Mate et al. 2007). A review of peer-reviewed articles published over a 31 year period (1980-2011) addressing the effects of marking and tagging found that none of the reviewed studies that assessed visual tag (e.g., roto tag) attachment found that visual tags affect survival (Walker et al. 2012). Several studies have demonstrated that PIT tags have no adverse effect on growth, survival, or reproductive success, (Brännäs et al. 1994; Clugston 1996; Elbin and Burger 1994; Hockersmith et al. 2003; Jemison et al. 1995; Keck 1994; Skalski et al. 1998). Studies that have monitored satellite tagged whales over several years have reported swelling (sometimes lasting several years), but no fitness consequences or mortalities as a result of those tags has been documented (Gendron et al. 2014; Robbins et al. 2013). No significant difference in survival was detected among LIMPET tagged versus non-tagged false killer whales and short-finned pilot whales in Hawaiian waters (Baird et al. 2013).

We believe minimization measures required by the permit terms and conditions and the 2022 FPEIS on the MMHSRP (NMFS 2022h) 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 sterilized (or disinfected in limited situations) 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; and
- 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 for the forseeable future (NMFS 2019c); We anticipate that these improvements will further minimize the potential physiological effects of tagging over the duration of the permit.

Based on the best available information, we believe the attachment of tags and scientific instruments by the MMHSRP may result in short-term stress responses, acute pain, and temporary low- to mid-level behavioral responses. Based on the best available information, we believe these responses are likely to be temporary and are not expected to result in fitness consequences (Baird et al. 2013; Baker and Johanos 2002; Eskesen et al. 2009; Mate et al. 2007; Walker et al. 2012). Minimization measures described above would further reduce the risk of fitness consequences occurring. Therefore, we believe takes beacause of the attachment of tags and scientific instruments will not affect the numbers, reproduction, or distribution of any ESA-listed species.

#### 7.4.2.5 *Marking*

Permits issued under the permit program considered in this consultation would authorize up to 60 takes annually for all ESA-listed pinniped species except Hawaiian monk seals, and 40 takes annually for all ESA-listed cetacean species except fin whales (70 annual takes), Main Hawaiian Islands insular false killer whales (20 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 7.1), marking procedures, including notching and branding, may result in a range of responses in both cetaceans and pinnipeds, from no response to acute pain for several hours to weeks (in the case of branding) and behavioral changes as a result of pain. In the case of pinnipeds, we believe that the capture and restraint necessary to perform a marking procedure would be the greatest potential stressor associated with marking. No capture of cetaceans is proposed for baseline health research. Freeze branding of cetaceans is not proposed for baseline health research, and thus would only occur under enhancement scenarios.

Several marking methods for pinnipeds, such as paint, bleach, grease pen, crayon, zinc oxide and dye, are not expected to result in responses beyond those that would be expected from capture, restraint, and handling. Researchers have applied thousands of bleach markings on monk seals and have observed no negative effects other than the occasional minor disturbance (NMFS 2013i). Most individuals are approached while sleeping and do not awaken during the process. More invasive marking techniques, such as notching and branding, may result in acute pain (lasting from hours to weeks). Some marking procedures (such as notching and branding) may also result in minor infections; however, based on the best available information, these infections are not expected to result in fitness consequences. Branding may induce short-term immune responses and may cause short-term behavior changes, but does not appear to result in any lasting physiological effects or increased mortality (Aurioles and Sinsel 1988; Di Poi et al. 2009; Hastings et al. 2009; Mellish et al. 2007a).

Hot branding is not proposed for baseline health research and thus would only occur during enhancement activities and only in situations where cold branding is deemed impractical. 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 on 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), the research activity must be discontinued. To the maximum extent practicable, 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.

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 behavior changes 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.

#### 7.4.2.6 *Diagnostic Imaging*

Permits issued under the program considered in this consultation will 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 fin whales (70 annual takes), Main Hawaiian Islands insular false killer whales (20 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 7.1) 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 because of diagnostic imaging. We expect that minimization measures will further reduce the risks of fitness consequences because 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 have the procedure 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 2014g).

Based on the best available information, we do not believe diagnostic imaging will result in significant behavior changes 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.

#### 7.4.2.7 *Sample Collection*

The first permit issued under the permit program considered in this opinion will 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 fin whales (70 annual takes), Main Hawaiian Islands insular false killer whales (20 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, 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 pinniped sampling (e.g., blood, sperm, milk, vibrissae sampling, and tooth extraction) will result from the stressors related to capture, handling, and restraint (described above, Section 7.1.3). The sampling of cetaceans will be conducted by boat which requires close approach by vessel; we expect that the responses to sampling will 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 because 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 to 125 milliters (3 to 4.2 fluid ounces)) 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 are expected to be temporary and minor. Blubber and muscle biopsies, like the blood draw, are invasive procedures. McCafferty et al. (2007) observed regions of elevated temperature at the sites of needle injection and biopsy, as a result of disruption of the fur layer, penetration of the blubber layer, or changes in peripheral circulation associated with an immune response. The hot spots around the injection and biopsy sites were not permanent and could not be detected at the following measurement period (McCafferty et al. 2007). Biopsy sampling has been performed on a number of different pinniped species with no serious injuries or fitness consequences reported (Baker and Johanos 2002; Henderson and Johanos 1988; Kanatous et al. 1999; Ponganis et al. 1993). To consider the fitness consequences of biopsy sampling, two studies were performed on Hawaiian monk seals. Baker and Johanos (2002) compared the survival, migration, and condition of 437 seals during the year after sampling to an equal number of matched controls; they found no differences in survival, migration, or condition between the sampled and control groups (Henderson and Johanos 1988). We are not aware of any injury or infection as a result of blood or biopsy collection, and we do not expect the reduction of fitness in any pinnipeds as a result of these procedures.

The removal of all whiskers (vibrissae) has been demonstrated to temporarily impair seals' ability to capture fish (Renouf 1979); however researchers would only remove one whisker per animal, reducing the potential for adverse effects to feeding. Pinnipeds shed their whiskers periodically; they also damage or lose whiskers during normal foraging activities (Hirons et al. 2001). These losses do not appear to affect their ability to forage, survive, or reproduce. Therefore, it is unlikely that the pulling of one whisker would affect a pinniped's ability to forage, survive, or reproduce.

Numerous studies have reported the outcomes of biopsy sampling on cetaceans, with the vast majority reporting mild behavioral reactions as the only response (Barrett-Lennard et al. 1996; Brown et al. 1994; Weinrich et al. 1991; Weinrich et al. 1992; Weller et al. 1997; Whitehead et al. 1990). We were able to find just one instance of fitness consequences or mortality because of biopsy sampling (Bearzi 2000). No long-term adverse responses or fitness consequences have resulted from biopsy sampling performed by the MMHSRP historically. Based on the best available information, we expect biopsy sampling of cetaceans to result in low-level behavioral responses; we do not expect biopsy sampling will result in injury or fitness consequences.

We believe the limited potential for fitness consequences as a result of biological sampling will be further minimized by permit terms and conditions and mitigation measures described in the 2009 PEIS (NMFS 2009c). 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; and
- 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.

#### 7.4.2.8 *Administration of Medications: Antibiotics*

The first permit issued under the permit program considered in this consultation will 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 fin whales (70 annual takes), Main Hawaiian Islands insular false killer whales (20 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 7.1.1 and 7.1.3).

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 will be administered by trained personnel, typically by or under the direct supervision of a marine mammal veterinarian or veterinary technician. Animals will be closely monitored for negative reactions, and the attending veterinarian or other personnel would be able to intervene if needed.

Antibiotic administration may occur under baseline health research when an animal that was thought to be healthy was later found to be in ill health and required treatment; antibiotics are also applied to biopsy tips and implantable tags before deployment. An examination of MMHSRP annual reports indicates that the program is conservative in its use of antibiotics, administering them in potentially life-threatening cases (e.g., to prevent septicemia in whales whose condition is deteriorating). In such cases, we believe infectious disease is more likely to reduce the fitness of the individual than any potentially negative impacts of the medication such as localized tissue damage (as may occur from a bent needle; see Moore et al. (2013)). Therefore, if used conservatively (on animals with deteriorating condition and to prevent infection during invasive research techniques), we believe the administration of antibiotics is likely to improve the fitness of an individual, relative to its current state.

Sedation of cetaceans is not proposed for baseline health research. The results of multiple studies have indicated that sedation likely reduces the stress response of pinnipeds that must be handled for health assessment (Champagne et al. 2012; Harcourt et al. 2010; Petrauskas et al. 2008). However, as described above, sedation and anesthesia of pinnipeds is inherently complicated and has led to injuries and mortalities of animals in the past (Heath et al. 1996). To avoid similar problems in the future, the MMHSRP has developed a host of methods to improve the safety and efficacy of sedation. For some species, drug performance has been improved by delivery through an intravenous route (McMahon et al. 2000). For other pinnipeds, the most substantial improvements have been achieved by utilizing inhalation anesthesia delivered with field-modified equipment (Gales et al. 2005; Gales and Mattlin 1998).

To minimize adverse effects of sedation on pinnipeds, an experienced marine mammal veterinarian, veterinary technician or animal husbandry specialist would be present to carry out or would provide supervision of all activities involving the use of anesthesia and sedatives. 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 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.

#### 7.4.2.9 *Administration of Medications: Vaccinations*

We believe that risks associated with the use of either a killed/inactivated vaccine, or a recombinant vaccine, are minimal and that the use of killed and recombinant vaccines will not result in fitness consequences in any animals. This is largely supported by the studies done on other mammals for which the vaccines are specifically labeled. Rigorous safety and efficacy studies conducted on terrestrial mammals (e.g., ferrets, giant pandas, Siberian polecats, African wild dogs) vaccinated with PureVax, the recombinant canary-pox–vectored canine distemper virus vaccine licensed for use in ferrets, have concluded that the vaccine is safe and effective, and does not result in fitness consequences or mortality (Bronson et al. 2007; Connolly et al. 2013; Welter et al. 1999; Wimsatt et al. 2003). No adverse effects, fitness consequences or mortalities have occurred, and no virus shedding has been documented, among captive harbor seals (n = 5) and captive Hawaiian monk seals (n = 6) that have been vaccinated with PureVax (NMFS 2016j; Quinley et al. 2013). PureVax is commercially available in the U.S. and at the time of this opinion was the only currently recommended canine distemper virus vaccine by the American Association of Zoological Veterinarians (http://www.aazv.org) for use in wild carnivores. The Fort Dodge West Nile virus vaccine "Innovator," an inactivated vaccine, has been routinely used for vaccinating captive pinnipeds, including Hawaiian monk seals, in managed care facilities with no adverse reactions observed (Braun and Yochem 2006).

General concerns about recombinant vaccines include the rare possibility of a local tissue reaction, such as minor heat, swelling, or inflammation; however, in the event that these reactions occurred, we would not expect that they would rise to level where treatment would be required (Dr. M. Barbieri, NMFS Pacific Island Fisheries Science Center, pers. comm., to J. Carduner, NMFS, May 1, 2015). In the case of recombinant vaccines, while there is technically a risk from the virus used as the recombinant host virus to become active, this risk is negated by using a virus that does not infect the host species. For example, recombinant vaccines for mammals usually use avian pox, ensuring that the bird virus cannot replicate in mammalian cells. The potential risk of virus shedding – whereby the virus is "shed" from body of an organism into the environment, where it may infect other bodies – is greatly mitigated in the case of recombinant vaccines where the whole virus is not present (Dr. P. Yochem, Hubbs-SeaWorld Research Institute, pers. comm. to J. Carduner, NMFS, May 13, 2015).

The alternative to vaccinating wild marine mammals against disease is to allow pathogens that affect wild marine mammal populations to run their course without intervention. We believe the potential risks to the survival of ESA-listed marine mammal species associated with 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 (Conrad et al. 2005; Costas and Lopez-Rodas 1998; Harwood and Hall 1990; Honnold et al. 2005; Miller et al. 2002; Osterhaus et al. 1997; Raga et al. 1997; Stoddard et al. 2005). Moreover, infectious diseases may have important influences on genetic structure and evolution of some species, particularly those with small populations (Lehman et al. 2004; Weber et al. 2000). For those species characterized by very low abundances and/or isolated discrete population segments with low genetic diversity, a newly introduced pathogen may result in a disease outbreak with significant population impacts. Severe epidemics may reduce host population density to such an extent that stochastic events or previously unimportant ecological factors may further reduce the host population size (Harwood and Hall 1990). For example, the canine distemper virus vaccine dramatically reduced black-footed ferret (*Mustela nigripes*) populations in Wyoming, bringing them to extinction in the wild (Thorne and Williams 1988); avian malaria reduced native Hawaiian honeycreeper (*Hemignathus parvus*) populations to such small numbers that many were finally eliminated by predation or habitat loss (Warner 1968).

Since 1987, viruses belonging to the *Morbillivirus* genus of the Paramyxoviridae family, including canine distemper virus, phocine distemper virus, and cetacean morbillivirus have emerged as significant causes of disease and mortality among marine mammals (Saliki et al. 2002). Phocine distemper virus epidemics resulted in the deaths of more than 23,000 harbor seals (*Phoca vitulina*) in 1988 and an additional 30,000 animals in 2002 (Härkönen et al. 2006). In 1997 more than half of the total population of about 300 Mediterranean monk seals (*Monachus monachus*) inhabiting the western Saharan coast of Africa died as a result of morbillivirus infection; analysis of the virus found that it most closely resembled previously identified cetacean morbilliviruses, indicating that interspecies transmission from cetaceans to pinnipeds had occurred (Osterhaus et al. 1997; Van de Bildt et al. 1999). In the early 1990s more than 1,000 striped dolphins (*Stenella coeruleoalba*) died in the Mediterranean Sea as a result of infection by cetacean morbillivirus (Aguilar and Raga 1993). A cetacean morbillivirus outbreak along the U.S. Atlantic coast in 1987-1988 was responsible for a 50 percent loss of the coastal migratory stock of bottlenose dolphins (*Tursiops truncatus*) (Scott et al. 1988). Blood samples obtained from free-ranging and stranded animals between 1986-1995 found serologic evidence of morbillivirus infection in eleven of fifteen species of odontocete cetaceans from the western Atlantic (Duignan et al. 1995). While there is greater documentation of morbillivirus in small odontocetes than in mysticetes, morbillivirus is known to infect baleen whales; necropsies of two fin whales that stranded on the Belgian and French coastlines in the late 1990s found that both whales were infected with morbillivirus (Losson et al. 2000). While mysticetes generally form smaller social groups than odontocetes, groups on feedings grounds may reach 100 or more animals (Gambell 1985), facilitating the spread of infections as in other cetacean species (Duignan et al. 1995). Although infectious disease does not currently appear to be significantly affecting the survival of any pinniped or cetacean species, there is the potential for some infectious diseases to have devastating effects on endangered and threatened species, especially those with particularly small populations.

We were concerned that the logistical challenges associated with vaccinating some species of marine mammals may limit the effectiveness of vaccination implementation. For instance, whereas Hawaiian monk seals are easily approached and captured and their population is small in number and well-monitored, making the population as a whole conducive to vaccination, the logistics associated with locating, identifying, and medicating whales and dolphins makes 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 because 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 3.2.3.14), for new vaccines (those not already approved for use on a particular species) the MMHSRP proposes a safety and efficacy testing regime on captive animals (either the target species, or, if unavailable, a surrogate species) prior to the use of the new vaccine on animals in the wild. We believe the required safety and efficacy testing will minimize the potential for adverse responses to vaccines among ESA-listed cetaceans and pinnipeds.

As with any administration of drugs, there are risks involving dosage, delivery, and side effects. The Permits Division and MMHSRP will minimize these risks and any discomfort to individuals by using standardized procedures and dosages, allowing only qualified personnel to administer the drugs, and minimizing interactions whenever feasible.

In summary, based on the best available information, we do not believe that ESA-listed cetaceans and pinnipeds are likely to respond to the administration of medications with behavior changes other than those that may result from any capture, restraint, and handling that may be required to administer a drug. The administration of drugs by the MMHSRP has not resulted in any documented loss of fitness in any individual in the past, and we do not believe the administration of medications will result in fitness reductions in the duration of the permit. Therefore, we do not believe that takes because 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).

#### 7.4.2.10 *Hazing, Attractants, Active Acoustic Playbacks*

The first permit issued under the permit program considered in this consultation will 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 fin whales (70 annual takes), Main Hawaiian Islands insular false killer whales (20 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, 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 7.1.1). 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 conducted during MMHSRP emergency response and research do not appear to cause any long-term adverse effects, such as permanent 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 2014g). Permit terms and conditions require that prior to acoustic playback research studies, the MMHSRP must ensure the received level of a playback series is less than the permanent threshold shift (PTS; Level A) onset of all marine mammal species expected in the area following the current acoustic thresholds in the 2018 NMFS Technical Guidance. A playback series may not be initiated unless the Level A and B harassment isopleths have been estimated on site to ensure that the protected species monitoring area will be feasible in all scenarios. 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.

#### 7.4.2.11 *Auditory Brainstem Response/Auditory Evoked Potential*

The first permit issued under the permit program considered in this consultation will 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 fin whales (70 annual takes), Main Hawaiian

Islands insular false killer whales (20 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 will 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, AEP testing has been conducted on several marine mammal species with no documented adverse effects (Castellote et al. 2014; Mooney et al. 2008; Mooney et al. 2012; Szymanski et al. 1999a; Szymanski et al. 1998; Yuen et al. 2005). The procedure would be suspended if the animal displayed negative reactions or if there was reason for concern regarding the animal's health. In AEP tests conducted in 2013 under the MMHSRP's previous permit, cetaceans were continuously provided with supportive care (thermoregulation, foam padding and quiet conditions); according to the MMHSRP, these measures appeared to be effective in minimizing stress (NMFS 2014g), 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.

#### 7.4.2.12 *Disentanglement*

Disentanglement activities are categorized as enhancement activities of the MMHSRP, thus an unlimited number of animals from any ESA-listed species may be disentangled by the MMHSRP or those authorized by the MMHSRP to respond to marine mammal entanglements over the duration of the permit. As disentanglements are emergency responses, the number of future disentanglements that will occur, and the species that will be affected, over the duration of the permit is difficult to predict. However, based on previous MMHSRP annual reports, we estimate that approximately 71 percent of disentanglements will be performed on Steller sea lions, approximately 17 percent on humpback whales (all DPSs), approximately six percent on Hawaiian monk seals, approximately three percent on North Atlantic right whales, approximately two percent on sei whales, approximately one percent on fin whales, and less than one percent on sperm whales. Animals that are disentangled could be any age, sex, and reproductive status.

As described in the Response Analysis, disentanglement response can result in stress, as well as lesions from cutting of ropes or lines, an increase in trauma resulting in wounds, and various other types of injuries. However, based on the best available information, we believe that the overall effects of disentanglement will be beneficial to the individual affected, the population to which that individual belongs, and to the species as a whole. In most cases, if an animal cannot free itself from the entangling material it will die without intervention, and death can occur after weeks or months of pain and suffering for the individual (Moore and Van der Hoop 2012). Entanglement response actions also provide crucial information on the causes of marine mammal entanglements, whether fisheries or other marine debris, which facilitates both the development of gear that is less likely to result in entanglement, and management actions to prevent or minimize future entanglements.

Between 2000 and 2013, there were 25 cases involving North Atlantic right whales that were presumed to be 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 their current permit application, entanglement responders employ measures to minimize stress responses and the potential for injury among entangled animals and entanglements are carefully assessed prior to disentanglement attempts. For large whale disentanglements, responders approach animals gradually, with minimal sound to reduce any reaction and minimize the time in close proximity to the animal. Responders approach at slow speeds, avoiding sudden changes in speed or pitch, and avoiding use of reverse gear. Additional caution is taken when approaching mothers and calves. The Criteria for the Large Whale Disentanglement Network ensure that only responders with extensive experience operating vessels near large whales are involved in vessel approaches and all individuals authorized to respond to large whale entanglements are adequately experienced and trained in entanglement response. Cutting of ropes only occurs when the entanglement is deemed potentially life threatening, thus, without the intervention the animal would have died and been removed from the population.

Non-target animals may be harassed during disentanglement attempts on entangled animals. For instance, on June 29, 2014, the Alaska Department of Fish and Game reported three takes by incidental harassment of a Steller sea lion that was in the vicinity of another Steller sea lion that was disentangled. Based on the best available information, we believe non-target animals that are incidentally harassed may respond behaviorally, but that any behavioral response will be short-term and will not affect the animal's fitness. Harassment of non-target pinnipeds poses the additional risk that behaviorally disturbed animals may leave a haul-out or rookery, which could lead to a stampede resulting in the mortality of pups. We believe protocols that have been developed for entanglement response to Steller sea lions will minimize effects to non-target animals from disentanglement attempts and will effectively reduce the risk of stampedes. For instance, protocols for approaching occupied rookeries and haul-outs include the following:

- Disentanglement will not be attempted in locations within breeding rookeries that are likely to disturb mother/pup pairs.
- Initial survey of the scene and identification of target entangled individual will be made by skiff, first passing carefully far offshore to judge wariness of the hauled out sea lions, later passing closer if needed to better judge the scene.
- Approach to the haul-out will be made by skiff from the most practical concealed direction.
- A small darting team will be landed at this location and stalk carefully, wearing camouflaging clothes and using natural cover, to within 5-20 meters of the subject animal.
- Prior to darting or restraint of target animal, personnel will cease efforts if significant injury to target or non-target animals appears imminent.

No animals have been reported injured or killed during previous MMHSRP disentanglement activities. Based on the best available information, we believe disentanglement activities over the duration of a permit will not result in fitness reductions. Therefore we do not believe that disentanglement will negatively affect the numbers, reproduction, or distribution of any ESA-listed species. On the contrary, we believe disentanglement activities will result in improved fitness and increased survivorship among animals that may otherwise have died.

#### 7.4.2.13 *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 period of permits issued under the permit program considered in this consultation. These mortalities may occur as a result of euthanasia, if a research animal that was thought to be healthy is found to be moribund. Euthanasia during baseline health research will only occur in the rare event that an animal that appeared healthy upon capture for research is found to be moribund, and it is determined that euthanasia is the preferred course of action to reduce suffering on the part of the animal (note that an unlimited number of animals from any ESA-listed species may be euthanized by the MMHSRP over the duration of the permit during enhancement activities).

Euthanasia is chosen as a last resort when all other options for 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, may 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, in the judgement of the MMHSRP, an immediate and pain-free death is preferable to letting the animal die on its own. Euthanasia procedures will 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* (Gulland et al. 2018), and/or the American Association of Zoo Veterinarians guidelines (Baer 2006).

As euthanized animals would be expected to die in the absence of the MMHSRP's response, we do not believe euthanasia will significantly affect the numbers, reproduction, or distribution of any ESA-listed species through mortality of certain individuals from the population of the species.

#### 7.4.2.14 *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. The permit would authorize up to one captive Hawaiian monk seal mortality over the duration of the permit due to euthanasia when deemed medically necessary. 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 would not be expected to be 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.

#### 7.4.2.15 *Serious Injury and Mortality Resulting from Baseline Health Research Activities*

As described above, while mortalities as a result of capture, restraint, handling, and other activities are uncommon, these activities inevitably carry some risk of injury and mortality. We believe it is reasonably certain that the MMHSRP will conduct more baseline research over the duration of the first five-year permit issued under this programmatic than has been conducted previously, thus more pinniped captures for baseline health research are expected to occur over the duration of the permit than have occurred historically. As such, the Permits Division proposes to authorize up to seven mortalities of ESA-listed pinnipeds over the duration of the first permit, as follows:

- A maximum of one individual Guadalupe fur seal may be killed over the five year permit;
- A maximum of one individual Hawaiian monk seal may be killed over the five year permit; and
- A maximum of five Steller sea lions (Western DPS), five ringed seals (Arctic subspecies), or 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 0.004 percent of the estimated total Guadalupe fur seal population (N = 31,019) (Carretta et al. 2020). The population of Guadalupe fur seals is increasing annually at an estimated rate of 5.9 percent (Carretta et al. 2020). 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 one individual for Hawaiian monk 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 0.07 percent (N = 1,437) (Carretta et al. 2021). It is currently estimated that the population has grown at an average rate of around two percent per year from 2013 to 2019. Based on the best available information on the status and trend of the Hawaiian monk 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 Hawaiian monk seal population and is not likely to reduce the viability of the Hawaiian monk 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. As of 2020, the best estimate of abundance of the western Steller sea lion DPS in Alaska was 12,581 for pups and 40,351 for non-pups (total $N_{min}$ = 52,932) (Muto et al. 2021). Based on this minimum population estimate, the death of five individual animals would represent a loss of less than 0.01 percent of the estimated total population. Annual anthropogenic mortality of Western DPS Steller sea lions is estimated at approximately 230 individual animals (based on an estimated average of 30.4 annual fishery-related mortalities, 199 subsistence hunt-related mortalities, and 0.4 other mortalities) (Allen and Angliss 2013d); thus a loss of an average of one individual animal per year (maximum five mortalities over a five-year permit) would represent an increase in annual anthropogenic mortality of less than 0.002 percent. Based on the best available information on the status of the Western DPS Steller sea lion population, we believe the mortalities of five individuals over five years that may occur as a result of capture, handling, and restraint would have a minimal impact on the Western DPS Steller sea lion population and is not likely to reduce the viability of the Western DPS Steller sea lion population or the species as a whole.

The total number of mortalities would not exceed five individuals for ringed seals (Arctic subspecies), thus we consider the impact to the subspecies from the loss of five individuals over five years. The 2013 status review estimated the population of the Arctic subspecies of ringed seals in Alaskan waters to be at least 300,000 individuals (this is considered a minimum population estimate and is likely an underestimate of the actual abundance) (Allen and Angliss 2013c); the population trend is unknown (Allen and Angliss 2013c). Using the population estimate of 300,000, the death of five individual animals would represent a loss of less than 0.002 percent of the estimated total population. Annual anthropogenic mortality of the Arctic subspecies of ringed seals is estimated at approximately 9,570 individual animals (based on an estimated 9,567 annual subsistence hunt-related mortalities and 3.52 average annual fisheries-related mortalities) (Allen and Angliss 2013c); thus a loss of an average of one individual animal per year (maximum five mortalities over a 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 a 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, 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 under a 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.

### 7.4.3 Risk for Non-Target Individuals of ESA-Listed Targeted Species and ESA-Listed Non-Target Species

Five mortalities of non-ESA-listed species have occurred in the past 10 years due to accidental drownings in capture nets associated with MMHSRP activities. However, for emergency response activities, captures typically involve a single targeted individual in need of emergency assistance, reducing the risk of non-target animals drowning in capture nets. Most captures for research and response activities occur close to shore in waters 1.5 meters (4.9 feet) deep or less.

In addition, the MMHSRP's mitigation paired with the permit conditions should minimize the risk of mortality or serious injury due to drowning in capture nets.

Non-target Guadalupe fur seals and Western DPS Steller sea lions may respond to disturbance and attempt to avoid responders. This poses the risk that behaviorally disturbed animals may leave a haul-out or rookery, which could lead to a stampede resulting in injuries or mortalities. If animals are startled and disperse from rookeries, pups may be trampled or abandoned. Capture attempts may disrupt non-target animals, including conspecifics, potentially causing them 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. Stampedes that result in trampling are more commonly reported in otariid species than in phocid species.

As mentioned above, the Permits Division believes authorizing a small number of mortality and serious injury takes for non-target individuals of these species during enhancement or baseline research activities is warranted: a maximum of one mortality or serious injury of a non-target Guadalupe fur seal or Western DPS Steller sea lion annually during net captures or harassment that can result in stampedes, not to exceed three total for both species over the life of the permit.

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. If animals are struck by a vessel, responses can include death, serious injury, and/or minor, non-lethal injuries. Because the goals of 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 carefully when ESA-listed non-target species may be in the area. However, as mentioned above, the Permits Division believes authorizing a small number of harassment/non-serious injury takes from possible vessel strikes during close approaches is warranted: 10 ESA-listed small cetaceans, 10 ESA-listed large whales, and 10 ESA-listed pinnipeds every five years (two ESA-listed small cetaceans, two ESA-listed large whales, and two ESA-listed pinnipeds annually).

Incidental capture can cause stress responses in sea turtles (Gregory 1994; Gregory and Schmid 2001; Hoopes et al. 1998; Jessop et al. 2004; Jessop et al. 2003; Thomson and Heithaus 2014), sturgeon (Kahn and Mohead 2010; Lankford et al. 2005), and other fishes including smalltooth sawfish (Korte et al. 2005; Moberg 2000; Sapolsky et al. 2000).

Because sea turtle, sturgeon, and sawfish entangled or netted would be immediately removed from the nets without human handling, if possible, we expect them to experience a low level of stress that would be 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. 1997b). 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 these occur, are likely due to acid-base imbalances resulting from accumulation of carbon dioxide and lactate in the bloodstream (Lutcavage et al. 1997b). 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 will 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 incidentally taken is difficult. That said, based on the expected responses of encountered sea turtles including 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 likely be removed from nets quickly. We expect animals will 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.

There is no indication 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. Similarly, we expect temporary disruptions of swim speed or direction to be inconsequential because animals can resume these behaviors almost immediately following release. Further, these sorts of behavioral disruptions may be similar to natural disruptions such as those resulting from predator avoidance, or fluctuations in oceanographic conditions. Therefore, behavioral responses of up to 10 sea turtles from any ESA-listed DPS or species to encountering or being captured in a net are unlikely to lead to fitness consequences and long-term implications for the population to which these individuals belong.

Smalltooth sawfish entangled in nets would likely experience stress in association with the event and some lacerations associated with net contact. However, they should be capable of continued respiration. If disentangled according to NOAA-approved protocols (NMFS 2009h), 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 netting under the proposed permit program.

We expect capture and handling of Atlantic, shortnose, gulf and green sturgeon would cause short-term stress (Kahn and Mohead 2010). This can be exacerbated by less than ideal environmental conditions, such as relatively high water temperature (higher than 28° Celsius (82.4° Fahrenheit)), high salinity, or low dissolved oxygen, potentially resulting in mortality or failure to breed (Hastings et al. 1987; Jenkins et al. 1993b; Kynard et al. 2007; Moser and Ross 1995; Niklitschek 2001; Niklitschek and Secor 2009; Niklitscheka and Secor 2009; Secor and Niklitschek 2002b; Secor and Gunderson 1998; Secor and Niklitschek 2001a). We do not expect the additional stress associated with incidental 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 2009h).

# 8 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 6). 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 and nothing is reasonably certain to occur at this time.

# 9 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 7) to the *Environmental Baseline* (Section 6) to formulate the agency's biological opinion as to whether the proposed action is likely to 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. This assessment is 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 5) *Environmental Baseline* (Section 6), and *Cumulative Effects* (Section 8), would jeopardize the continued existence of ESA-listed species.

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. If there is a reduction in one or more of these elements for any species or DPS, we explore in this section whether it will cause an appreciable reduction in the likelihood of both the survival and the recovery of the species or DPS.

In the *ESA Section 7 Handbook* (USFWS and NMFS 1998), for the purposes of determining jeopardy, "survival" is defined as: "The species' persistence as ESA-listed or as a recovery unit, beyond the conditions leading to its endangerment, with sufficient resilience to allow for the potential recovery from endangerment. Said in another way, survival is the condition in which a species continues to exist into the future while retaining the potential for recovery." The term "recovery" is defined in 50 CFR 402.02 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. As discussed in the *Description of the Proposed Action* (Section 3), and the *Exposure Analysis* (Section 7.3), 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.

## 9.1 Marine Mammals and Enhancement Activities

As described in the *Exposure Analysis* (Section 7.3), we estimate the annual take of ESA-listed marine mammals over the duration of five-year permits under the permit program considered in this consultation during enhancement activities, based on historical takes that have occurred during enhancement activities and the best available information on vaquita import/export activities, as follows: 73 Steller sea lions; 56 humpback whales; 34 Hawaiian monk seals; 32 Guadalupe fur seals; 13 gray whales; 10 North Atlantic right whales; 10 killer whales; 10 Cook Inlet beluga whales; six fin whales; three sei whales; two sperm whales; two ringed seals; one bearded seal; and one blue whale. We assume these cetaceans and pinnipeds may represent any age, gender, reproductive condition, or health condition. However, as enhancement activities are conducted in response to emergencies, and these emergency scenarios are unpredictable, actual exposures among ESA-listed species to MMHSRP enhancement activities that will occur over the duration of the five-year permits to be issued under the permit program are largely unpredictable.

Due to the unpredictable nature of emergency response, during enhancement activities the MMHSRP will be authorized to expose an unlimited number of ESA-listed marine mammals to close approaches, aerial and vessel surveys, hazing and attractants, capture, restraint, handling, transport, holding, release, attachment of scientific instruments, marking, diagnostic imaging, sample collections, administration of medications that include vaccinations, ABR/AEP, active acoustic playbacks, and disentanglement within the action area. The proposed permit program would also authorize the MMHSRP to euthanize an unlimited number of ESA-listed marine mammals.

As described in the *Risk Analysis* (Section 7.4), 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, the vast majority of animals involved in enhancement activities in the absence of the MMHSRP's response to their distress would either die or suffer fitness consequences that would reduce their longevity or reproductive success. As such, we believe that, over the duration of the five-year permits proposed under the permit program, 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. 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. Therefore, we find that enhancement activities are not likely to reduce appreciably the likelihood of both the survival and recovery of the beluga whale (Cook Inlet DPS), blue whale, bowhead whale, Chinese river dolphin, false killer whale (Main Hawaiian Islands Insular DPS), fin whale, gray whale (Western North Pacific DPS), Gulf of California harbor porpoise (vaquita), humpback whale (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), Indus river dolphin, killer whale (Southern Resident DPS), Maui's and South Island Hector's dolphins, North Atlantic right whale, North Pacific right whale, Rice's whale, sei whale, southern right whale, sperm whale, Taiwanese humpback dolphin, bearded seal (Beringia and Okhotsk DPSs), Guadalupe fur seal, Hawaiian monk seal, Mediterranean monk seal, ringed seal (Arctic, Baltic, Ladoga, Okhotsk, and Saimaa subspecies), spotted seal (Southern DPS), and Steller sea lion (Western DPS).

## 9.2 Marine Mammals and Baseline Health Research Activities

Unlike enhancement activities, the procedures that constitute baseline health research may be performed on animals that are healthy; thus, any fitness consequences or mortalities that result from those activities would have the potential to impact the reproduction, numbers, or distribution of ESA-listed species in the wild. Therefore, in assessing the potential impacts of baseline health research activities on the reproduction, numbers, or distribution of ESA-listed species, we analyzed the various procedures proposed as part of those activities, and the likely risks those activities pose to ESA-listed marine mammals given the likely exposure of those animals to the various procedures.

The first step in that analysis was to determine the take that was reasonably certain to occur. As described in the *Exposure Analysis* (Section 7.3), we believe previous take data are not a reliable estimator of takes that will occur during baseline health research over the duration of the five-year permits to be issued under the permit program. Instead, we believe the takes for baseline health research as described in Section 7.3.2 are reasonably certain to occur over the duration of the permit. Therefore we based our assessment of the expected impacts to ESA-listed marine mammals from baseline health research activities on those take numbers.

In the *Response Analysis* (Section 7.1), 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 7.4, in consideration of their likely exposure level (Section 7.3) and the measures to minimize the likelihood of exposure (Section 7.2). 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. 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 ESA-listed cetaceans). The likelihood of death is small; however, given the inherent risks associated with these procedures, the Permits Division proposes to authorize takes for mortality during baseline health research as follows: a maximum of one Guadalupe fur seal, and a maximum of five Steller sea lions (Western DPS), five bearded seals (Beringia DPS), and five ringed seals (Arctic subspecies) may die as a result of baseline health research activities over the duration of the first five-year permit to be issued under the permit program considered in this consultation. As such, we analyzed the impact of these mortalities on the numbers, reproduction, and distribution of the four species listed above.

The death of up to four Guadalupe fur seals (sum of the maximum one mortality during baseline research and maximum three incidental mortalities from enhancement activities or baseline research resulting in stampedes or net captures) would represent a loss of less than 0.02 percent of the estimated total Guadalupe fur seal population (N = 31,019) (Carretta et al. 2020). The population of Guadalupe fur seals is increasing annually at an estimated rate of 5.9 percent (Carretta et al. 2020). The species is also expanding its breeding range (one of three recovery criteria), 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 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), we believe the mortality of up to five Guadalupe fur seals 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 up to eight Western DPS Steller sea lions (sum of the maximum five mortalities during baseline research and maximum three incidental mortalities from enhancement activities or baseline research resulting in stampedes or net captures) over five years would represent a loss of less than 0.02 percent of the estimated total population (Alaska $N_{min}$ = 52,932) (Muto et al. 2021). 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 1.6 animals per year (maximum eight mortalities over the five year permit) would represent an increase in annual anthropogenic mortality of less than 0.7 percent. These factors lead us to believe the loss of up to eight 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 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), 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) from MMHSRP baseline research activities 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 a 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 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), 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 Beringia DPS bearded seals from MMHSRP baseline research activities 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 a 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 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), 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.

In addition to the mortalities analyzed above, the permit would authorize up to one Hawaiian monk seal mortality in captivity, rehab, or during "piggy-backing" research in the wild over the duration of the permit. The death of one wild Hawaiian monk seal would represent a loss of less than 0.07 percent of the estimated total population (N = 1,437) (Carretta et al. 2021). It is currently estimated that the population has grown at an average rate of around two percent per year from 2013 to 2019. Taking into account the *Status of the Species* (Section 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), 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. Because the captive animal will 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 first permit to be issued under the permit program considered in this consultation will 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 will not result in fitness consequences or mortality beyond that which would have occurred in the absence of the euthanasia. 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.

Because we determined that the baseline health research activities that have the potential to result in fitness consequences or mortality of 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 (in other words, non-target animals). Thus, taking into account the *Status of the Species* (Section 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), 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, Chinese river dolphin, false killer whale (Main Hawaiian Islands Insular DPS), fin whale, gray whale (Western North Pacific DPS), Gulf of California harbor porpoise (vaquita), humpback whale (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), Indus river dolphin, killer whale (Southern Resident DPS), Maui's and South Island Hector's dolphins, North Atlantic right whale, North Pacific right whale, Rice's whale, sei whale, southern right whale, sperm whale, Taiwanese humpback dolphin, bearded seal (Beringia and Okhotsk DPSs), Guadalupe fur seal, Hawaiian monk seal, Mediterranean monk seal, ringed seal (Arctic, Baltic, Ladoga, Okhotsk, and Saimaa subspecies), spotted seal (Southern DPS), and Steller sea lion (Western DPS).

## 9.3 Sea Turtles, Sturgeon, and Sawfish and Enhancement and Baseline Health Research Activities

As described in the *Exposure Analysis* (Section 7.3), several ESA-listed sea turtle, sturgeon, and sawfish species may be exposed to incidental capture and entanglement because of cetacean net captures. Using data from previous reports from the MMHSRP, we estimated that up to 50 hardshell turtles (green sea turtles from the Central South Pacific DPS, Central West Pacific DPS, Central North Pacific DPS, East Pacific DPS or North Atlantic DPS, hawksbill sea turtles, Kemp's ridley sea turtles, loggerhead sea turtles from the North Pacific Ocean DPS, Northwest Atlantic Ocean DPS, or the South Pacific Ocean DPS, and olive ridley sea turtles from the Mexico's Pacific coast breeding colonies or all other areas), 10 leatherback turtles, 15 smalltooth sawfish (U.S. DPS), 15 Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina or South Atlantic DPS), five gulf sturgeon, five shortnose sturgeon, and five green sturgeon (Southern DPS) may be exposed to cetacean net captures and potentially be incidentally captured or become entangled during both enhancement and baseline health research activities. No mortalities are expected or would be authorized for these species.

Based on the information available, because sea turtles, sturgeon and sawfish will be released from nets well before to the onset of severe metabolic and respiratory changes, encounters or captures of a sea turtle, sturgeon, or sawfish during MMHSRP activities will 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, including breeding, feeding or sheltering.

Based on the evidence available, the issuance of Permit 24359 (the first permit to be issued under the permit program considered in this consultation) and the implementation of the MMHSRP could result in minor disturbance and stress of ESA-listed sea turtles, sturgeon and sawfish, if encountered during MMHSRP activities. However, taking into account the *Status of the Species* (Section 5.2), the *Environmental Baseline* (Section 6) and the *Cumulative Effects* (Section 8), we believe that enhancement and baseline health research activities are not likely to reduce appreciably the likelihood of both the survival and recovery of the following species in the wild by reducing their reproduction, numbers, or distribution: green turtles (Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, and North Atlantic DPSs), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean DPSs), olive ridley turtles (from the Mexico's Pacific coast breeding colonies or all other areas), Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina or South Atlantic DPS), green sturgeon (Southern DPS), gulf sturgeon, shortnose sturgeon, and smalltooth sawfish (U.S. DPS).

# 10 Conclusion

After reviewing the current status of the ESA-listed species, the environmental baseline within the action area, the effects of the proposed action, and cumulative effects, it is NMFS' biological opinion that the proposed action (the issuance of a permit by the Permits Division and establishment of a permit program by the Permits Division for 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 following targeted ESA-listed species: beluga whale (Cook Inlet DPS), blue whale, bowhead whale, Chinese river dolphin, false killer whale (Main Hawaiian Islands Insular DPS), fin whale, gray whale (Western North Pacific DPS), Gulf of California harbor porpoise (vaquita), humpback whale (Arabian Sea, Cape Verde Islands/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs), Indus river dolphin, killer whale (Southern Resident DPS), Maui's and South Island Hector's dolphins, North Atlantic right whale, North Pacific right whale, Rice's whale, sei whale, southern right whale, sperm whale, Taiwanese humpback dolphin, bearded seal (Beringia and Okhotsk DPSs), Guadalupe fur seal, Hawaiian monk seal, Mediterranean monk seal, ringed seal (Arctic, Baltic, Ladoga, Okhotsk, and Saimaa subspecies), spotted seal (Southern DPS), and Steller sea lion (Western DPS).

Further, the proposed action is not likely to jeopardize the continued existence of the non-targeted ESA-listed species that may be taken through incidental capture or behavioral harassment: green turtles (Central North Pacific, Central South Pacific, Central West Pacific, East Pacific, and North Atlantic DPSs), hawksbill turtles, Kemp's ridley turtles, leatherback turtles, loggerhead turtles (North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific

Ocean DPSs), olive ridley turtles (from the Mexico's Pacific coast breeding colonies or all other areas), Atlantic sturgeon (Gulf of Maine, New York Bight, Chesapeake Bay, Carolina or South Atlantic DPS), green sturgeon (Southern DPS), gulf sturgeon, shortnose sturgeon, and smalltooth sawfish (U.S. DPS).

# 11 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 a 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 regulation (50 CFR § 222.12) 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. As stated previously, NMFS has not yet defined "harass" under the ESA in regulation. On December 21, 2016, NMFS issued interim guidance on the term "harass," defining it as to "create the likelihood of injury to wildlife by annoying it to such an extent as to significantly disrupt normal behavior patterns which include, but are not limited to, breeding, feeding, or sheltering," For purposes of this consultation, we relied on NMFS' interim definition of harassment to evaluate when the proposed seismic survey activities are likely to harass ESA-listed marine mammals.

Incidental take is defined as take that is incidental to, and not the purpose of, the carrying out of an otherwise lawful activity. Section 7(o)(2) provides that taking that is incidental to an otherwise lawful agency action is not considered to be prohibited taking under the ESA if that action is performed in compliance with the terms and conditions of this incidental take statement.

## 11.1 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 specifies the impact, i.e., the amount or extent, of such incidental taking on the species and may be used if we cannot assign numerical limits of animals that could be incidentally taken during the course of an action (see 80 FR 26832).

We expect that up to ten non-target ESA-listed small cetaceans (Cook Inlet DPS beluga whales, Chinese River dolphins, Main Hawaiian Island DPS false killer whales, vaquita, Indus River dolphins, Southern Resident killer whales, Maui's and South Island Hector's dolphins, or Taiwanese humpback dolphins), up to ten non-target ESA-listed large whales (blue whales; bowhead whales; fin whales; Western North Pacific DPS gray whales; Rice's whales; Arabian Sea, Cape Verde/Northwest Africa, Central America, Mexico, and Western North Pacific DPSs of humpback whales; North Atlantic right whales; North Pacific right whales; sei whales; or sperm whales), up to ten non-target ESA-listed pinnipeds (Beringia and Okhotsk DPSs of bearded seals; Guadalupe fur seals; Hawaiian monk seals; Mediterranean monk seals; Arctic, Baltic, Ladoga, Okhotsk, and Saimaa ringed seal subspecies; Southern DPS spotted seals; or Western DPS Steller sea lions), and up to ten ESA-listed sea turtles (Central North Pacific, Central West Pacific, East Pacific, and North Atlantic DPs of green turtles; hawksbill turtles; Kemp's ridley turtles; leatherback turtles; North Pacific Ocean, Northwest Atlantic Ocean, and South Pacific Ocean DPSs of loggerhead turtles; or breeding populations on the Pacific coast of Mexico and all other areas of olive ridley turtles) will be taken in the form of harassment and non-serious injuries resulting from vessel strikes every five years (two ESA-listed small cetaceans, large whales, pinnipeds, and sea turtles annually).

We expect that up to three non-target Guadalupe fur seal mortalities or up to three non-target Steller sea lion (Western DPS) mortalities may occur every five years during MMHSRP activities. These mortalities may occur due to stampedes of animals, net captures, or euthanasia when deemed medically necessary after such accidents occur.

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-year period of permits to be issued by the Permits Division, 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 are 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 are 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 are 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. 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 are 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 are anticipated or exempted from the prohibition on incidental take provided by this incidental take statement.

## 11.2 Reasonable and Prudent Measures

"Reasonable and prudent measures" are measures that are necessary or appropriate to minimize the amount or extent of incidental take (50 C.F.R. §402.02). The measures described below must be undertaken by the MMHSRP and the Permits Division 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, we will issue a statement that specifies the impact of any incidental taking of threatened or endangered 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.

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. 24359 and subsequent permits issued to the MMHSRP under this programmatic.
2. The Permits Division and the MMHSRP must exercise care when operating in areas and when handling all ESA-listed species to minimize the possibility of injury.
3. The Permits Division and the MMHSRP must monitor and report on all incidental takes of ESA-listed species.

## 11.3 Terms and Conditions

To be exempt from the prohibitions of section 9 of the ESA and regulations issued pursuant to section 4(d), the Federal action agency (i.e., the MMSHRP and the Permits Division) must comply (or must ensure that any applicant complies) with the following terms and conditions. These include the take minimization, monitoring, and reporting measures required by the section 7 regulations (50 C.F.R. §402.14(i)). For complete permit terms and conditions, see Section 15.2.

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. 24359 and any subsequent permits issued as part

of implementation of this programmatic 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. 24359 and any subsequent permits issued as part of implementation of this programmatic 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. 24359 and any subsequent permits issued as part of implementation of this programmatic 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 the maximum extent feasible 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 the particular activity, and the Permits Division must contact us (the NMFS ESA Interagency Cooperation Division) via email (nmfs.hq.esa.consultations@noaa.gov; with subject line including "MMHSRP ESA Section 7 Programmatic Consultation OPR-2020-03699" plus the nature of the review requested) if authorized take is exceeded in any of the following ways:
   a) More ESA-listed animals other than marine mammals are taken than are anticipated in the incidental take statement and exempted from the take prohibitions,
   b) ESA-listed animals other than marine mammals are taken in a manner not authorized by this permit, or
   c) ESA-listed species other than those exempted from the take prohibitions by this incidental take statement are taken.
4) The Permits Division and the MMHSRP shall report the annual number of incidental takes of each ESA-listed each species that occurs under this incidental take statement. The annual report from the MMHSRP is due to the Permits Division by March 31 for each year a permit is valid. The annual report from the Permits Division summarizing how the MMHSRP complied with the incidental take statement and permit requirements is due by May 31 for each year the permit is valid. Reports must be submitted to us via email (nmfs.hq.esa.consultations@noaa.gov; with subject line including "MMHSRP ESA Section 7 Programmatic Consultation OPR-2020-03699" plus the nature of the review requested).

# 12 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.

# 13 Reinitiation Notice

This concludes formal consultation for the Permits Division's proposal to implement a program for the issuance of permits to the MMHSRP for enhancement and baseline health research activities on ESA-listed cetaceans and pinnipeds. Since the MMHSRP permitting program does not have a definitive sunset (or expiration) date, there is no pre-determined end date on this opinion. The standard reinitiation triggers, which apply to all opinions, provide an additional safeguard against jeopardy or adverse modification over time.

Consistent with 50 C.F.R. §402.16(a), reinitiation of formal consultation is required and shall be requested by the Federal agency or by the Service, where discretionary Federal involvement or control over the action has been retained or is authorized by law and:

(1) The amount or extent of taking specified in the ITS 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 previously considered.
(3) The identified action is subsequently modified in a manner that causes an effect to the listed species or designated critical habitat that was not considered in this opinion.
(4) A new species is listed, or critical habitat designated under the ESA that may be affected by the action.

As discussed in the Description of the Proposed Action (Section 3), the Permits Division will work closely with us throughout implementation of its MMHSRP permitting program. The two divisions will routinely (e.g., every five years or more frequently as needed as well as through annual reporting) check-in on how the MMHSRP permitting program is functioning overall, discuss take levels for non-target and target ESA-listed species, and determine whether new information indicates that the Permits Division should request reinitiation of this programmatic consultation. The Permits Division foresees regular reporting and periodic check-ins with us as an ongoing dialogue as part of the adaptive management of the MMHSRP permitting program using the best available information.

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# 15 APPENDICES

## 15.1 Permit No. 24359 Take Tables

The following tables were taken directly from draft Permit No. 24359, the first permit to be issued by the Permits Division under this programmatic consultation.

Table A1. Authorized emergency response related enhancement and response-related research activities, method/tool development during emergency response, and import/export of marine mammals and marine mammal parts under the jurisdiction of the NMFS conducted pursuant to ESA Section 10(a)(1)(A) , in conjunction with MMPA Sections 109(h) and 112(c), and additionally MMPA Sections 104(c) and Title IV. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur at any time of year on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammals and marine mammal parts.

| Line | Species | Life stage | No. Authorized Takes[9] | Procedures | Details |
|---|---|---|---|---|---|
| 1 | Cetacean, unidentified | All | 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 (IM, IP, IV, subcutaneous, topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Captive, maintain; Captive, research; Collect, remains for predation study; Collect, sloughed skin; Collect, U.S. subsistence; Count/survey; Evan's blue dye and serial blood samples; Export; Hormones and serial blood samples; Imaging, thermal; Import; Import/export/receive, parts; Insert ingestible telemeter pill; Instrument, belt/harness; Instrument, bolt/pin; Instrument, dart/barb; Instrument, deep-implant; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; Intentional (directed) mortality; Lavage, gastric; Mark (freeze brand; roto tag; notch; paint); Measure; Measure colonic temperature; Metabolic chamber/hood; Observation, monitoring; Necropsy; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Receive domestically; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Restrain, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, swab (all mucus membranes; anal; blowhole; nasal; ocular; oral, other); Sample, blood; Sample, exhaled air; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine (catheter, needle, or free catch); Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Weigh; X-ray and imaging (e.g., CT, MRI) | Emergency response of target ESA-listed cetaceans; and, emergency response research, rehabilitation and release, disentanglement, intentional harassment, and import/export of all cetaceans (ESA-listed and non-listed). All activities as warranted to respond to emergencies including emergency-related research and method/tool development. Other = pneumnotachometer, esophageal catheterization. Unintentional mortality or serious injury of target animals including euthanasia if deemed medically necessary (see footnote 2), and unintentional Level A and B harassment of target animals. No deep-implant tags for small cetaceans, See Appendices B and D for deep-implant tagging restrictions. |
| 2 | Cetacean, unidentified | All | As warranted to respond to emergencies and | Incidental harassment | Incidental harassment of non-target cetacean species (ESA-listed and non-listed). Includes Level A harassment (non-serious injury excluding vessel strike) and Level B |

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| | | | conduct response related research | | harassment during emergencies including emergency response-related research and method/tool development. |
| 3 | Pinniped, unidentified | All | 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 (IM, IP, IV, subcutaneous, topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Bioelectrical impedance (subcutaneous); Bioelectrical impedance (surface); Calipers (skin fold); Captive, maintain permanent; Captive, maintain temporary; Cognitive studies; Collect, molt; Collect, scat; Collect, spew; Collect, U.S. subsistence; Collect, urine; Count/survey; Evan's blue dye and serial blood samples; Export; Hormones and serial blood samples; Import; Import/export/receive, parts; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Intentional (directed) mortality; Mark (bleach; clip fur; dye or paint; flipper tag; freeze brand; hot brand; other [e.g., neoprene patch]; PIT tag); Measure (standard morphometrics); Metabolic chamber/hood; Necropsy; Observation, mark resight; Observation, monitoring; Observations, behavioral; Other; Photo-id; Photogrammetry; Photograph/Video; Receive domestically; Remote vehicle, aerial (fixed wing); Remote vehicle, aerial (VTOL); Remote vehicle, amphibious; Remote vehicle, vessel; Remote video monitoring; Restrain, (board; cage; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; fecal loop; fecal swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; nasal; ocular; oral; other); Sample, skin biopsy; Sample, stomach lavage; Sample, tooth extraction; Sample, urine (catheter; needle; free catch); Sample, vibrissae (clip or pull); Stable isotopes and serial blood samples; Transport; Ultrasound; Underwater photo/videography; Weigh; X-ray and imaging (e.g., CT, MRI) | Emergency response of target ESA-listed pinnipeds; and, emergency response research, disentanglement, intentional 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 and method/tool development. Unintentional mortality or serious injury of target animals including euthanasia if deemed medically necessary (see footnote 2), and unintentional Level A and B harassment of target animals. Other = pneumnotachometer, esophageal catheterization. |
| 4 | Pinniped, unidentified | All | As warranted to respond to | Incidental harassment | Incidental harassment of non-target pinniped species (ESA-listed and non-listed). |

[9] *Takes = the maximum number of animals, not necessarily individuals, that may be targeted annually for the suite of procedures in each row of the table.*

| | | | | | |
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| | | | emergencies and conduct response related research | | excluding walrus. Includes Level A harassment (non-serious injury excluding vessel strike) and Level B harassment during emergencies including emergency-related research and method/tool development. |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 1 | Cetacean, unidentified | All | Unlimited | Import/ export/ receive; Collect | Collect, U.S. subsistence; Export; Import; Receive domestically; Salvage (carcass, tissue, 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. Includes collection (e.g., subsistence harvest, bycatch, etc.) |

[10] *Takes = the maximum number of animals, not necessarily individuals, that may be targeted annually for the suite of procedures in each row of the table.*

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 2 | Small cetaceans, unidentified; Range-wide | All | 5,000 | Harass; Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Imaging, thermal; 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, fecal; Tracking; Underwater photo/videography; Unintentional harassment | 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 unintentional harassment during any research activity. |
| 3 | Small cetaceans, unidentified | Non-neonate | 800 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Captive, maintain; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, belt/harness; Instrument, bolt/pin; Instrument, dart/barb; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; Mark, roto tag; Measure; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Transport; Remote ultrasound; Underwater photo/videography; Unintentional harassment | Remote sampling or tagging (bolt/ pin, dart/barb, suction cup) of small cetaceans in the wild, captivity, or rehabilitation; all non-ESA listed or MMPA-depleted small cetaceans. 800 takes/year total for all species; including Level B activities, remote biopsy sampling, and direct and unintentional harassment. |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 4 | Small Cetaceans, unidentified | Non-neonate | 500 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM, IP, IV, subcutaneous, topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Captive, maintain; Captive, research; 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; Instrument, bolt/pin; Instrument, dart/barb; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; Lavage, gastric; Mark (freeze brand; notch; roto tag; paint); 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; Restrain, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, swab (all mucus membranes; anal; blowhole; ocular; oral, other);Sample, blood; Sample, exhaled air; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Sample, sperm; Sample, tooth extraction; Sample, urine (catheter; needle; free catch); Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Weigh; X-ray and imaging (e.g., CT, MRI) | Small cetacean capture (hoop, seine, or other net) and sampling research activities in the wild, captivity, or rehabilitation; all non-ESA listed small cetaceans including MMPA-depleted stocks[11]; includes captures, sampling, direct and unintentional harassment. Other= pneumnotachometer and esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species;<br>Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 5 | Small cetacean, unidentified | Non-neonate | 3 | Unintentional mortality | Unintentional mortality or serious injury | Small cetacean unintentional mortality for target species; 3 annually (total for all species combined); all non-listed small cetaceans during research activities; includes euthanasia when deemed medically necessary resulting from research activities; necropsy |

[11] *Includes all non-ESA, MMPA-depleted small cetaceans. E.g., Western North Atlantic bottlenose dolphin stocks (Western North Atlantic Central Florida Coastal stock, Western North Atlantic Northern Florida Coastal stock, Western North Atlantic Northern Migratory Coastal stock, Western North Atlantic South Carolina-Georgia Coastal stock, and Western North Atlantic Southern Migratory Coastal stock); Pantropical spotted dolphin Northeastern offshore stock; spinner dolphins (Eastern Stock, Eastern Tropical Pacific Ocean).*

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 6 | Small cetacean, unidentified | All | 500 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM, IP, IV, subcutaneous, topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Captive, maintain; Captive, research; Collect, sloughed skin; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness; Instrument, bolt/pin; Instrument, dart/barb; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; Lavage, gastric; Mark (freeze brand; notch; roto tag; paint); 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; Restrain, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, swab (all mucus membranes; anal; blowhole; ocular; oral, other); 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 ; Stable isotopes and serial blood samples; Tracking; Ultrasound; Underwater photo/videography; Weigh; X-ray and imaging (e.g., CT, MRI) | Small cetacean piggy backing; sample collection during other legal takes/permitted activity (permitted research, subsistence harvest, bycatch, etc.) in wild, captivity, or rehab; all small cetaceans (non-listed and ESA-listed); 500 takes/yr for all species combined. Includes sampling and direct and unintentional harassment. Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 7 | Large Whales, unidentified | All | 5,000 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Imaging, thermal; 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, fecal; Tracking; Underwater photo/videography; Unintentional harassment | Large whale aerial and vessel surveys (manned and unmanned) and associated non-intrusive sampling in the wild; all large whales, non-listed and ESA-listed, including sperm whales; up to 5,000 takes/yr for all species combined. Includes sampling and direct and unintentional harassment. |
| 8 | Large Whales, unidentified | Non-neonate | 500 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, bolt/pin; Instrument, dart/barb; Instrument, deep-implant; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | Large whale research activities in the wild; all non-ESA listed large whales; 500 takes/yr total for all species; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging. Includes direct and unintentional harassment. See Appendix D for invasive tagging restrictions. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 9 | Large Whales, unidentified | All | 400 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM, IP, IV, subcutaneous, topical); Auditory brainstem response test; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, deep-implant; Instrument, suction-cup; Measure; Measure colonic temperature; 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, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, swab (all mucus membranes; anal; blowhole; ocular; oral, other); Sample, blood; 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; Stable isotopes and serial blood samples; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment; X-ray and imaging (e.g., CT, MRI) | Large whale piggy backing; sample collection during other legal takes/permitted activity (permitted research, subsistence harvest, bycatch, etc.) in wild, captivity or rehab; all species (non-listed and ESA-listed); 400 takes/yr for all species combined. Includes sampling, and direct and unintentional harassment.<br>See Appendix D for invasive tagging restrictions. No deep-implant tags for NARW, Rice's whale, and sei whales for baseline health research. No dart tagging of reproductive age female NARWs for baseline health research |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
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| 10 | Pinniped, unidentified | All | Unlimited | Import/ export/ receive; Collect | Collect, U.S. subsistence; Export; Import; Receive domestically; Salvage (carcass, tissue, parts) | Receipt, possession, transport, import, export, analysis, and curation of hard and soft parts from all pinniped species (non-listed and ESA-listed) excluding walrus; analytical and diagnostic samples may be transported, imported, or exported to labs world-wide |
| 11 | Pinniped, unidentified | All | 10,000 | Harass; Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Collect, molt; Collect, scat; Collect, spew; Collect, urine; Count/survey; 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; Unintentional harassment | Pinniped aerial, ground, and vessel surveys (manned and unmanned) in wild, captivity, or rehab; all species of pinniped (non-listed and ESA-listed) except Hawaiian monk seals in the wild and walrus. Includes sampling, and direct and unintentional harassment. |

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| 12 | Pinniped, unidentified | All | 700 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; 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; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; hot brand;, other [e.g., neoprene patch]; PIT tag); 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; cage; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; anal; nasal; ocular; oral, other); 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; Transport; Ultrasound; Underwater photo/videography; Unintentional harassment; Weigh; X ray and imaging (e.g., CT, MRI) | Pinniped research activities in the wild, captivity, or rehabilitation; all non-ESA listed species of pinniped, including MMPA-depleted species[12]; 700 takes/yr total for all species combined. Includes captures, sampling, and direct and unintentional harassment. Other = pneumotach and esophageal catheterization. |
| 13 | Pinniped, unidentified | All | 5 | Unintentional mortality | Unintentional mortality or serious injury | Pinniped unintentional mortality for target species; 5 annually (total for all non-listed pinnipeds, including MMPA-depleted stocks) during research activities; includes euthanasia when deemed medically necessary |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species;<br>Stock/<br>Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| | | | | | | resulting from research activities; necropsy. |

[12] *Includes all non-ESA listed, MMPA-depleted pinniped species. E.g., Northern fur seal (Eastern Pacific Stock)*

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species;<br>Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 14 | Pinniped, unidentified | All | 1,000 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; 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; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; hot brand;, other [e.g., neoprene patch]; PIT tag); 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, swab (all mucus membranes; anal; nasal; ocular; oral, other); Sample, tooth extraction; Sample, urine catheter; Sample, vibrissae (clip); Sample, vibrissae (pull); Stable isotopes and serial blood samples; Ultrasound; Underwater photo/videography; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Pinniped piggy backing; on all species combined; all species (non-listed and ESA-listed) except walrus; sample collection during other legal takes/permitted activities in wild, captivity or rehabilitation. 1,000 takes/yr. Includes sampling, and direct and unintentional harassment. Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 15 | Sea lion, Steller; West of 144° Long (Western US; NMFS Endangered) | All | 60 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; A Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; 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; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; hot brand;, other [e.g., neoprene patch]; PIT tag); 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; cage; hand; net;other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; anal; nasal; ocular; oral, other); 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; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned). Includes captures, tagging, sampling, and direct and unintentional harassment. Other = pneumnotachometer, esophageal catheterization. |

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| 16 | Seal, bearded;<br>Beringia DPS<br>(NMFS<br>Threatened) and Okhotsk DPS (NMFS Threatened) | All | 60 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); 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; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; hot brand;, other [e.g., neoprene patch]; PIT tag); 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; cage; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; fecal loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; anal; nasal; ocular; oral, other); 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; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned). Includes captures, tagging, sampling, and direct and unintentional harassment. Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 17 | Seal, Guadalupe fur; Range-wide (NMFS Threatened) | All | 60 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; 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; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; hot brand;, other [e.g., neoprene patch]; PIT tag); 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; cage; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; anal; nasal; ocular; oral, other); 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; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned), Includes captures, sampling, tagging, and direct and unintentional harassment. Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species;<br>Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 18 | Seal, Hawaiian monk;<br>Hawaiian Islands (NMFS Endangered) | All | 60 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Calipers (skin fold); Cognitive studies; Collect, molt; Collect, scat; Collect, spew; Collect, urine; Evan's blue dye and serial blood samples; Hormones and serial blood samples; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; other [e.g., neoprene patch]; PIT tag); 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; cage; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; anal; nasal; ocular; oral, other);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; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Research in captive settings (rehabilitation or permanent captivity) only; piggy-backing research may occur in the wild (captures under seaparte authority); no hot branding. Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 19 | Seal, ringed; Okhotsk (NMFS Threatened) and Arctic (NMFS Threatened) | All | 60 | Capture/ Handle/ Release | Acoustic, active playback/broadcast; Acoustic, passive recording; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; 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; Instrument, external (e.g., VHF, SLTDR); Instrument, internal (e.g., catheter, SQ, LHX); Mark, bleach ; clip fur; dye or paint; flipper tag; freeze brand; other [e.g., neoprene patch]; PIT tag); 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; cage; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, blubber biopsy; Sample, clip hair; Sample, clip nail; Sample, fecal (enema; loop; swab); Sample, milk (lactating females); Sample, muscle biopsy; Sample, swab (all mucus membranes; anal; nasal; ocular; oral, other); 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; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Research activities in the wild, captivity, or rehabilitation; aerial and vessel surveys (manned and unmanned). Includes captures, tagging, sampling, and direct and unintentional harassment. No hot branding. Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 20 | Seal, bearded; Beringia DPS (NMFS Threatened)<br><br>Seal, ringed; Arctic DPS (NMFS Threatened)<br><br>Sea lion, Steller; Western DPS (NMFS Endangered) | All | 5 | Unintentional mortality | Unintentional mortality or serious injury | Unintentional mortality for target; ESA-listed ringed seal, bearded seal, or Western Steller sea lion, not including Guadalupe fur seals or Hawaiian monk seals; not to exceed 5 individuals total over the lifetime of the permit; includes euthanasia when deemed medically necessary due to any research; necropsy. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
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| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 21 | Seal, Guadalupe fur; Range-wide (NMFS Threatened) | All | 1 | Unintentional mortality | Unintentional mortality or serious injury | 1 total for the life of the permit (not annual) for target animals; includes euthanasia when deemed medically necessary due to any research; necropsy. |
| 22 | Seal, Hawaiian monk; | All | 1 | Unintentional mortality | Unintentional mortality or serious injury | 1 total for the life of the permit (not annual) for target animals; animals sampled in captivity, rehab, or piggy backing only; includes euthanasia when deemed medically necessary due to any research; necropsy. |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 23 | Whale, beluga; Cook Inlet DPS (NMFS Endangered) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Captive, maintain; Captive, research; Collect, sloughed skin; Count/survey; Hormones and serial blood samples; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness; Instrument, dart/barb; Instrument, suction-cup; Lavage, gastric; Mark, freeze brand; notch; roto tag; paint); 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; Salvage (carcass, tissue, parts); Restrain, (board; hand; net; other); Sample, swab (all mucus membranes; anal; blowhole; ocular; oral, other); Sample, blood; 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 ; Stable isotopes and serial blood samples; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment; Weigh; X-ray or imaging (e.g., CT, MRI) | Research in wild, captivity or rehabilitation; aerial and vessel surveys (manned and unmanned) and assoc. sampling including biopsy, tagging, direct and unintentional harass; no captures in wild; No spider tags, No deep-implant tags; no sedation (except in permanent captivity or rehabilitation). Other = pneumnotachometer, esophageal catheterization. |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 24 | Whale, blue; Range-wide (NMFS Endangered) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, bolt/pin; Instrument, dart/barb; Instrument, deep-implant; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | 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 unintentional harassment; no sedation. See Appendix D for deep-implant tagging restrictions. |
| 25 | Whale, bowhead; Range-wide (NMFS Endangered) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, deep-implant; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | 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 unintentional harassment; no sedation. See Appendix D for deep-implant tagging restrictions. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species;<br>Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 26 | Whale; Rice's;<br>Range-wide (NMFS Endangered) | All | Up to 10[13] | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | Research activities in the wild; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and unintentional harassment; no sedation; no more than 2 biopsy samples per year per individual. No deep-implant tags. |

[13] *Annual research take numbers and activities are contingent upon annual authorization per Condition A.2.c., and must have a separate authorization accompanying this permit each year. See additional Permit Conditions for research coordination requirements for this species.*

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 27 | Whale, false killer; Main Hawaiian Islands Insular (NMFS Endangered) | All | 20 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Captive, maintain; Captive, research; Collect, sloughed skin; Count/survey; Hormones and serial blood samples; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness; Instrument, dart/barb; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; Lavage, gastric; Mark (freeze brand; notch; roto tag; paint); 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; Restrain, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, swab (all mucus membranes; anal; blowhole; ocular; oral, other);Sample, blood; 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 (catheter; needle; free catch); Stable isotopes and serial blood samples; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment; Weigh; X-ray and imaging (e.g., CT, MRI) | Research in wild, captivity or rehabilitation; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and unintentional harass; no captures in wild; no spider tags, no deep-implant tags; no sedation (except in permanent captivity or rehabilitation). Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 28 | Whale, fin; Range-wide (NMFS Endangered) | All | 70 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, deep-implant; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | Research activities in the wild; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and unintentional harassment; no sedation. |
| 29 | Whale, humpback; Range-wide (NMFS Endangered/ Threatened) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, bolt/pin; Instrument, dart/barb; Instrument, deep-implant; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | ESA-listed humpback whale DPSs research activities in the wild; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and unintentional harassment; no sedation. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 30 | Whale, killer; Southern Resident DPS (NMFS Endangered) | All | 20 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Captive, maintain; Captive, research; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Hormones and serial blood samples; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness; Instrument, suction-cup; Lavage, gastric; Mark (freeze brand; notch; roto tag; paint); 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; Restrain, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, blood; Sample, swab (all mucus membranes; anal; blowhole; ocular; oral, other);; 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 (catheter; needle; free catch); Stable isotopes and serial blood samples; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment; Weigh X-ray and imaging (e.g., CT, MRI) | Research in wild, captivity or rehabilitation; aerial and vessel surveys (manned and unmanned) and assoc. sampling including biopsy and suction-cup tagging, direct and unintentional harassment; no captures in wild; no spider tags, no dart tags, and no deep-implant tags; no sedation (except in permanent captivity or rehabilitation). Other = pneumnotachometer, esophageal catheterization. |

| Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts. | | | | | | |
|---|---|---|---|---|---|---|
| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
| 31 | Whale, killer; AT1 Transients (MMPA depleted) | All | 10 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Administer drug (IM; IP; IV; subcutaneous; topical); Anesthesia (gas w/cone or mask; gas w/intubation; injectable sedative); Auditory brainstem response test; Captive, maintain; Captive, research; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Hormones and serial blood samples; Imaging, thermal; Insert ingestible telemeter pill; Instrument, belt/harness; Instrument, bolt/pin; Instrument, dart/barb; Instrument, dorsal fin/ridge attachment; Instrument, suction-cup; Lavage, gastric; Mark (freeze brand; notch; roto tag; paint); 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; Restrain, (board; hand; net; other); Salvage (carcass, tissue, parts); Sample, swab (all mucus membranes; anal; blowhole; nasal; ocular; oral, other); Sample, blood; 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 (catheter; needle; free catch); Stable isotopes and serial blood samples; Tracking; Transport; Ultrasound; Underwater photo/videography; Unintentional harassment; Weigh X-ray and imaging (e.g., CT, MRI) | 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 unintentional harassment. Other = pneumnotachometer, esophageal catheterization. |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species;<br>Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 32 | Whale, right, North Atlantic;<br>Range-wide (NMFS Endangered) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | Research activities in the wild; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and unintentional harassment; no deep-implant tags for any age-class and no dart tagging of reproductive-aged females, for baseline research no sedation. No more than 10 dart tags deployed annually. See Appendix D for invasive tagging restrictions. |
| 33 | Whale, right, North Pacific;<br>Range-wide (NMFS Endangered) | All | 5 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, deep-implant; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | Research activities in the wild; aerial and vessel surveys (manned and unmanned) and associated sampling including biopsy and tagging, direct and unintentional harassment; no sedation. No more than 3 deep-implant tags annually. |

Table A2. Authorized research (unrelated to emergency response), method/tool development and training, and import/export of marine mammal parts under the jurisdiction of the NMFS conducted pursuant to Sections 104 (c) and Title IV authorities of the MMPA and Section 10(a)(1(A) of the ESA. Includes unintentional and incidental Level A harassment (non-serious injury excluding vessel strike) and Level B harassment of target and non-target species. Activities may occur year-round on land and beaches, and in rivers and coastal waters of the United States, waters within the U.S. EEZ, and international waters; and at captive facilities and rehabilitation centers. Includes world-wide import/export of marine mammal parts.

| Line | Species; Stock/ Listing Unit | Life stage | No. Authorized Takes[10] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|
| 34 | Whale, sei; Range-wide (NMFS Endangered) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | 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 unintentional harassment; no sedation; no deep-implant tags. See Appendix D for deep-implant tagging restrictions. |
| 35 | Whale, sperm; Range-wide (NMFS Endangered) | All | 40 | Harass/ Sampling | Acoustic, active playback/broadcast; Acoustic, passive recording; Acoustic, sonar for prey mapping; Auditory brainstem response test; Collect, remains for predation study; Collect, sloughed skin; Count/survey; Imaging, thermal; Instrument, dart/barb; Instrument, deep-implant; Instrument, suction-cup; 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, fecal; Sample, muscle biopsy; Sample, skin and blubber biopsy; Sample, skin biopsy; Tracking; Ultrasound; Underwater photo/videography; Unintentional harassment | 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 unintentional harassment; no sedation. |

| Table A3. Annual incidental take of non-target species during emergency response or research under Tables A1 and A2. Activities may occur any time of year on land and beaches, and in rivers and coastal waters of the U.S., waters within the U.S. EEZ, and international waters. These takes of ESA-listed sea turtles and fishes are authorized by the incidental take statement in the ESA Section 7 Programmatic Biological Opinion prepared for this permit. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Line | Species | Stock/Listing Unit | Life stage | No. Authorized Takes[14] | Take Action | Procedures | Details |
| 1 | Turtle, unidentified sea | N/A (NMFS Endangered/ Threatened) | Juvenile/ Subadult/ Adult | 10 | Harass; Capture/ Handle/ Release | Other; Incidental capture and harassment | Incidental take of up to 10 animals annually of any species including green, hawksbill, Kemp's ridley, loggerhead, or olive ridley sea turtles; live release or transport to rehab as directed by vet. Not to exceed 50 total over the duration of the permit. |
| 2 | Turtle, leatherback sea | Range-wide (NMFS Endangered) | Juvenile/ Subadult/ Adult | 2 | Harass; Capture/ Handle/ Release | Other; Unintentional harassment | Incidental live capture and release of up to 2 leatherback sea turtles annually; disentanglement, resuscitation or transport to rehab as directed by vet. Not to exceed 10 total over the duration of the permit. |
| 3 | Sawfish, smalltooth | U.S. DPS (NMFS Endangered) | All | 3 | Harass; Capture/ Handle/ Release | Other; Unintentional harassment | Incidental live capture and release of up to 3 smalltooth sawfish annually; includes disentanglement and resuscitation. Not to exceed 15 total over the duration of the permit. |
| 4 | Sturgeon, Atlantic | Range-wide (NMFS Endangered/ Threatened) | Subadult/ Adult | 3 | Harass; Capture/ Handle/ Release | Other; Unintentional harassment | Incidental live capture and release of up to 3 Atlantic sturgeon annually; includes disentanglement and resuscitation. Not to exceed 15 total over the duration of the permit. |
| 5 | Sturgeon, green | Southern DPS (NMFS Threatened) | Juvenile/ Adult | 1 | Harass; Capture/ Handle/ Release | Other; Unintentional harassment | Incidental live capture and release of up to 1 green sturgeon annually; includes disentanglement and resuscitation. Not to exceed 5 total over the duration of the permit. |

[14] *Takes = the maximum number of animals, not necessarily individuals, that may be taken annually for the suite of procedures in each row of the table.*

| Table A3. Annual incidental take of non-target species during emergency response or research under Tables A1 and A2. Activities may occur any time of year on land and beaches, and in rivers and coastal waters of the U.S., waters within the U.S. EEZ, and international waters. These takes of ESA-listed sea turtles and fishes are authorized by the incidental take statement in the ESA Section 7 Programmatic Biological Opinion prepared for this permit. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Line | Species | Stock/Listing Unit | Life stage | No. Authorized Takes[14] | Take Action | Procedures | Details |
| 6 | Sturgeon, Gulf | Range-wide (NMFS Threatened) | Subadult/ Adult | 1 | Harass; Capture/ Handle/ Release | Other; Unintentional harassment | Incidental live capture and release of up to 1 gulf sturgeon annually; includes disentanglement and resuscitation. |
| 7 | Sturgeon, shortnose | Range-wide (NMFS Endangered) | Subadult/ Adult | 1 | Harass; Capture/ Handle/ Release | Other; Unintentional harassment | Incidental live capture and release of 1 shortnose sturgeon annually; includes disentanglement and resuscitation. |
| 8 | Pinniped, unidentified | Range-wide | All | 2 | Harass | Unintentional harassment | Unintentional Level A harassment, non-serious injury resulting from accidental vessel strike; 2 pinnipeds annually not to exceed 10 total over the duration of the permit. Any species of pinniped (ESA-listed and non-listed); can be target or non-target animal. |
| 9 | Small cetacean, unidentified | Range-wide | All | 2 | Harass | Unintentional and incidental harassment | Unintentional Level A harassment, non-serious injury resulting from accidental vessel strike; 2 small cetaceans annually, not to exceed 10 total over the duration of the permit. Any species of small cetacean (ESA-listed and non-listed) can be target or non-target animal. |
| 10 | Large Whale, unidentified | Range-wide | All | 2 | Harass | Unintentional and incidental harassment | Unintentional Level A harassment, non-serious injury resulting from accidental vessel strike; 2 large whales annually, not to exceed 10 total over the duration of the permit. Any species of large whale (ESA-listed and non-listed). May be target or non-target animal. |
| 11 | Turtle, unidentified sea | N/A (NMFS Endangered/ Threatened) | Juvenile/ Subadult/ Adult | x | Harass | Incidental harassment | Unintentional Level A harassment, non-serious injury resulting from accidental vessel strike; 2 sea turtles annually, not to exceed 10 total of any species of sea turtle (ESA-listed and non-listed) over the duration of the permit. |

Table A3. Annual incidental take of non-target species during emergency response or research under Tables A1 and A2. Activities may occur any time of year on land and beaches, and in rivers and coastal waters of the U.S., waters within the U.S. EEZ, and international waters. These takes of ESA-listed sea turtles and fishes are authorized by the incidental take statement in the ESA Section 7 Programmatic Biological Opinion prepared for this permit.

| Line | Species | Stock/Listing Unit | Life stage | No. Authorized Takes[14] | Take Action | Procedures | Details |
|---|---|---|---|---|---|---|---|
| 12 | Pinnipeds:<br>California sea lion;<br>Gray seal;<br>Guadalupe fur seal;<br>Harbor seal;<br>Northern fur seal; and<br>Steller sea lion only. | Pinniped from the following species and stocks only:<br>California sea lion (U.S. stock);<br>Gray seal (Western North Atlantic stock);<br>Guadalupe fur seal (Mexico stock);<br>Harbor seal (11 stocks[b]);<br>Northern fur seal (Eastern Pacific and California stock); or<br>Steller sea lion (Western stock and Eastern stocks). | All | 1 | Capture; Unintentional harassment; Unintentional mortality | Incidental mortality or serious injury | Incidental mortality or serious injury of non-target animal as a result of stampede or net capture. One animal annually, not to exceed 3 total over the duration of the permit. Includes euthanasia when deemed medically necessary and necropsy. Does not include M/SI from vessel strike. |

| Table A3. Annual incidental take of non-target species during emergency response or research under Tables A1 and A2. Activities may occur any time of year on land and beaches, and in rivers and coastal waters of the U.S., waters within the U.S. EEZ, and international waters. These takes of ESA-listed sea turtles and fishes are authorized by the incidental take statement in the ESA Section 7 Programmatic Biological Opinion prepared for this permit. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Line | Species | Stock/Listing Unit | Life stage | No. Authorized Takes[14] | Take Action | Procedures | Details |
| 13 | Small cetacean:<br>Beluga whale or<br>Bottlenose dolphin only | Small cetacean from the following species and stocks only:<br>Beluga whale (Beaufort Sea; Bristol Bay; Eastern Bering Sea; or Eastern Chukchi stock); or<br>Bottlenose dolphin (31 stocks[a]) | All | 1 | Capture; Unintentional harassment; Unintentional mortality | Incidental mortality or serious injury | Unintentional mortality or serious injury of non-target beluga whale (non-listed stocks) or bottlenose dolphin (limited stocks) during net captures. One animal annually, not to exceed 3 total over the lifetime of the permit. Includes euthanasia when deemed medically necessary and necropsy. Does not include M/SI from vessel strike. |

## 15.2 Permit Terms and Conditions

The following text was taken directly from draft Permit No. 24359 to be issued to the MMHSRP by the Permits Division. These, or similar terms and conditions will also apply to future permits:

The activities authorized herein must occur by the means, in the areas, and for the purposes set forth in the permit application, and as limited by the Terms and Conditions specified in this permit, including appendices and attachments. Permit noncompliance constitutes a violation and is grounds for permit modification, suspension, or revocation, and for enforcement action.

**A. <u>Duration of Permit</u>**

1. Personnel listed in Condition C.1 of this permit (hereinafter "Researchers") may conduct activities authorized by this permit through December 31, 2027. This permit may be extended by the Director, National Marine Fisheries Service (NMFS) Office of Protected Resources or the Chief, Permits and Conservation Division (hereinafter "Permits Division"), pursuant to applicable regulations and the requirements of the MMPA and ESA.

2. Researchers must immediately stop a particular activity and the Permit Holder or Principal Investigator must contact the Chief, Permits Division for written permission to resume:

    a. If serious injury or mortality[15] of protected species reaches that authorized in Appendix A.

    b. If authorized take[16] is exceeded in any of the following ways:

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*[15] This permit allows for unintentional serious injury and mortality caused by the presence or actions of researchers up to the limit in Appendix A, Tables A1, A2, and A3. This includes, but is not limited to: deaths of dependent young by starvation following research-related death of a lactating female; deaths resulting from infections related to sampling procedures or invasive tagging; and deaths or injuries sustained by animals during capture and handling, or while attempting to avoid researchers or escape capture. Note that for marine mammals, a serious injury is defined by regulation as any injury that will likely result in mortality.*

*[16] By regulation, a take under the MMPA means to harass, hunt, capture, collect, or kill, or attempt to harass, hunt, capture, collect, or kill any marine mammal. This includes, without limitation, any of the following: the collection of dead animals, or parts thereof; the restraint or detention of a marine mammal, no matter how temporary; tagging a marine mammal; the negligent or intentional operation of an aircraft or vessel, or the doing of any other negligent or intentional act which results in disturbing or molesting a marine mammal; and feeding or attempting to feed a*

i. More animals are taken than allowed in Appendix A.

ii. Animals are taken in a manner not authorized by this permit.

iii. Protected species other than those authorized by this permit are taken.

c. Following incident reporting requirements at Condition E.2.

3. For Rice's whale baseline health research,[17] annual authorization must be obtained in writing from the Permits Division prior to each year's research activities.

a. Authorization may include modifying the number of takes and types of research activities you are authorized. Authorization will be based on evaluating the following:

i. All submitted Rice's whale annual research reports including all research proposed on Rice's whales by authorized permit holders for the upcoming year (January – December) (see Condition E.6);

ii. Findings from annual coordination meetings (see Condition F.3); and

iii. Recovery priorities and status updates.

b. Authorization may be denied or delayed if the Rice's whale research annual report has not been received by December 31st and approved as complete by January 31st.

*marine mammal in the wild. Under the ESA, a take means to harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect, or attempt to do any of the preceding. A take or taking under the FSA means to harass, hunt, capture, or kill, or attempt to harass, hunt, capture, or kill. The FSA authorizes the taking, transportation, importation, exportation, or possession of northern fur seals or their parts for educational, scientific, or exhibition purposes.*

[17] *Authorized in Appendix A, Table A2.*

c. Authorization does not guarantee or imply that NMFS will authorize subsequent years' activities or the same take numbers and activities.

## B. Number and Kinds of Protected Species, Locations and Manner of Taking

1. The tables in Appendix A outline the authorized species and stock or distinct population segment (DPS); number of animals to be taken; number of animals from which parts may be received, imported, and exported; and the manner of take, locations, and time period.

2. Under Table A1 of Appendix A, Researchers may conduct emergency response and emergency response-related research. Emergency response-related research may occur during an emergency event or after the fact, including but not limited to oil spills, mass strandings, unusual mortality events (UMEs), and other natural or man-made disasters. Emergency response-related research will directly derive from an emergency event investigation, and these investigations will be developed after consulting with the Working Group on Marine Mammal Unusual Mortality Events (WGMMUME) for UMEs, the Natural Damage Resource Assessment (NRDA) process for oil spills or other pollutant spills, or other expert panels depending upon the emergency. The WGMMUME, scientists through the NRDA process (respectively) or expert panels may recommend continued monitoring, assessment, and study of a population (or several populations) for a number of years, even after the UME has ended, some of the oil spill restoration has been conducted, or the emergency is resolved. Therefore, emergency response-related research will typically continue for 1-3 years post emergency and possibly longer if recommended by the expert body. Once this post-event assessment period is completed, continued health assessment research on the population may occur under Table A2 of Appendix A. Small scale testing of new and untested technologies and methods may be conducted during emergency response to develop and test their efficacy. Permit Conditions B.4 and B.5 must be met prior to implementation.

3. Under Table A2 of Appendix A, Researchers may conduct non-emergency response research such as "baseline health research" or "biomonitoring," which may include research on marine mammals in the wild that are not associated with an emergency event and marine mammals undergoing rehabilitation or in permanent captivity. Small scale opportunistic studies and training exercises may be conducted to develop and test the efficacy of new and untested technologies

and methods for baseline health research. Conditions B.4 and B.5 must be met prior to implementation.

4. Institutional Animal Care and Use Committee (IACUC) approval and the approved IACUC protocols must be submitted to the Permits Division prior to conducting research under Tables A1 or A2 of Appendix A.

5. The Permit Holder must ensure that research and enhancement methods are consistent with those described in the permit application. New procedures or modifications to procedures must be submitted to the Permits Division for review and approval.

6. As applicable, personnel authorized under this permit must comply with the Conditions in the following appendices for conducting permitted activities on marine mammals under NMFS jurisdiction:

   a. Appendix B for enhancement activities;

   b. Appendix C for biological sampling during enhancement or research;

   c. Appendices D and E for research involving cetaceans and pinnipeds, respectively;

   d. Appendices F and G for research involving animals undergoing rehabilitation or in permanent captivity, respectively;

   e. Appendix H for auditory testing during enhancement or research;

   f. Appendix I for disposition of marine mammal parts; and

   g. Appendix J to minimize impacts to non-target species.

7. In addition to the conditions in this permit and Appendices B-J, to avoid, minimize, or eliminate impacts on target and non-target species and the environment, mitigation measures described in the 2022 Final PEIS must be followed for the activities authorized by this permit.

8. This permit does not authorize Researchers to respond to or take U.S. Fish and Wildlife Service (USFWS) marine mammal species or parts. Appendix J includes requirements to minimize impacts to non-target USFWS species.

9. Researchers working under this permit may collect images (e.g., photographs, video) and audio recordings in addition to the photo-identification or behavioral photo-documentation authorized in Appendix A as needed to document the permitted activities, provided the collection of such images or recordings does not result in takes.

10. The Permit Holder may use visual images and audio recordings collected under this permit, including those authorized in the Tables of Appendix A, in printed materials (including commercial or scientific publications) and presentations provided the images and recordings are accompanied by a statement indicating that the activity was conducted pursuant to NMFS ESA/MMPA Permit No. 24359. This statement must accompany the images and recordings in all subsequent uses or sales.

11. The Permit Holder may grant written approval for personnel performing activities not essential to achieving the emergency response or research objectives (e.g., a documentary film crew) to be present, provided:

    a. A request is submitted to the Permit Holder specifying the purpose and nature of the activity, location, approximate dates, and number and roles of individuals for which permission is sought.

    b. Non-essential personnel/activities will not influence the conduct of permitted activities or result in takes of protected species.

    c. Persons authorized to accompany the Researchers or emergency responders for the purpose of such non-essential activities will not be allowed to participate in the permitted activities.

    d. The Permit Holder and Researchers or emergency responders do not require compensation from the individuals in return for allowing them to accompany Researchers or emergency responders.

## C. <u>Qualifications, Responsibilities, and Designation of Personnel</u>

1. At the discretion of the Permit Holder, the following Researchers may participate in the conduct of the permitted activities in accordance with their qualifications and the limitations specified herein:

    a. Principal Investigator – Sarah Wilkin.

b. Co-Investigators – Trevor Spradlin; Teri Rowles, D.V.M., Ph.D.; Deborah Fauquier, D.V.M., Ph.D.; Stephen Manley; additional Co-Investigators may be authorized pursuant to Condition 6 below.

c. Research Assistants – personnel identified by the Permit Holder or Principal Investigator and qualified to act pursuant to Conditions C.2, C.3, and C.4 of this permit.

2. Individuals conducting permitted activities must possess qualifications commensurate with their roles and responsibilities. The roles and responsibilities of personnel operating under this permit are as follows:

a. The Permit Holder is ultimately responsible for activities of individuals operating under the authority of this permit. Where the Permit Holder is an institution/facility, the Responsible Party is the person at the institution/facility who is responsible for the supervision of the Principal Investigator.

b. The Principal Investigator (PI) is the individual primarily responsible for the taking, import, export and related activities conducted under the permit. This includes coordination of field activities of all personnel working under the permit. The PI must be on site during activities conducted under this permit unless a Co-Investigator named in Condition C.1, or authorized in accordance with Condition C.7, is present to act in place of the PI.

c. Co-Investigators (CIs) are individuals who are qualified to conduct activities authorized by the permit, for the objectives described in the application, without the on-site supervision of the PI. CIs assume the role and responsibility of the PI in the PI's absence.

d. Research Assistants (RAs) are individuals who work under the direct and on-site supervision of the PI or a CI. RAs cannot conduct permitted activities in the absence of the PI or a CI.

3. Personnel involved in permitted activities must be reasonable in number and essential to conduct of the permitted activities. Essential personnel are limited to:

    a. Individuals who perform a function directly supportive of and necessary to the permitted activity (including operation of vessels or aircraft essential to conduct of the activity),

    b. Individuals included as backup for those personnel essential to the conduct of the permitted activity, and

    c. Individuals included for training purposes.

4. Persons who require state or Federal licenses or authorizations (e.g., veterinarians, pilots – including UAS operators) to conduct activities under the permit must be duly licensed/authorized and follow all applicable requirements when undertaking such activities.

5. Permitted activities may be conducted aboard vessels or aircraft, or in cooperation with individuals or organizations, engaged in commercial activities, provided the commercial activities are not conducted simultaneously with the permitted activities, except with approval from the Permits Division.

6. The Permit Holder cannot require or receive direct or indirect compensation from a person approved to act as PI, CI, or RA under this permit in return for requesting such approval from the Permits Division.

7. The Permit Holder may designate additional personnel without prior approval from the Chief, Permits Division as indicated below:

    a. The Permit Holder, PI, or an identified CI approved by the PI, may designate additional CIs provided the following:

        i. A copy of the letter designating the individual and specifying their duties under the permit is provided to the Permits Division by email on the day of designation;

ii. The copy of the letter is accompanied by a curriculum vitae, qualifications form, or resume including summary of the individual's qualifications to conduct and supervise the permitted activities;

iii. The Permit Holder acknowledges that the designation is subject to review and revocation by the Chief, Permits Division; and

iv. Each CI must receive the letter from the Permit Holder or PI confirming their status and detailing specific roles and responsibilities, attached to a copy of this permit. Designation of CIs is at the discretion of the Permit Holder or PI and may be rescinded at any time. CIs are limited by the Terms and Conditions of the CI authorization provided by the PI.

b. The Permit Holder, PI, or an identified CI with approval from the PI, may designate additional qualified personnel to act as agents of the permit during enhancement activities involving emergency responses. Such authorization may be informal (e.g., verbal authorization or authorization via email) to allow for timely responses in emergency situations. If such persons are authorized under this permit on a frequent or routine basis, then a CI letter is required.

8. The Responsible Party may request a change of PI by submitting a request to the Chief, Permits Division that includes a description of the individual's qualifications to conduct and oversee the activities authorized under this permit.

**D. <u>Possession of Permit</u>**

1. This permit cannot be transferred or assigned to any other person.

2. The Permit Holder and all persons operating under the authority of this permit must possess a copy of this permit when:

a. Engaged in a permitted activity.

b. A protected species is in transit incidental to a permitted activity.

c. A protected species taken or imported under the permit is in the possession of such persons.

3. A duplicate copy of this permit must accompany or be attached to the container, package, enclosure, or other means of containment in which a protected species or protected species part is placed for purposes of storage, transit, supervision or care.

## E. <u>Reporting</u>

1. The Permit Holder must submit annual, final, and incident reports, and any papers or publications resulting from the activities authorized herein by one of the following:

   a. The APPS system at https://apps.nmfs.noaa.gov;

   b. An email attachment to the permit analysts for this permit; or

   c. A hard copy mailed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Room 13705, Silver Spring, MD 20910.

2. Incident Reporting

   a. If the total number of authorized mortalities is reached, or authorized takes have been exceeded as specified in Conditions A.2 and Appendices D and E, the Permit Holder must:

      i. Email your permit analysts or call the Permits Division (301-427-8401) as soon as possible, but no later than 2 business days of the incident;

      ii. Submit a written report within 2 weeks of the incident as specified below; and

      iii. Receive approval from the Permits Division before resuming work. The Permits Division may grant authorization to resume permitted activities based on review of the incident report and in consideration of the Terms and Conditions of this permit.

b. Any time a mortality or serious injury of a protected species (target or non-target species) occurs during any enhancement or research activity authorized under this permit, a written report must be submitted within two weeks. This includes, but is not limited to, unintentional or accidental deaths or serious injuries of target ESA-listed marine mammals during rescue or rehabilitation; mortality or serious injury of non-target animals; and deaths, serious injuries, or euthanasia during research. (See annual reporting requirements below for reporting euthanasia conducted under the permit).

c. The incident report must include 1) a complete description of the events, and 2) identification of steps that will be taken to reduce the potential for additional mortality, serious injury, or exceeding authorized take.

3. For bottlenose dolphin stocks from BSE and coastal areas accidentally sampled in the dorsal fin, report each event within two business days as indicated in Appendix D to the Permits Division (See E.1 above). Co-Investigators must also report to the MMHSRP headquarters (nmfs.mmhsrp.hq@noaa.gov).

a. The notification must include:

i. Date biopsy sampling occurred;

ii. Geographic location of sampling (latitude and longitude);

iii. Photographic identification of the individual (if available);

iv. Sampling location on the dorsal fin, including photographs or drawings (if available);

v. Age-class and group size of the individual;

vi. Biopsy sampler and their experience[18];

vii. Deployment device (e.g., crossbow, pole);

[18] *E.g., experience level (trainee/less than 1 year, 1-2 years, 3-5 years, or more than 5 years); number of animals successfully sampled; and species sampled.*

viii. Environmental conditions that were recorded at the time of sampling, as available and if known (e.g., Beaufort sea state, salinity, depth, water quality,[19] water clarity,[20] water temperature, in-air visibility[21]);

ix. The total number of bottlenose dolphin biopsy samples collected from these stocks during the current annual reporting period (January 1 – December 31); and

x. Identification of steps that will be taken to reduce the potential for additional dorsal fin hits.

b. The Permits Division may notify you to stop biopsy sampling activities and/or modify these permitted activities based on review of the event, consultation with the MMHSRP and applicable NMFS Regional Office, and in consideration of the Terms and Conditions of this permit.

4. To assist in monitoring the North Atlantic Right whale (NARW) population and current UME, any time Researchers dart tag a NARW, they must report the tagging to the Permits Division within 24 hours. CIs must also report to the MMHSRP (nmfs.mmhsrp.hq@noaa.gov). The notification must include:

a. Date tagging occurred;

b. Location tagging took place (latitude and longitude);

c. Identification of the individual NARW (if known at the time, or provide within 1 week of individual identification);

d. Location of the tag on the body; and

e. Photograph(s) of the tag placement.

Annual Reports

5. Annual reports describing activities conducted during the previous permit year (from January 1 to December 31) must:

[19] *Water quality = the condition of the water, such as the chemical, physical, or biological characteristics.*
[20] *Water clarity = a measure of how far down light can penetrate through the water column.*
[21] *In-air visibility = a measure of how far an object can be seen.*

a. Be submitted by March 31 each year for which the permit is valid.

b. Include a tabular accounting of takes and a narrative description of activities and their effects (See details in Appendix K).

c. Include a summary of euthanasia conducted under this permit, e.g., euthanasia of ESA-listed stranded animals or euthanasia during permitted rescue or rehabilitation activities.

d. Provide data on Southern Resident killer whale behavioral responses to approaches between 200 and 50 yards, and within 50 yards.

e. Include results of post-invasive tagging monitoring (as outlined in Appendix D) to include photographs, video.

f. For bottlenose dolphin stocks from BSE and coastal areas accidentally biopsy sampled in the dorsal fin, the Permit Holder must provide results of post-biopsy monitoring including details outlined in Appendix D and E.3 and the following:

i. Coordination with the MMHSRP or any other Researchers for post-biopsy monitoring until the wound is healed;

ii. The total number of dorsal fin hits and total number of biopsy samples collected from these stocks of bottlenose dolphins during the current annual reporting (January 1 – December 31); and

iii. Results of efforts to reduce the potential for additional dorsal fin hits.

6. For Rice's whales, for the purposes of monitoring and annual reauthorization of Rice's whale research, the Permit Holder must submit a separate annual report to the Permits Division on research conducted on this species for January – December, by December 31 of each year. Details should include, but are not limited to:

a. Date, location, number, and type of takes;

b. Identification of individuals when possible;

c. Status and disposition of biopsy samples including field number and dates samples were entered in the genetics database;

d. Success rate of biopsy and tagging attempts;

e. Post-tag monitoring (See Appendix D) and retention time of any tags;

f. Progress made toward meeting your objectives, including a narrative summary, citing any reports, publications, and presentations that resulted;

g. Future field plans (including proposed dates, number and type of takes, and objectives) and funding levels for the next 3 years; and

h. Descriptions of opportunistically observed human interactions or other observations (e.g., health, behavior, etc.) that may be of management interest or concern.

7. A joint annual/final report including a discussion of whether the objectives were achieved must be submitted by March 31, 2028, or, if the research concludes prior to permit expiration, within 90 days of completion of the research.

8. Research results must be published or otherwise made available to the scientific community in a reasonable period of time. Copies of technical reports, conference abstracts, papers, or publications resulting from permitted research must be submitted the Permits Division upon request.

## F. Notification and Coordination

1. NMFS Regional Offices are responsible for ensuring coordination of the timing and location of all research activities in their areas to minimize unnecessary duplication, harassment, or other adverse impacts from multiple researchers.

2. The Permit Holder must ensure written notification of planned field research (Appendix A, Tables A1 or A2) for each project is provided to the NMFS Regional Offices listed below at least two weeks prior to initiation of each field trip/season.

a. Notification must include the following:

i. Locations of the intended field study and/or survey routes;

ii. Estimated dates of activities; and

iii. Number and roles of participants (for example: PI, CI, veterinarian, boat driver, safety diver, animal restrainer, Research Assistant "in training").

b. Notification must be sent to the following Assistant Regional Administrators for Protected Resources as applicable to the location of your activity:

For activities in AK; Arctic Ocean; and Bering, Beaufort, and Chukchi Seas: Alaska Region, NMFS, P.O. Box 21668, Juneau, AK 99802-1668; phone (907)586-7235; fax (907)586-7012;

For activities in WA, OR, CA, and Antarctic:

West Coast Region, NMFS, 501 West Ocean Blvd., Suite 4200, Long Beach, CA 90802-4213; phone (562)980-4005; fax (562)980-4027

Email (*preferred*): WCR.research.notification@noaa.gov;

For activities in HI, American Samoa, Guam, and Northern Mariana Islands:

Pacific Islands Region, NMFS, 1845 Wasp Blvd., Building 176, Honolulu, HI 96818; phone (808)725-5000; fax (808)973-2941

Email *(preferred)*: Jeff Walters (Jeff.Walters@noaa.gov) and Nicole Davis (Nicole.Davis@noaa.gov);

For activities in NC, SC, GA, FL, AL, MS, LA, TX, PR, and USVI:

Southeast Region, NMFS, 263 13th Ave South, St. Petersburg, FL 33701;

Email (*preferred*): nmfs.ser.research.notification@noaa.gov; and

For activities in ME, VT, NH, MA, NY, CT, NJ, DE, RI, MD, and VA: Greater Atlantic Region, NMFS, 55 Great Republic Drive, Gloucester, MA 01930; phone (978)281-9328; fax (978)281-9394

Email (*preferred*): NMFS.GAR.permit.notification@noaa.gov

3. To the maximum extent practicable, the Permit Holder must coordinate their permitted activities with other permitted researchers to avoid unnecessary disturbance of animals or duplication of efforts. Contact the applicable Regional Offices listed above for information about coordinating with other Permit Holders.

4. When working with bottlenose dolphins in the Southeast United States, Researchers must comply with recommendations provided by the NMFS Southeast Regional Office (SERO) to coordinate research, including any additional measures necessary to minimize impacts from multiple permit holders working on the same stocks. This may include but is not limited to data sharing (see Appendix 4).

5. In addition, for Rice's whale research:

   a. For all research permits authorizing takes of Rice's whales combined, no more than the entire population (currently estimated at 51 whales) may be intentionally taken twice per calendar year by each biopsy sampling and tagging.

      i. Individuals may only be intentionally biopsy sampled a maximum of twice per year.

      ii. No more than 2 tags (1 suction-cup and 1 dart/barb tag) may be attached at one time to an animal in the same calendar year.

   b. Researchers must comply with recommendations provided by the SERO to coordinate research, including additional measures deemed necessary to minimize unnecessary duplication, harassment, or other adverse impacts from multiple permit holders.

   c. Researchers (including the Responsible Party, PI, and/or CIs) proposing to conduct research on Rice's whales must participate in that year's Rice's whale annual research coordination meeting convened by the SERO and the Permits Division.

d. The Rice's whale research coordination meetings will include, but are not limited to, discussions regarding the following aspects of the research:

i. Geographic location and seasonality of sampling sites;

ii. Type of takes (e.g., UAS surveys, biopsy sampling, tagging);

iii. Numbers of takes, by type;

iv. Takes of known individuals through photo-identification or genetics;

v. Laboratory analyses; and

vi. Final disposition and repository of samples.

e. The Permit Holder must coordinate their activities with other permitted researchers before and during Rice's whale field research to avoid unnecessary disturbance of these animals and duplication of efforts. Collaboration and coordination are mandatory to ensure that only one group of researchers is targeting the same animals in the course of a day for procedures that may result in take.

f. Collected photographs or video of Rice's whales must be shared with the NMFS Southeast Fisheries Science Center (SEFSC) for development of a photo-identification catalog as a shared resource among managers and Permit Holders.

g. A skin sub-sample from each biopsy collected from Rice's whales must be included in the SEFSC's database of genetic identification of individuals in the population.

## G. <u>Observers and Inspections</u>

1. NMFS may review activities conducted under this permit. At the request of NMFS, the Permit Holder must cooperate with any such review by:

a. Allowing an employee of NOAA or other person designated by the Director, NMFS Office of Protected Resources to observe and document permitted activities; and

b. Providing all documents or other information relating to the permitted activities.

**H. <u>Modification, Suspension, and Revocation</u>**

1. Permits are subject to suspension, revocation, modification, and denial in accordance with the provisions of subpart D [Permit Sanctions and Denials] of 15 CFR Part 904.

2. The Director, NMFS Office of Protected Resources may modify, suspend, or revoke this permit in whole or in part:

a. In order to make the permit consistent with a change made after the date of permit issuance with respect to applicable regulations prescribed under Section 103 of the MMPA and Section 4 of the ESA;

b. In a case in which a violation of the terms and conditions of the permit is found;

c. In response to a written request[22] from the Permit Holder;

d. If NMFS determines that the application or other information pertaining to the permitted activities (including, but not limited to, reports pursuant to Section E of this permit and information provided to NOAA personnel pursuant to Section G of this permit) includes false information; and

[22] *The Permit Holder may request changes to the permit related to: the objectives or purposes of the permitted activities; the species or number of animals taken; and the location, time, or manner of taking or importing protected species. Such requests must be submitted in writing to the Permits Division in the format specified in the application instructions.*

e. If NMFS determines that the authorized activities will operate to the disadvantage of threatened or endangered species or are otherwise no longer consistent with the purposes and policy in Section 2 of the ESA.

3. Issuance of this permit does not guarantee or imply that NMFS will issue or approve subsequent permits or amendments for the same or similar activities requested by the Permit Holder, including those of a continuing nature.

## I. Penalties and Permit Sanctions

1. A person who violates a provision of this permit, the MMPA, ESA, or the regulations at 50 CFR Part 216 and 50 CFR Parts 222-226 is subject to civil and criminal penalties, permit sanctions, and forfeiture as authorized under the MMPA, ESA, and 15 CFR Part 904.

2. The NMFS Office of Protected Resources shall be the sole arbiter of whether a given activity is within the scope and bounds of the authorization granted in this permit.

   a. The Permit Holder must contact the Permits Division for verification before conducting the activity if they are unsure whether an activity is within the scope of the permit.

   b. Failure to verify, where the NMFS Office of Protected Resources subsequently determines that an activity was outside the scope of the permit, may be used as evidence of a violation of the permit, the MMPA, the ESA, and applicable regulations in any enforcement actions.

## J. Acceptance of Permit

1. In signing this permit, the Permit Holder:

    a. Agrees to abide by all terms and conditions set forth in the permit, all restrictions and relevant regulations under 50 CFR Parts 216, and 222-226, and all restrictions and requirements under the MMPA, and the ESA, and the FSA;

    b. Acknowledges that the authority to conduct certain activities specified in the permit is conditional and subject to authorization by the Office Director; and

    c. Acknowledges that this permit does not relieve the Permit Holder of the responsibility to obtain any other permits, or comply with any other Federal, State, local, or international laws or regulations.

______________________________ __________________

Kimberly Damon-Randall | Date Issued

Director, Office of Protected Resources

National Marine Fisheries Service

______________________________ __________________

Sarah Wilkin | Date Effective

Coordinator, MMHSRP

Office of Protected Resources

Responsible Party

### 15.3 Annual Report Template

The following text was taken directly from the Annual Report Form provided to us by the Permits Division:

Protected Species Research and Enhancement Annual Permit Report Form

Annual reports may be submitted:

a. Through the online system at https://apps.nmfs.noaa.gov;

b. By email attachment to the permit analysts for this permit; or

c. By hard copy mailed to the Chief, Permits Division, Office of Protected Resources, NMFS, 1315 East-West Highway, Suite 13705, Silver Spring, MD 20910; phone (301)427-8401.

Date: ______________________ Reporting Period: ______________________________

Permit Number: ______________ Permit Holder's Name: __________________________

Contact Name: _______________ Contact Email: _________________________________

Contact Phone #: _____________ (Contact = person submitting report)

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Part I. Tabular Section

1) Enter the actual number of animals taken, imported, or exported during this annual reporting period in Take Tables A1, A2, and A3 of Appendix A. For parts, enter the number of animals from which parts were received, imported, or exported.

2) Fill out these additional reporting tables.

| Take activities: Enter the actual number of animals (live or dead) taken during this reporting period. | | | | | | | |
|---|---|---|---|---|---|---|---|
| Species (and Stock/DPS where known) | Life stage | Sex | Live or dead when first encountered | Number of animals taken | Procedures (e.g., close approach; photo ID; biopsy; tagging; disentanglement; capture/handling/sampling; necropsy) | Location | Dates/time period |
| | | | | | | | |

| Biological sample reporting: Enter the following information for samples imported, received, exported, or transferred during this reporting period. | | | | | | |
|---|---|---|---|---|---|---|
| Date | Type of activity (e.g., import, export, receipt) | Species (common and scientific name) | Type and number of samples | Sample origin (e.g., subsistence) | Where and when was sample originally collected and under what legal authority? | Where/who are you getting the samples from? Or where/who did you send them to? Include NMFS permit if applicable |
| | | | | | | |

Part II. Narrative

1) Provide responses to the questions to the best of your ability and as applicable to your activities. See annual report questions below and an overview on https://www.fisheries.noaa.gov/national/reports-protected-species-permits).
2) If a question is not applicable, explain why.
3) Also describe if you created cell lines from any marine mammal parts received.
4) Review Section E of your permit to ensure you address any specific questions related to your activities.

Annual Report Questions

1. What progress did you make toward meeting your objectives this year? *(64,000 characters maximum).*

2. Describe the following observations during your activities (*64,000 characters maximum*):

- The physical condition of the animals you encountered and conducted procedures or activities on.
- How the animals reacted to specific procedures or activities. Include normal and abnormal responses of target and non-target animals.

- Where possible, provide quantitative data and estimate the proportion of animals (%) that had those physical conditions or reactions.

3. Explain your efforts to conduct follow-up monitoring. Report your findings. Photographs are useful to document things like wound healing. *(64,000 characters maximum)*

   We are especially interested in:

   - Animal responses to new or novel procedures or activities.
   - Time it takes to resume normal behavior after harassment.
   - Time it takes to re-populate rookeries or haul outs after harassment.
   - Condition of animals when resighted or recaptured.
   - Recovery from sedation and/or handling and post-release behavior.
   - Healing at site of invasive sampling (e.g., biopsy).
   - Healing at site of invasive tag deployment (e.g., surgical tag implants requiring sutures, remotely deployed dart/barb, deep-implant, medial ridge, and pygal tags).
   - Tag retention and tag breakage (i.e., is the tag still attached and what condition is it in?).

4. Answer and discuss the following: (*64,000 characters maximum*)

   - Did serious injuries or mortalities occur?
   - Did you exceed the number of takes authorized in any row of the take table?
   - Did you take animals in a manner not authorized in the permit?
   - Did you take a protected species you were not permitted?

   If so, and you already submitted an incident report, please briefly describe the event here and refer to the incident report.

   If such an incident occurred and you have not yet reported it, provide:

   - A full description of the incident (date and location; species; circumstances of how the take occurred; photographs; necropsy and histopathology reports, or other information to confirm cause of death or extent of injuries; etc.).
   - Steps that were or will be taken to reduce the possibility of it happening again.

5. Describe any other problems encountered during this reporting period and steps taken or proposed to resolve them. Examples include equipment failure, weather delays, safety issues, and unanticipated effects to habitats or other species. (10,000 characters maximum)

6. Discuss your efforts to coordinate and collaborate with others: (*10,000 characters maximum*)

   - Which NMFS Regional Office(s) and permit holder(s) did you contact for coordination?

- How did you coordinate or collaborate (e.g., avoiding field work at the same time, sharing vessels, sharing data)?

ONLY FOR THE FINAL REPORT: In addition to the questions above:

7. Did you meet your objectives for the permit? What did you learn? (10,000 characters maximum)

8. If you did not meet your objectives, explain why. For example, if you did not sample, tag or mark as many animals as needed to meet your sample size, explain why and how that impacted your ability to meet the goals of your study. (10,000 characters maximum)

9. For ESA-listed or MMPA-depleted target species: Explain how the results of your permitted work benefitted or promoted their conservation or recovery. How did your activities contribute to fulfilling Recovery or Conservation Plan objectives (as applicable)? (10,000 characters maximum)

10. Did you identify any additional or improved mitigation measures? (10,000 characters maximum)

Feedback (optional)

11. We appreciate any feedback on APPS and your permit. For example, did you have problems using APPS? Were any permit conditions difficult to comply with or unclear? Were your permitted take numbers appropriate? (10,000 characters maximum)

<u>Cetacean Invasive Tagging Module</u> (You may attach a file.)

Please discuss the following for invasive tagging (dart/barb tags and deep-implant tags) of ESA-listed cetaceans during this reporting period. This information is needed to comply with the requirements of the ESA, including the programmatic biological opinion, and for monitoring our permit program. If you have more than five species, reference your take table rows or attach a table.

1. For each species or DPS, provide how many dart/barb tags were (*10,000 characters maximum*):

- Successfully deployed (i.e., remained attached and collected data to achieve your objectives)
- Unsuccessfully deployed (i.e., failed to attach, briefly attached, or failed to transmit data).

2. For each species or DPS, provide how many deep-implant tags were (*10,000 characters maximum*):

- Successfully deployed (i.e., remained attached and collected data to achieve your objectives)
- Unsuccessfully deployed (i.e., failed to attach, briefly attached, or failed to transmit data).

3. Did you always deploy tags in the intended location on the body? If not, please describe and discuss the following (*10,000 characters maximum*):

- Why and how often this occurred;
- Where the tags were deployed on the body;
- The potential for serious injury (e.g., sensitive areas, if the location of the tag was near blood vessels or in an area with inadequate blubber thickness).

4. If not already included in the response to the standard annual report question No. 3, describe your efforts and results of post-tag monitoring of animals instrumented with invasive tags to assess the following (10,000 characters maximum):

- The location on the body and condition of the tag (including breakage);
- Tag wound reaction and healing (e.g., severity of swelling, depressions, and coloration);
- Animal health and behavior;
- Fecundity (presence of calf); and Survival.